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RWAC 2013 Welcome

Chris Bowden

Welcome to Frankston Hospital for the 22nd Real World Anaesthesia Course. This is the third course held at Frankston; the inaugural course was held at the Royal Hobart Hospital in 1999 (as the Remote Situations, Developing Country, Difficult Circumstances Anaesthesia Course), with subsequent courses being held at Launceston, Royal Darwin and Christchurch Hospitals.

The course is designed to assist in preparing anaesthetists for work in challenging and potentially remote clinical environments. Well over three hundred anaesthetists have participated in the course since 1999, many of whom have since (and continue to) work under such circumstances.

The course Instructors all have considerable experience working in the real world. We deliberately have a high instructor to participant ratio to allow for as much discussion as possible to take place both during course hours and at the social functions. This allows for the broad range of experience and teaching styles to be expanded beyond the confines of the theatre or lecture room.

This year we will be joined by international speakers from Canada, the United Kingdom and Fiji. Dr Tom Coonan was a participant at the 2008 RSDCDCA course held at Frankston, and has subsequently initiated the Canadian version of the course, Anaesthesia for Global Outreach.

We are also joined by Dr Sereima Bale from the Fiji School of Medicine (now the Fiji National University). Dr Bale has been involved in clinical work and education in the Pacific for nearly thirty years. We will have the opportunity to hear from someone who lives and works in these challenging environments (the rest of us spend time as visitors and guests in these places, with the option to return home at the end of the day).

The importance of teaching (and learning) is not forgotten – I often feel I gain more from the local anaesthesia practitioners than I teach them.

Exploring personal motivation for going allows us all to reflect on why we choose to partake in this line of work, rather than staying home in a more familiar, comfortable environment.

I hope you have a great week and that this time will allow you to reflect on previous experiences and consider future ventures.

Acknowledgements

Chris Bowden

Special thanks to:

Tzung, who works behind the scenes (and takes the great pictures).

Lynne, our Department PA who arranges the catering for the week and generally makes sure everyone is ok.

Our theatre and wait list teams, who welcome everyone and also make sure the theatre sessions run as smoothly as possible.

The instructor group – what a great week to catch up, and as Haydn says "share the love".

Timetable

MONDAY 28/10/2013	**TUESDAY 29/10/2013**	**WEDNESDAY 30/10/2013**	**THURSDAY 31/10/2013**	**FRIDAY 1/11/2013**
0730-0845 OT	**0730-0845** OT	**0730-0845** OT	**0800-0900** OT	Sleep in
0845-0930 Why our Ways may not be the Best Ways **TC**	**0845-0930** Paediatric Drawover **HP**	**0845-0915** Ketamine **EV**	**0900-1000** Obstetrics in the Real World **EV**	**0900-1000** Difficult Airway **DP**
0930-1000 What is Drawover **RT**	**0930-1000** Pain in the real world **WM**	**0915-0945** Halothane **WM**	**1000-1045** Blood Supply **SK**	**1000-1015** Morning tea
1000-1015 Morning Tea	**1000-1015** Morning Tea	**0945-1015** Ether **PB**	**1045-1100** Morning Tea	**1015-1130** Adaptation Challenges **PB**
1015-1100 Drawover circuits **SK**	**1015-1100** O2 supplies **ST**	**1000-1015** Morning Tea	**1100-1200** Tropical Medicine **PB**	**1130-1215** Preparing to go – longer missions **HP**
1100-1145 Intro to vaporisers **RT/GM/TEL/WM**	**1100-1145** Cleaning/ Sterilisation **GM**	**1030-1130** Service trips **DP/DHS**	**1200-1300** LUNCH	**1215-1300** LUNCH
1145 -1230 LUNCH	**1145 -1230** LUNCH	**1130-1230** What it is really like in the Real World **SB**	**1300-1330** Why we should teach **WM**	**1300-1330** Pacific Fellowship **JB**
1230-1330 OT	**1230-1330** OT	**1230-1330** LUNCH	**1330-1400** Why I teach **SB**	**1330-1400** CASIEF/RWANDA/ZAMBIA **TC/DB**
1330-1415 Vaporiser Performance **GM**	**1330-1500** Boyles Overview/ Troubleshooting **ST**	**1400-1800** Moorooduc Estate	**1400-1500** Education in low resource settings **DB**	**1400-1415** Afternoon Tea
1415-1515 Vaporiser Maintenance **RT/HP/WM/SK**	**1500-1515** Afternoon Tea		**1500-1515** Afternoon tea	**1415-1500** Work Opportunities **SK**
1515-1530 Afternoon tea	**1515-1600** Pearls from the experts - tips and tricks **RT**		**1515-1600** Reflections, Serendipity, & Development **HP**	**1500-1530** Close **CB**
1530-1600 Meccanno **GM/HP/TEL/PB**	**1600-1700** Personal Reflection **SK/PB**		**1600-1715** Personal Reflection **TEL/EV**	
1600-1700 Personal Reflection **DP/ST**				

Instructors – TC Tom Coonan, RT Richard Tully, SK Steve Kinnear, GM George Merridew, TEL Terry Loughnan, WM Wayne Morris, HP Haydn Perndt, PB Phil Blum, DP David Pescod, ST Steve Threlfo, EV Eric Vreede, SB Sereima Bale, DHS David Hunter-Smith, DB Dylan Bould, JB Justin Burke, CB Chris Bowden

Why Our Ways May Not Be The Best Ways

Tom Coonan

"Go, and do, and sustain": Paul Farmer.

This lecture is absolutely not intended to discourage anyone from engaging in overseas service. In fact it is absolutely essential that anaesthetists of good will should engage. There are 2 billion people in low and middle income countries (LMIC) who have no access to surgical care, 85% of children in these countries will need some sort of surgical care by age 18, the paediatric surgery rate in Uganda is 3% of the rate in the UK, and 17% of anesthesia providers in Uganda have had no formal training. Anesthesia mortality rates in LMIC's average 17 times those of high-income countries, and this figure can climb in some countries to 1000 times the mortality rates in high-income areas.

Unfortunately, there are realities that await volunteers who travel far afield. One may well encounter a relatively large, busy, district hospital with significant acuity (and very limited options for transfer) that performs all anaesthesia with IV or IM ketamine. No one is offered airway protection with a tracheal tube, not even the high midline laparotomies, and there is no laryngoscope. There are no pressured gases, no anesthesia circuitry and no halothane. Spinal needles might be available for Caesarian sections, but they are seldom used – the nurses haven't been trained to manage the concomitant circulatory aberrations.

In a landmark 2007 study in Uganda, only 23% of anaesthetists had the minimum technical requirements to administer anesthesia to an adult, 13% for a child, and 6% for a Caesarian section[1]. There was a very significant gap between government and mission hospitals, but overall there was a tremendous insufficiency of support for anaesthesia at all levels. At least part of the time, there were absences of pulse oximeters (74%), a tilting table (23%), oxygen (22%), tracheal tubes (21%), running water (44%), electricity (80%), intravenous fluids (30%), and blood for transfusion (77%). Actually, some anesthetists never had access to oxygen at any time (10%).

In a country with a very high fertility, and a very high maternal mortality rate (primarily from toxemia, hemorrhage, sepsis and anaesthesia for caesarian section), critical medications were often unavailable: magnesium sulfate (78% of the time), spinal anesthetics (59%), ergometrine and oxytocin (13%), thiopental (41%), suxamethonium (46%) and epinephrine (26%). The capacity to measure hemoglobin was sometimes missing for 43% of anaesthetists, biomedical support was available for only 36% of anesthetists and only 40% of anaesthetists personally owned a textbook.

Once can only shudder at the responsibility that must be taken by nurse anaesthetists and anaesthesia officers (with one year, two year, and in many cases "on the job" training) who must deal with eclampsia, placenta accreta, huge goiters, upper airway infections and tumors, severe late stage head/neck burn contractures, congenital defects, cancrum oris and tempero-mandibular ankylosis, with no capacity for flexible bronchoscopy and little capacity for tracheostomy, or post - tracheostomy care, and no supervision . Indeed, anesthesia-training requirements for such environments are very system specific, often involving techniques such as blind and retrograde intubation, and nasal trumpets, that are seldom seen any longer in wealthy countries.

Environmentally and culturally sensitive approaches are necessary to advance patient safety during the perioperative period. In general, anesthesia equipment that is appropriate for the upper income world

serves poorly in the humidity, heat and dust of lower income environs. Such machines depend on compressed gases that are expensive and difficult to procure in the developing world, and depend on electricity that is often far from reliable. Most machines that are manufactured in wealthy countries utilize complex circuitry that cannot be repaired, except by technicians who will seldom be found in locations such as sub-Saharan Africa – indeed, African hospitals are infamous for their graveyards of expensive donated equipment.

A wise volunteer, who travels more or less alone, to an austere environment will need to consider a number of specific issues:

1 One might choose to bring along portable draw-over equipment on case the equipment that is in place fails.
2 One should consider strategic approaches to airway management in the absence of a bronchoscope or video-laryngoscope.
3 One will need to consider options for equipment disinfection in an environment where there is only an autoclave, perhaps a device for pasteurization, and bleach.
4 Options for procuring blood should be considered – certainly techniques for blood salvage and auto transfusion[2], but an understanding of the implications of type specific donation is also very helpful.
5 Primary pain management in the absence of epidural analgesia, and regional anesthesia techniques in the absence of ultrasound are also of particular value[3,4].
6 Burn care in LIC's is a particular challenge.[5]
7 A capacity for basic maintenance of equipment will be essential
8. A basic familiarity with electrical safety and tropical medicine is essential.

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What is Drawover

Richard Tully

Defining the difference/similarity between a drawover and plenum vaporiser. An introduction to the drawover vaporisers that you may come across, how they work and what to expect of them.

Pearls from the experts, tips and tricks

Notes:

Drawover Circuits - the Basics

Steve Kinnear

Drawover circuits are the simplest anaesthetic circuits that have been invented, after the rag-and-bottle and Schimmelbusch mask.

As with any circuit, it is always possible to make them look complicated and confusing.

But the key is to see and understand the basic components, which in this case are very simple.

What are the **bare essentials**?? These are ….

1. A drawover vaporiser

2. Flexible tubing from vaporiser to patient, with a facemask on the end, and a one-way valve that makes sure the patient does not re-breathe the air he /she has sucked through the system.

That's all !!!

The system can be improved, and made more flexible and user-friendly, by adding two more parts.

3. Reservoir tubing upstream of the drawover vaporiser, with a side-port to allow oxygen supplementation. This improves the inspired oxygen concentration

4. A self-inflating bag or a bellows. This is placed in the flexible tubing between the vaporiser, and the facemask. This allows the anaesthetist to observe the patient breathing spontaneously more easily, and /or to manually ventilate the patient.

These 4 components make up an excellent drawover circuit. There are, of course, several variations of each of the four components. They each have their advantages and disadvantages, and we will study these as the week progresses. However, if you
start by thinking " 1 2 3 4 " , then the rest will follow.

Included is my simple diagram of the four parts of the drawover circuit.

This is followed by another diagram that shows the drawover circuit at it's most basic, then with bellows for watching SV, then with an extra valve to allow controlled ventilation, and finally with reservoir and oxygen supplementation.

During the week we will look at each component ……

Reservoir tubing with side-port for oxygen supplementation

How long should the tubing be?
How much oxygen flow should we use?
What sort of oxygen supplementation can we use?

With reservoir tube over 400mls,
FIO2 over 30% @ 1 L / min 02 supplementation
FIO2 over 60% @ 4 L / min " " "

02 Supplementation often not necessary with ether, but is very desirable with all other volatile anaesthetic agents.

Houtonox valve) can both be used to supply extra oxygen upstream of the
Oxygen concentrators) vaporiser to enrich the inspired oxygen concentration.

Vaporiser

EMO PAC OMV Goldman Diamedica.

Which is best for what situation?
What agent should we use with each one?
What about if it is really hot or really cold?
Which ones have the lowest resistance to breathing?
What if it gets knocked over?

These and many other questions will be answered during the week in other sessions.

Self-inflating bag or bellows

What types are there?

Essentially, there are two types. Self-inflating bags (SIB), and the Oxford Inflating Bellows (OIB).

Which are easiest to use?

SIBs are cheap and robust, and adequate for the occasional short case, but are tiring and not very ergonomic for long or many cases. For the serious draw-over anaesthetist needing to give many such anaesthetics, the OIB is the best option by far. It's weight and stability keeps it in one place, and it is easy to learn to use it for a long time with less "RSI" problems than a SIB.

Do they increase resistance to breathing?

Both add very little resistance to the circuit when the patient is "drawing through" them. When the anaesthetist is ventilating the patient, this is of course not an issue.

Non Re-Breathing valves

Laerdal Ambu E1 (anaesthetic) Ruben (anaesthetic)

Where are they in the circuit?

They are always at the patient end of the circuit attached to the facemask.

Do they make breathing harder?

They do add a small degree of resistance to inspiration and expiration. This is not a problem for a healthy patient having a short procedure, but this increased work of breathing, added to the depressant effect on ventilation of the volatile anaesthetic agents, means that hypercarbia can become an issue in sick patients, long procedures, and infants. These patients may need assisted spontaneous ventilation, or manual IPPV.

Can they cause problems?

Yes, there is one major issue to be aware of when using the new non re-breathing valves, as opposed to the old APL (adjustable pressure limiting) valves.

A ventilation "lock" can occur, if a non re-breathing valve is used in tandem with an Oxford Inflating Bellows.

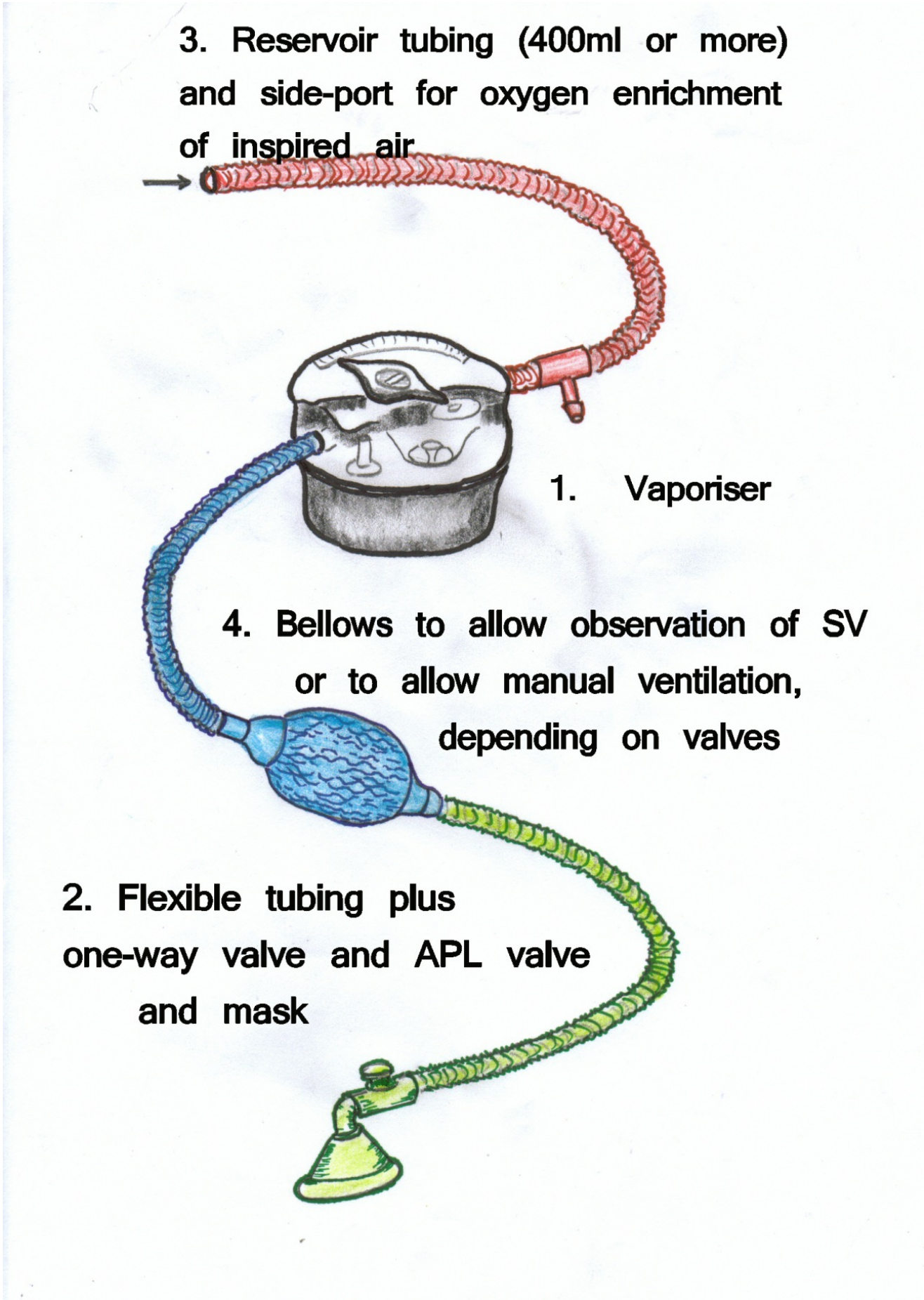
This can happen if the OIB does not have a magnet attached to hold permanently open the downstream valve of the OIB. What can happen is this ….

If the patient breathes out reasonably forcefully, the Laerdal Valve, the Ambu E valve, and the Ruben valve can all get stuck in a position that will not allow the patient to breathe out any further. The anaesthetist can perform further inflation of the patient using the OIB, but a block to expiration can happen again, such that the patient's lungs will become further and further inflated – "stacking". The problem can only be rectified by disconnecting the patient from the circuit, and allowing him / her to expire to the atmosphere directly.

During the course we will look at the valves and the OIB to see exactly how this occurs.

This problem has evolved because of the substitution of new technology (i.e. the non re-breathing valve, for the APL valve) onto an old system (i.e. the drawover vaporiser and OIB) that was not designed for it.

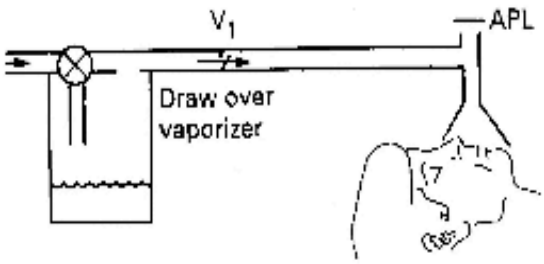
It does not happen if the new non re-breathing valves are used with self-inflating bags.



Drawover circuits - a historical progression

The Basic Circuit

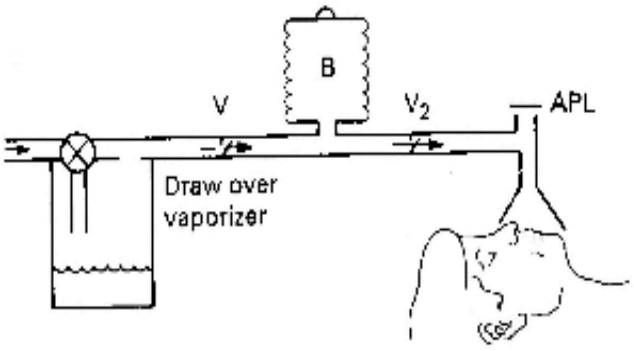
Vaporiser
One-way valve
Mask and APL valve



Basic Circuit plus bellows to observe spont. ventilation

Vaporiser
One-way valve
Mask and APL valve

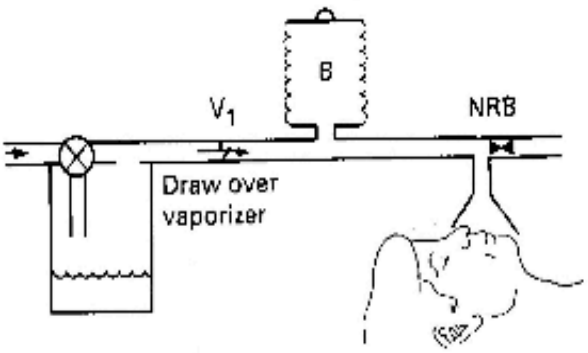
PLUS bellows and extra one-way valve to prevent pt exhaling back into bellows.
(This circuit can also be used for manual IPPV but is very cumbersome and tiring to do so because you have to close the APL valve with
every inflation)



Bellows Circuit with APL valve substituted by non-rebreathing valve allowing easy IPPV as well as SV

Vaporiser
One-way valve
Mask
Bellows

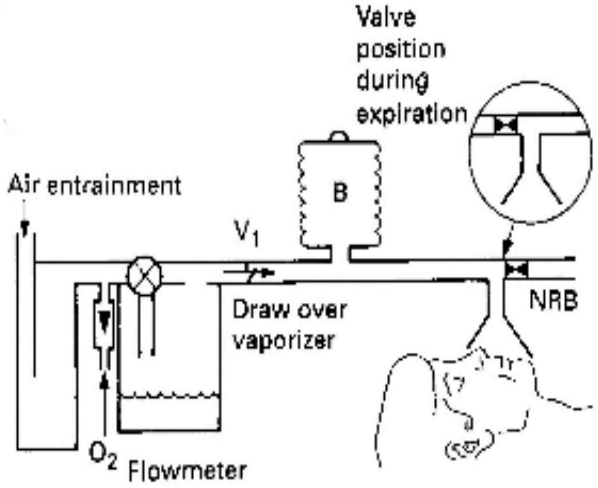
PLUS non-rebreathing valve
AND Valve V2 inactivated (usually by a magnet)



Bellows IPPV circuit with oxygen enrichment

Vaporiser
One-way valve
Mask and bellows and non-rebreathing valve

PLUS oxygen supply and reserve



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Vaporiser performance, for anaesthesia in the Real World

George Merridew

The Real World has a lesser safety margin than conventional Western environments.
For example:

- Usually no air conditioning.
- Ambient temperatures can be well outside vaporiser published specifications
- Vaporiser perhaps not scaled for the only agent at hand
- Vaporizer scales might be A, B, C, D, E, F (from low to high output)
- Vaporiser might never have been serviced
- Vaporiser type might be new to you

Nonetheless, effective anaesthesia can be provided with a marked safety benefit to the patient compared with no anaesthesia (or essential surgery).

Vaporiser output under given conditions:

- Isoflurane 3%
- Halothane 3%
- Sevoflurane 2%
- Enflurane 2%

The performance of a vaporizer is summarised as its vapour output % (vol/vol at 760 mm Hg ambient pressure) in the carrier gas stream exiting the vaporizer under given conditions of:

- Agent
- Ambient temperature
- Carrier gas flow (volume per minute)
- Duration of that flow
- Flow mode: Is the flow of carrier gas intermittent (drawover, pushover) or continuous (plenum)?
- Pressurisation: Is measured vapour output% altered if the pressure in the vapour chamber is markedly positive in IPPV, instead of near-ambient as in spontaneous ventilation?
- Physical movement: Is the vaporizer being agitated?
- Full universality, i.e. designed for all volatile agents
- Limited universality; e.g. filler-fittings; calibration scale; damaged by a specific agent
- Degree of filling of the liquid agent reservoir; does it affect vapour output%?

Calibration curves
Performance under given conditions is conveniently presented by a calibration curve, a graph of the vaporizer control setting (x-axis, increasing incrementally from zero to the maximum setting) versus the vapour output measured at each setting.
Desirability (output controllability) of a calibration curve increases the closer it is to:

- Rectilinear
- Not nearly-parallel to either the x- or y- axis
- Passing through zero on y axis (i.e. vapour can be turned off)
- Passing through zero on x-axis (i.e. vapour% is zero only when set to zero)

Calibration curves commonly presented are for the various combinations of:

- Ambient temperature (in a clinically relevant range)
- Carrier gas volume per minute (in a clinically relevant range)
- Flow mode (plenum and/or drawover, pushover)

Vaporisers can be of low resistance to carrier gas flow, or high resistance.

High resistance vaporisers:
- Ubiquitous in Western anaesthesia,
- Must be used as continuous flow devices
- Need high-pressure oxygen.

Usually they feed partial rebreathing circuits.

Low resistance vaporisers:
- Easy for a CNS-depressed patient to inspire through.
- Can be used drawover (or pushover).
- Some can be used in plenum mode
- Some cannot.

Portable Anaesthesia Complete (PAC) vaporizer is designed solely for drawover use, with all its design compromises made with in that in mind; it is useless in plenum mode even with a vapour analyser at hand.

Epstein Macintosh Oxford (EMO) in plenum mode under-produces at FGF of < 10 L/min, vs drawover output%.

Diamedica Draw Over Vaporiser (DDOV)
Oxford Miniature Vaporiser (OMV)
Goldman vaporizer (GM)

FGF 4-8 L/min calibration curves are as for drawover

FGF of 1-2 L/min **plenum** give much less (0-⅓−½, depending on vaporiser) vapour % versus **drawover** at those carrier gas volumes/minute.

Manufacturers produce vaporisers according to specifications defined by regulatory bodies (CE, TGA, FDA) and advisory ones (ANZCA and equivalents).
The owners' manual typically specifies an ambient temperature range of 15-35°C, not the 0-45°C common in non-air conditioned surgical rooms.

More considerations
- Is a robust stand needed for physical stability? Is such a stand present?
- Vaporiser availability for trial & purchase
- Purchase price
- Maintenance needed
  - Frequency
  - Knowledge
  - Tools
  - Parts
  - Accessibility
  - Price of knowledge, tools & parts

Bench testing high resistance vaporisers:
- Sevoflurane,
- Vaporisers: Dräger *Vapor 2000* [DV], Blease *Datum* [BD], Penlon *Sigma Delta* [SD], Penlon *Sigma Elite* [SE], GE *Tec7* [GE].
- All 0-8% on their scale.
  - All weigh 7 kg, except SD (5 kg)

Test variables:
- FGF: 1, 2, 4, 8 L/min
- Maximum output compared at the start and end of 10 minutes flow, set full on
- Ambient temperature, °C: -1, 10, 22, 35, 45, 55

Main findings:

- All calibration curves are rectilinear
- All curves through zero (Not SD, delivering not quite 0% at 55°C, turned off)
- All curves independent of FGF at all temperatures (*Not GE above 35°C)

	Measured sevoflurane % v/v, 1 ATA				
	DV	**SD**	**SE**	**GE**	**BD**
-1°C, set 4%	4.4%	3.3	1.7	2.0	4.3
45°C, set 4%	4.8	4.5	5.2	4.5*	5.8
-1°C, set 8%	5.8	4.8	3.3	3.8	5.4
45°C, set 8%	11	11	14	11*	13

Paediatric Drawover

Haydn Perndt

This talk covers draw over anaesthesia in children as well as some general developing country paediatric anaesthesia issues.

Paediatric draw over

There are two key questions for anaesthetising babies and small infants:
1. Will the patient breathe spontaneously with a face mask? Or is intubation +/- ventilation needed?
2. Will the patient draw over?

The physiological and pharmacological considerations in the decision to breathe spontaneously with a facemask or to intubate and ventilate are familiar. Can gaseous homeostasis be maintained by spontaneous ventilation? Does the airway need protection (intubation)? Does the surgery need muscular relaxation (ventilation)?

The "draw over" question arises because some draw over vaporisers (OMV, DDV, EMO) can also be used in plenum or continuous flow mode. Using these vaporisers in the plenum mode offers **no** physiological advantages but might offer some psychological advantages. It may be reassuring for the occasional paediatric anaesthetist to use a familiar T piece when dealing with a very unfamiliar small baby.

The "draw over" question is only an issue when considering patients who are going to breathe spontaneously because in positive pressure ventilation, the ventilator (or anaesthetic hand) "draws over" for them.

In reality, the anaesthetic technique chosen is often determined by the actual equipment (vaporiser, endotracheal tubes, circuits) and other resources - oxygen, vapour, drugs which are available. Familiarity with either the paediatric draw over apparatus or the T piece may be an important consideration.

My own take home draw over recipes (probably the same as for Plenum):

< 5 kg intubate and ventilate
5 - 10 kg ?intubate and assist
> 10 kg face mask and assist

Summary: vaporiser characteristics and mode of use

PAC
The PAC can only be used draw over. The plenum output is negligible and unpredictable at lower settings and therefore not recommended. It's draw over output is satisfactory at small tidal volumes and the draw over output is stable with temperature, with < 1% variation.

OMV
The OMV can be used in either draw over or plenum modes. It's plenum performance is satisfactory at 4 L/min and can therefore be used with an oxygen concentrator or cylinder. Draw over output is satisfactory at small tidal volumes but draw over output increases with temperature, > 1% at 35° C.

DDV
The DDV can be used in either draw over or plenum modes.

Manual "Continuous" Flow Techniques (OMV, PAC)
An Ambu or Laerdal bag squeezed 70 times a minute, using a tidal vol of about 100 mls, generates an almost continuous flow permitting an Ayre's T piece to be used. The output from the vaporisers is lower than set, but satisfactory.

Paediatric anaesthesia in developing countries

There are many children in developing countries and paediatric anaesthesia is not regarded as a "specialty". The major problems involve one's own comfort and skill with paediatric cases and the lack of appropriate paediatric anaesthesia equipment, monitors, perioperative assistance and postop care.

Accident (including burns) and abscess are common problems and simple anaesthetic techniques are best. Ketamine is the mainstay for paediatric anaesthesia in developing countries. There is a very limited place for complex regional extravaganzas and IM / IV

Paediatric challenges involve dark skin and vein finding, ubiquitous anaemia and the implications for the detection of cyanosis plus the presence of other prevalent illnesses such as malnutrition, malaria, TB and HIV.

Developing country children are often very trusting and accepting and their parents' expectations are more reasonable than in Western practice. The parents are invariably the best nurses. There are fortunately less neonatal surgical heroics than in our practice.

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Pain in the Real World

Wayne Morris

Real World Issues

- Pain is common.
    - Cancer
    - Trauma
    - Chronic non-cancer pain
    - Other types

- Pain management is not given a high priority (does this sound familiar?).

- There are many factors that contribute to suboptimal pain management, including:
    - Patient expectations
    - Staff numbers
    - Staff knowledge and attitudes
    - Lack of drugs, especially opioids

Some Cases: What Would You Advise?

1. A 42-year-old man has a laparotomy for bowel obstruction. The nurses in the Recovery Ward do not want to give morphine or pethidine because it will cause addiction.

2. A 55-year-old woman has metastatic uterine cervical cancer and is expected to die within a month. She is unable to go home because of debilitating pelvic pain. The pharmacy does not have oral morphine.

3. A 5-year-old girl has burns to her chest and abdomen following a cooking fire accident. She has been having frequent dressing changes without pain relief.

4. A 25-year-old woman has a 2-year history of severe generalized headache. She presents at the Emergency Department every 2-3 days and is usually given pethidine.

5. A 60-year-old man had a right below knee amputation 7 months ago. He has phantom pain and thinks he is "possessed".

Essential Pain Management (EPM)

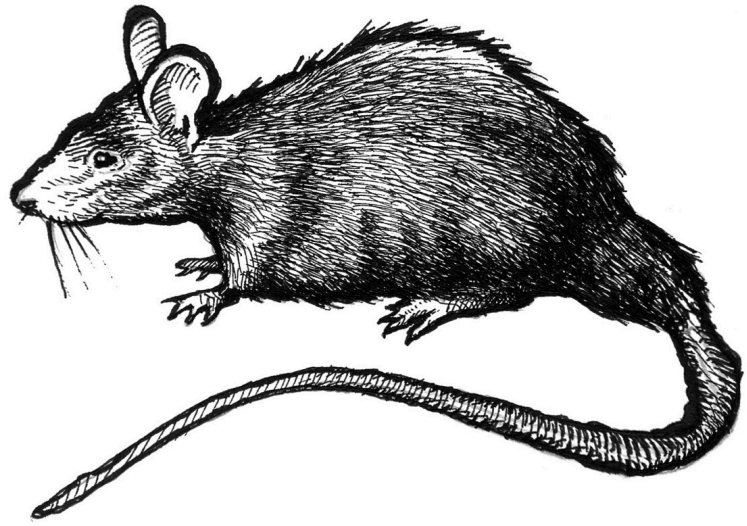
This is a basic pain management course designed:

- To improve understanding of pain (all types).
- To teach a simple framework for managing pain.
- To address pain management barriers.

EPM is usually run as a series of courses:

- One-day workshop
- Half-day instructor course
- Two or more one-day workshops run by the newly trained instructors

The EPM Framework: RAT



Recognize
Assess

- How severe is the pain?
- Make a pain diagnosis*
- What other factors are contributing?

Treat

- Non-drug treatments
- Drug treatments

***Pain Diagnosis**

- Acute or chronic?
- Cancer or non-cancer?
- Nociceptive or neuropathic?

What Seems To Be Important

- Teaching or reinforcement of basic pain management principles
    - Regular patient assessment (the "fifth vital sign")
    - "By the clock" analgesia
    - Multimodal analgesia

- Local multidisciplinary involvement
    - "Pain champions"

  - Nurses play a key role

- Addressing issues relating to the use of opioids
  - Fears about addiction
  - Key role of morphine in acute pain and cancer pain
  - Availability of oral morphine

More Information

EPM webpage

- http://www.essentialpainmanagement.org
- Information about EPM, manual and slide downloads

Acute Pain Management: Scientific Evidence

- http://www.anzca.edu.au/resources/college-publications/Acute%20Pain%20Management/books-and-publications/acutepain.pdf
- Free download from ANZCA website

Guide to Pain Management in Low-Resource Settings

- www.iasp-pain.org/LowResourceGuide/
- Detailed reference text
- Free download from IASP website

Help the Hospices website

- http://www.helpthehospices.org.uk/our-services/international/what-we-do-internationally/education-and-training/
- Information and resources about palliative care

WHO Essential Medicines List

- http://www.who.int/medicines/publications/essentialmedicines/en/
- List available for download

Oxygen supply

Steven Threlfo

Irrespective of its origin, oxygen must be delivered and administered in a safe manner as it supports combustion. As a result, oxygen systems must be clean, in particular, free of dust and any form of flammable liquid or petroleum based grease which could fuel a fire or explosion.

The rule is, the higher the delivery pressure, the more hazardous oxygen delivery systems become. As a result, full cylinders with a working pressure of 16Mpa (approximately160 atmospheres) could be considered the most dangerous form of oxygen delivery in any part of the World and in order to minimise risk, the hazards associated with cylinder supplies need to be clearly understood.

Australia and New Zealand have changed all medical gas cylinders and regulators to pin indexed connections which provide a clear separation from industrial gas systems. In addition, medical gas cylinders are clearly identified with labelling, standard colour systems and are protected from contaminants by heat shrinkable plastic seals when filled. In less well developed parts of the World oxygen cylinders are harder to identify. In addition, caring for connections and sealing cylinders against dust ingress and external contamination during transport may not be a priority.

In remote areas, provided electricity is available, oxygen concentrators provide an alternative to cylinder supplies, however, the pressures they generate are too low to operate most medical equipment. Oxygen concentrators work on a principle know as pressure-swing gas separation, where filtered, compressed and cooled air is passed through chambers called sieve beds containing zeolite, a substance with an affinity for nitrogen at elevated pressure. The oxygen production cycle continues as long as the unit is running.

Modern oxygen concentrators are basic in design and generally reliable, however, their life is predominantly determined by the level of user care and maintenance the units receive. Optimal oxygen production and maximum service life is reliant on filters being cleaned and replaced on a strict schedule based on unit operating hours. The quality of the local power supply is important as low voltage or frequency causes electric motors to run slowly resulting in reduced cooling air flow and increased current in the motor windings, ultimately leading to catastrophic equipment failure.

Oxygen concentrators operate reliably provided they are kept as cool and clean as possible and are used within stated limits. Most routine service on oxygen concentrators is simple and with mains supply disconnected, units are easily opened allowing consumable components to be accessed and replaced.

Sterilisation & Disinfection in the Real World

George Merridew Compiled by Keith Streatfield with help from Patrick Keefe & LGH RN's

Accepted probability of microbial survival in a treated article, depending on its use:

- Mucous membranes or intact skin 1×10^{-3}
- Surgical instruments 1×10^{-6}
- *C. botulinum* in canned food 1×10^{-12}

Cleaning is essential always before any sterilization or disinfection process
Cleaning means fewer microbes & less chance of failure to kill them all.

- Washing 40-50°C Too hot coagulates protein, now hard to remove
- Rinsing 40-50°C Use sterile water; if none, use running water
- Drying 65-75°C In a cabinet

Optimal packaging & loading allows heat penetration quickly to all items.
Options: Wire baskets; wrapping in paper or cloth (rather than solid containers)

Sterilisation = No viable bacteria, viruses, spores
For surgical instruments, needles, syringes

- Easiest to kill: HIV, Hep C, Hep B
- Then bacteria: *S. aureus, Pseudomonas,* coliforms, streptococci
- Then spores: *Clostridiae*
- Hardest to kill: Prions (135°C for two periods each of 25 minutes)

Determinants of adequacy of sterilisation

- Cleaning thoroughness (microbe numbers; hiding places for them)
- Temperature (of superheated steam) inside the sterilizer
- Duration at temperature
- Packaging & loading

Sterilization techniques
Moist heat (i.e. superheated steam, is the preferred method).
Follow the autoclave manufacturer's instructions

- Open safety valve
- Steam flow for 5 minutes (expels all chamber air via the safety valve port)
- Close safety valve
- Target chamber temperature 115°C
- Target chamber pressure 10 psi (=115°C) above sea level pressure
- Timing starts when gauge target is reached

Dry heat: 160°C for 2 hours (microwave ovens are unreliable for sterilizing)
Other (not available in remote locations, as complex, expensive and slow)

- Ethylene oxide, clinically. Gamma irradiation, for large scale manufacturing

Sterilization monitoring: Often multiple techniques for a single item

- **Autoclave tape AS A MINIMUM**
- Thermometers chamber temperature
- Pressure chamber pressure
- Thermocouples inside load
- Graph recorders history of the cycle
- Bio-burden reduction filtered water to irrigate the load
- Chemical indicators
- Biological indicators

High-level disinfection: No viable bacteria or viruses, but spores might survive

For instruments in contact with mucous membranes or non-intact skin

- Respiratory equipment (Australian Standard 4187 [1994]; p19):
- Other, e.g. Vaginal speculum
- Sigmoidoscope

Pathway: Clean > Rinse > Dry > Process > Protect

Determinants of adequacy of disinfection

- Cleaning adequacy
  - How many microbes; How much other matter; Spores or actively multiplying
- Conditions adequacy
  - Temperature (Better disinfection if warmer)
  - pH
  - Accessibility of the items to the agent
- Disinfectant
  - Concentration
  - Age: 4 weeks of use reduces efficacy of some by 50%

Techniques

Moist heat = Steam = Bench-top autoclave (pressure-cooker needed at high altitude)
Instruments must be unwrapped if there is no drying cycle

Boiling
Boil 10-30 minutes according to load size

Chemical disinfectant
Household bleach = 5% sodium hypochlorite, NaOCl
Dilutions used: 0.5%; 0.1%; 0.05%
Pits metal surfaces

Hydrogen peroxide 0.5%
For bench tops and stainless steel trolleys.
Pits brass and copper

Potassium permanganate is said to remove protein and particles from LMA's, and thereby reduce the chance of prion transmission. Disinfection needs added steps.

Formaldehyde vapour
Formaldehyde tablets and apparatus left overnight in a container e.g. a plastic bag
Used in India, for: Heat labile equipment (e.g. laparoscopes)
Electrical apparatus
Cabinets

Sunlight Water is filtered, put in a PET container then left in the sun for hours.

Multiple use of single-use devices

Practised in Germany, Canada, Sweden, USA, India, Brazil. Evidence based.
Reuse categories
Non-critical Intact skin only (ECG plate)
Semi-critical Mucous membrane or non-intact skin (ETT, laryngoscope)
Critical Cavities, vascular system (laparoscopes, pacemakers, cardiac caths)
Not prohibited by the FDA (Google: *Daniel Schultz, M.D., Director CDRH, Before the Committee on Government Reform –Sep 26, 2006*)

Airway equipment

ETT, Guedel airways

- Reject if grossly contaminated
- Clean (neutral detergent), rinse, boil 3 minutes, shake water off, leave to dry
- Check for heat damage including ETT cuff integrity

LMA (Prions are a consideration)

- Reusable Clean (neutral detergent), rinse, steam sterilize
- Disposable Clean (neutral detergent), rinse, boil 3 minutes, leave to dry

Bougie

- Clean (neutral detergent), rinse, dry, 70% alcohol

Laryngoscope handles

- Clean (neutral detergent), rinse, dry, gas (formaldehyde)

Breathing systems

- Short-term aid: HME
- Long-term aid: No HME (i.e. local standard)
  Sterilize after an open TB case

Syringes and needles (as seen in Africa, 1994) Usable for spinal needles too

- Low-risk needle & syringe (e.g. used in clean I.V. tubing)
- Separate the syringe and plunger
- Clean (needles with wire probe)
- Rinse with NaOCl (0.5%) for 5 minutes; rinse with clean water; dry

Heat-sensitive equipment: Electric, electronic, technical
Experience in Africa 1994, Bangladesh, from reports (India 2006) and published information about successful use of formaldehyde for high level disinfection of laparoscopic gear and hardware electric drills.

- Clean (neutral detergent), rinse, dry

- Formaldehyde tablets with item for disinfection overnight in a sealed container or closed plastic bag
- Best results in tropical high humidity and temperature (biologic marker monitoring rarely available

Paraformaldehyde tabs 1 gm, 800/pack; were Merck, now China (Google, 05 Sep13)

Surfaces & beds in theatre and other hospital locations

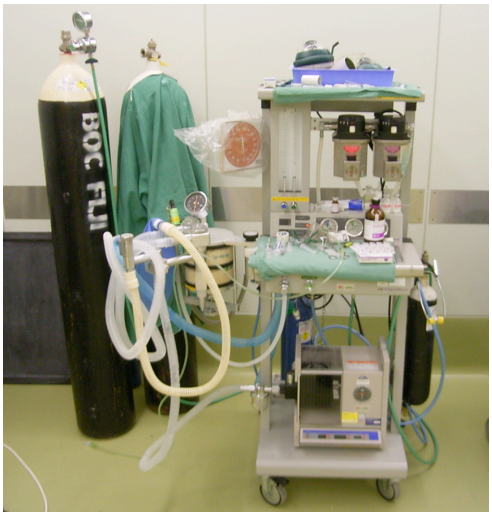
- ALWAYS soap & water first (as for everything else)
- Window cleaner for glass
- Vinegar & water (if not very soiled)
- Proprietary detergent wipes (e.g. "Tuffie")
- Dettol (don't keep prepared for days, as *Pseudomonas* grows)
- Or hydrogen peroxide 0.5% (pits brass & copper)
- Or ethanol

Understanding Boyles Design Anaesthetic Equipment

Steven Threlfo

There is a range of anaesthetic equipment based on the Boyles design in developing countries which is very diverse in both design, set-up and state of maintenance. With a basic understanding of the Boyles design concept it is possible to functionally check any machine from the gas source right through to the circle breathing system. In remote areas, checking the gas source may extend to determining how much medical gas is available and ensuring spare cylinders are available in sufficient quantity and within easy reach of the operating theatre when they are required.

It is not uncommon to find medical gas pipeline installations in remote hospitals have been abandoned due to poor maintenance and leaks. As a result, large (G-size) medical gas cylinders are used in the operating theatre. These cylinders are often unrestrained requiring careful attention as to how hoses are run and equipment moved.



A typical equipment configuration.

The oxygen cylinder, on the left, and the nitrous oxide cylinder, behind the machine, are both freestanding on the floor of the operating theatre.

The oxygen regulator contents gauge is bent forward from one strike with the floor and is no longer working.

Note the electrically powered anaesthetic ventilator on the lower shelf.

Gas cylinders and connection hoses may have unusual colours and fittings which may easily bypass safety systems designed to prevent incorrect attachment. Index pins may be missing from emergency cylinder mounting yokes with the potential for an incorrect gas supply cylinder to be fitted. With this in mind, it is worthwhile confirming the external gas inlets are connected to the correct cylinders prior to commencing any machine checks.

External regulator attachments, supply hoses, and on-board emergency cylinder mounts may be damaged or have subtle leaks which over time waste significant volumes of medical gas. Cylinder valve keys and correctly fitting regulator spanners need to be on hand or substitutes located in the work area ready for immediate use.

Careful management of medical gas supplies is extremely important and local hospital staff benefit greatly from instruction and the example of good practice in action.
It is important to understand how gas supply changeover systems work on Boyles type equipment and the condition where a poorly regulated or failed external gas supply could easily, and without alarm,

deplete an open emergency supply cylinder. Based on this, all machine checks must finish with final confirmation the emergency cylinder valves are closed firmly.

If present, the oxygen failure alarm and nitrous oxide shutoff systems need to be checked thoroughly before a machine is used. These are simply checked by running a flow of oxygen and nitrous oxide through the flowmeters, the external oxygen supply is then turned off and as the oxygen pressure falls there will be a point at which the alarm whistle will sound with an abrupt cessation of nitrous oxide flow preceding any major drop in oxygen flow. Restoration of oxygen supply from the emergency cylinder should then cause an immediate return of both nitrous oxide and oxygen flow. Once tested, the emergency supply cylinder is turned off firmly and the connection to external oxygen supply re-established. If fitted, an anti-hypoxic gas delivery system needs to be checked to deliver oxygen and nitrous oxide in a minimum ratio of 1:3 or 25% oxygen.

Gas delivery flowmeters (rotameters) are tested by carefully observing the rotameter bobbin as flow is increased. The bobbin must have a smooth vertical lift and freedom to rotate over the maximum range of flow adjustment.

With an understanding of the gas flow paths within the assembly, leaks can be easily located and simply corrected. Machines which feature a 50cmH2O (36.7mmHg) pressure relief valve installed prior to the common gas outlet (CGO) may be leak tested using an aneroid sphygmomanometer. Once this is complete, the testing is extended to the absorber and circle breathing system.

Anaesthetic gas scavenging is generally unavailable in remote areas as it is dependant on powered suction systems which exhaust outside the operating theatre. A simple passive scavenger system may be implemented by running a large bore hose from the machine exhaust to a point close to the floor. This allows machine exhaust to disperse relatively safely with minimal mixing in room air

Careful decisions are necessary when using anaesthetic machines fitted with pneumatically powered ventilators. When in use, the volume of oxygen used to power this type of ventilator far exceeds that admitted to the patient via the anaesthetic machine. There are electrically operated ventilators which are ideal for use in remote areas, they feature a bellows which can receive and deliver a precisely controlled tidal volume with independent control of I:E ratio and breath rate. Connection is simple as they merely replace the handbag in the circle breathing circuit. Depending on the design, electrically operated ventilators may also control PEEP, have audible and visual alarms and internal battery backup.

An electrically powered anaesthetic ventilator, built by Acoma Japan.

In conclusion, Boyles type anaesthetic machines are simple, robust and survive in remote areas with remarkably little ongoing maintenance. In my experience, most

problems with equipment are confined to leaks around cylinders, the circle breathing system and absorber which fortunately are accessible, simple to understand and relatively easy to fault find and repair if approached logically. Test equipment is simple, durable and small enough to pack easily when travelling.

Checking medical gas availability and the ability to be frugal in its use is beneficial and may make a significant contribution to the success of a medical outreach program. Skills in testing a machine from the gas source through to the patient connection and attention to detail at each step will ensure maximum patient safety during anaesthesia and provide a good vehicle for skills transfer to local staff.

The ability to assess and work with hazards such as unrestrained cylinders in the operating theatre will at times be necessary and must be treated sensitively as they are part of the normal working environment for local hospital staff.

Where possible, avoid the temptation to use ventilators unnecessarily. Ventilators do not feature highly in routine anaesthesia in remote areas and training local staff in their use needs careful consideration. Unrestrained ventilator use could trigger an unsustainable increase on oxygen consumption or introduce a potential risk due to overconfidence in their use.

Electrically powered ventilators which have no high pressure gas connection are suitable for use if local staff are well trained and confident in their application.

Ketamine

Notes prepared by Chris Bowden Modified by Keith Streatfeild Remodified by Eric Vreede

Introduction

Keto derivative of an amine (therefore ketamine)
Introduced > 35 years ago as less potent derivative of phencyclidine (PCP)
Synthesised by Stephens in 1963
First clinical use in early 1970's – "dissociative anaesthesia"
Designed to function as "monoanaesthetic" drug ie inducing analgesia, amnesia, loss of consciousness, and immobility – significant side effects defeated this

Physical Properties

Racemic mixture of 2 optical enantiomers, R(-) and S(+)
S(+) isomer available in some countries (Germany)
Water soluble, clear solution Acidic pH 3.5-5.5 PKa 7.5 Benzethonium Chloride preservative
200 mg/ 2 ml preparation in Australia – Ketalar
Compatible (in syringe) with fentanyl, lignocaine, muscle relaxants, midazolam

Clinical Pharmacology

Actions– not a "clean" drug
(1) NMDA glutamate receptor (glutamate 1° excitatory AA in CNS)
Non competitive antagonist of Ca+ channel
Interacts with PCP binding site
Decreases NMDA receptor activity
NB Postsynaptic antagonistic effect
Accounts for most of analgesic, amnesic, psychotomimetic, and neuroprotective effects

(2) Non NMDA glutamate receptor
AMPA, kainate
Block glutamate/NO/ cGMP system

(3) Opioid receptor
μ>κ>δ (minor effect)
Naloxone no effect on ketamine analgesia

(4) Nicotinic, muscarinic cholinergic, monoaminergic receptors (complex)

(5) Voltage gated K+/Na+ channels (inhibition)

Pharmacokinetics

(1) Oral, rectal, intranasal
15-30% 1st pass metabolism from intestines
(2) IM
93% bioavailability
Onset 5 minutes, duration anaesthesia 15-30 minutes
(3) IV
Onset < 1 minute, duration anaesthesia slightly less than IM route with bolus dose
(4) Intrathecal/ Epidural

Not licensed in Australia
Should only be used as preservative free solution
Questionable benefit in published studies

Volume of distribution large (3L/kg)
T1/2 elim 2-3 hours
High hepatic clearance (1L/min)
Demethylation by cytochrome P450 to norketamine + 5 others
Norketamine 20-30% potency ie active metabolite and long half-life
Hydroxylated/ conjugated to H2O soluble glucuronide
Renal excretion of metabolites

NB **tolerance**/ accelerated metabolism 2° enzyme induction with chronic use

Pharmacodynamics

Classic ketamine anaesthetic best described as a dose-dependent CNS depression leading to a so called **dissociative state**, characterized by profound analgesia and amnesia but not necessarily loss of consciousness. Although not asleep, the subject seems completely unaware of their environment – uncommunicative; eyes open with a slow nystagmus gaze. Varying degrees of facial grimacing, vocalization, hypertonus and purposeful skeletal muscle movements often occur independently of surgical stimulation.

CNS effects

2° functional and electrophysiological dissociation of the thalamic and limbic systems from the neocortex.
Traditionally considered to ↑ CBF and CMRO2, and therefore ICP.
Mechanism most likely hypercapnoea (hypoventilation), regionally specific stimulation and inhibition of cerebral metabolism, and direct vasodilatation (Ca+ channel block).
Recent studies – with controlled ventilation +/- hyperventilation no ↑ in ICP
Anticonvulsant properties
Potential yet unconfirmed neuroprotective/ neuroregenerative effects

Emergence delirium
Visual/ auditory/ proprioceptive/ confusional illusions +/- → delirium
May dream/ hallucinate up to 24 hours post ketamine anaesthetic
Incidence 5-30% - ↑ with age > 15, female, dose > 2mg/kg IV, Hx of personality problems or dreaming
Minimised by BZD's, GA, preop discussion

CVS

Ketamine produces CVS effects that resemble SNS stimulation
↑ SBP/PAP/HR/CO/cardiac work/MVO2
Effect appears after 2-3 minutes and settles after 10-20 minutes
Wide individual variation in response
Not-Blunted by BZD's
NB direct myocardial depressant effect if? depletion endogenous catecholamine stores
Effect on cardiac rhythm inconclusive

Respiratory

Minimal resp. depression – ventilatory response to CO_2 maintained (more than other depressants)
NB apnoea if large rapid IV injection/ concurrent opioids, benzos
Upper airway skeletal muscle muscle tone maintained

Airway reflexes relatively intact
↑ Salivary/ tracheobronchial mucous gland secretions
Bronchodilator 2° ↑ catecholamines – as effective as halothane in animal studies

Skeletal Muscle
Muscle tone often ↑ - Spontaneous movements may occur during surgery

Uterus and Placenta
Ketamine crosses the placenta easily
Uterine tone preserved

Eyes
Transient ↑ in IOP post administration
Eye movements/ nystagmus may continue throughout surgery

Clinical Use of Ketamine

Sole anaesthetic agent

- Short superficial procedures
    - Abscess
    - D&C
    - Fractures
    - Burns
    - Minor to intermediate orthopaedic procedures (eg fracture manipulation)
    - Dental procedures, cleft lip repair
    - EUA's of many types
    - Adjunct to many procedures with LA

- Long procedures when resources very limited
- Casualty extraction/road side anaesthesia
- ? Untrained users?

Induction of anaesthesia

- In shocked patients
- If no other agent available
- IM induction especially in children

Ketamine as a Premed/ Sedative

Oral ketamine is an effective premed in children
Usual dose ***7***mg/kg - Dilute in paracetamol Give with clonidine ***4-5***µg/kg for sedation for paediatric procedures

Intranasal ketamine ***2-3***mg/kg Not well accepted by children high incidence of nasal and pharyngeal burning

Intramuscular/ Rectal ketamine ***4***mg/kg

Ketamine as an Analgesic

Intense analgesia with subanaesthetic doses
0.2-0.5 mg/kg IV 2-4 mg/kg IM

TIVA
Sedation in ICU
Severe asthma attack

Contraindications

Few in comparison to clinical uses.
IHD, severe or poorly controlled HT, pulmonary HT, traumatic head injury
Needs to be placed in context of alternative options, if any.

Caution needed with small infants – irregular respiratory patterns +/- apnoea

Premedication

May give antisialogogue eg atropine 10-20 mcg/kg to max 600 mcg, but rarely necessary. Can always be given IV if there is excessive salivation.
Premedicate with clonidine whenever possible: Doses (oral ***4-5***µg/kg ***1***hr preop:
IV ***1.5-2***µg/kg 5mins before IV ketamine)

Intramuscular Ketamine

Traditional dose quoted to produce surgical anaesthesia 8-10 mg/kg
Surgery can start approx 5 min after injection and anaesthesia will last 20-30 min
If surgery to last longer, further IM dose ½ original dose PRN
NB minor surgery, malnourished children, BZD premed – may only need 5-7 mg/kg

Intravenous Ketamine

Preferred route if IV access available
Induction dose ***1-2***mg/kg given slowly
- Onset very similar to propofol
– anaesthesia for 10-15 min
- top-up 0.5 mg/kg/10mins- short procedures

TIVA

- Intermittent boluses

- Simple bag technique
  - 500 mg into 500ml NS/RL
  - 3 mg/kg/hour = 1 drop/kg/min Spont Vent
  - 1 – 2 mg/kg/hour IPPV

- Propofol + Ketamine
  - Young/healthy 200/40mg @ 10-8-6 ml/hr
  - Old/frail 200/100mg @ 5-4-3 ml/hr

- British forces
  - Ketamine 200mg, Midazolam 5mg, Vecuronium to 50ml syringe
  - Infusion rate (ml/hr) = body weight (kg)/2

(increasing the dose of ketamine will prolong the duration of recovery. "Awareness" has never been reported for ketamine)

Caudal/ Epidural Ketamine

Doses 0.25-1.0 mg/kg cause significant prolongation of postoperative analgesia cf 0.25% bupivacaine alone
Dilute in preservative free NS or LA (1 ml/kg)
No ↑ AE's eg delayed motor strength, time to micturition, postop sedation or n+v
Preservative free ketamine should only be used
Benzathonium Chloride demonstrates no histopathological changes in nerve root/ spinal cord specimens in animal studies – not confirmed in human subjects.

Intrathecal Ketamine

No advantage cf local anaesthetic.

S(+) Ketamine

It is out there. Particularly if there is any German presence or influence.
Advantages
1.5-3 fold greater hypnotic
& 3 fold greater analgesic potency cf R(-) compound and 2 fold cf racemic mixture
Therefore ↓ induction dose required, shorter recovery phase, and ↓ agitation, disorientation and anxiety.

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Perrson J. Wherefore ketamine? Curr Op in Anaesthesiol 2010: 231; 435-446 Oxygen supply is not only necessary to provide safe anaesthesia. Oxygen is a lifesaving and a relatively cheap health intervention.

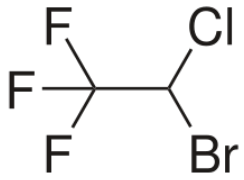
Halothane

Wayne Morriss

Halothane: Be Alert, Not Afraid!

Fluorinated hydrocarbon

2-bromo-2-chloro-1,1,1-trifluoroethane



History

- First synthesised by Charles Suckling of Imperial Chemical Industries (ICI) in 1951.
- First clinical use by Dr Michael Johnstone in 1956
- Marketed as Fluothane, quickly replaced ether and cyclopropane in high income countries.
- Use decreased during the 1980s and 1990s in high income countries as sevoflurane and desflurane became popular
- Continued use in low income countries; has replaced ether in many parts of the world

Physicochemistry

- **Minimum key facts:**
  - **SVP = 243 mmHg (at 20˚C) (approximately 30%)**
  - **MAC = 0.75%**

	Halothane	**Isoflurane**	**Enflurane**	**Sevoflurane**	**Desflurane**
MW	**197**	184	184	200	168
BP (˚C)	**50**	49	57	59	23
SVP at 20˚C (mmHg)	**243**	240	175	160	681
MAC	**0.75**	1.2	1.6	2.0	6.0
Blood-gas partition coefficient	**2.4**	1.4	1.8	0.65	0.42
Oil-gas partition coefficient	**224**	98	98	80	29
Odour	**Non-irritant, sweet**	Irritant	Non-irritant	Non-irritant	Pungent

- Unstable when exposed to light (therefore presented in brown bottles)
- Presented with 0.01% thymol to prevent liberation of free bromine (thymol clogs OMV)
- Corrodes certain metals (old EMO)
- Non-flammable and non-explosive

Pharmacodynamics

- Main points
  - Much more potent than other commonly used volatile agents (MAC 0.75)
  - Predictable dose-related respiratory and cardiovascular depression
- Respiratory
  - Sweet, non-irritant odour, good for inhalational induction
  - Marked dose-related depression of ventilation
  - Good bronchodilator
- Cardiovascular
  - Marked dose-related reduction in heart rate and contractility. Use with extra caution in ill patients / those with cardiovascular disease.
  - Sensitises myocardium to catecholamines, increases risk of VT and VF
- Central nervous system
  - Cerebral vasodilation

	Halothane	**Isoflurane**	**Enflurane**	**Sevoflurane**	**Desflurane**
Respiratory					
Respiratory rate	↑↑	↑	↑↑	↑	↑
Tidal volume	↓↓	↓↓	↓↓	↓	↓
PaCO2	↑	↑	↑↑	↑	↑↑
CVS					
HR	↓	↑	↑	nil	nil or ↑
Contractility	↓↓	↓	↓↓	↓	minimal
SVR	↓	↓↓	↓	↓	↓↓
BP	↓↓	↓↓	↓↓	↓	↓↓
Sensitisation to catecholamines	↑↑↑	nil	↑	nil	nil
CNS					
Cerebral vasodilation	↑↑↑	↑	↑	↑	↑

Pharmacokinetics

	Halothane	**Isoflurane**	**Enflurane**	**Sevoflurane**	**Desflurane**
Metabolism	**20%**	0.2%	2%	2%	0.1%

- Oxidised in liver by an isoenzyme of cytochrome P-450 (2EI) to trifluoroacetic acid
- Reductive metabolism in absence of oxygen

Halothane Hepatitis

- Very rare (1 in 35,000)
- Incidence in low income countries unknown
- Pathophysiology
  - Reductive metabolites
  - Immune mechanism (liver proteins altered by trifluoroacetic acid)

- Need to rule out other causes of postoperative hepatic dysfunction
    - Viral hepatitis
    - Other drug –induced hepatitis
    - Parasites, e.g. schistosomiasis
    - Hypoxic liver injury
    - Sepsis
- Relative contraindications to halothane anaesthesia
    - Recent halothane exposure (within 3 months)
    - Pre-existing hepatic disease

Clinical Use

1. Learn the numbers

- You probably won't have agent monitoring and the machine won't tell you the MAC!

2. Take it easy!

- Slower onset and offset than sevoflurane or desflurane.
- Great for inhalational induction but be careful with high concentrations.
    - Start with 3%, then reduce to 1-1.5% for maintenance.

3. Overdosing is easy

- Beware:
    - HIgh potency (MAC = 0.75%)
    - Vaporizer may have relatively high maximum setting (5% on TEC 4 vaporiser, i.e. over 6 times MAC)
    - Agent monitoring may be absent or inaccurate.
- Respiratory depression
    - Easy to cause apnoea. Use supplemental oxygen and SpO_2 monitoring in Recovery if possible.
- Cardiovascular depression
    - Much greater than with sevoflurane and desflurane
    - May be exacerbated by other drugs (e.g. β-blockers, calcium channel blockers)

4. Check your vaporiser

- Thymol build-up may clog unserviced vaporisers. Ideally, empty the vaporiser and refill before use.
- Don't go too low with the flows. Halothane output may be greater than set concentration at flows less than 2 litres/min, especially in older plenum vaporizers.
- Occasionally, a sevoflurane vaporiser may have been filled with halothane. Do not use! Halothane has a higher SVP than sevoflurane, therefore the vaporiser output will be high. Halothane can be delivered with relative safety using an isoflurane vaporiser (because halothane and isoflurane have similar SVPs).

5. Beware VT and VF

- Sensitisation of the myocardium to catecholamines is a real risk.

- Limit exogenous adrenaline dose to 1.5 mcg/kg (compared with 5 mcg/kg for enflurane), e.g. 20 ml of 1:200,000 adrenaline solution.
- Hypercapnia and acidosis increase the risk of arrhythmias.

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Myatt J. Pharmacology of inhalational anaesthetics. Update in Anaesthesia. 2008; 24(2):102-107
Ether has enjoyed over a hundred years of popularity as an anaesthetic drug being slowly being replaced from 1950's by Halothane.

Diethyl Ether

Phil Blum with thanks to Haydn Perndt

The take home message: ether is inhaled ketamine.

Physical properties of ether

Diethyl ether is a colourless volatile liquid with a characteristic pungent smell. It has a molecular weight of 74, boils at 35° C and has a saturated vapour pressure of 425 mmHg at 20° C. The latent heat of vaporisation is 89 calories per gram. Ether's specific gravity is 2.6 in air and 0.70 in liquid. Although the MAC is 1.9% concentrations of 2-20% are delivered in anaesthesia. Solubility coefficients are 13 in water, 65 for oil/gas, 12 for blood/gas and 3.2 for oil/water. The saturation concentration (SVP/atmospheric pressure) is 55%. Ether is flammable in air from 1.85 to 37% and explosive in oxygen from 2 to 8%. Ether is heavier than air.

From these figures some interesting observations emerge:

1. Ether's boiling point of 35°C means that ether anaesthesia in a hot climate may prove impossible. Ether's relatively low boiling point gives ether a higher SVP at a given temperature and hence saturation concentration. Compare that with isoflurane 49°C, halothane 50, enflurane 57, sevoflurane 58, trichlorethylene 87 and methoxyflurane 105 °C.

2. The MAC of ether is similar to enflurane and sevoflurane. (ether 1.9%, sevoflurane 2.2%, enflurane 1.7%, isoflurane 1.1%, halothane 0.8%, trichlorethylene 0.3%, methoxyflurane 0.2%)

3. The blood/gas solubilities of the agents are: methoxyflurane 13, ether 12, trichlorethylene 9, halothane 2.5, enflurane 1.9, isoflurane 1.4, sevoflurane 0.6 (NB nitrous oxide 0.47).

A vaporiser designed around the properties of ether (ie the EMO) must be able to deliver high concentrations for substantial periods and carrier gas flow during induction and therefore must have efficient temperature compensation to allow for the loss of latent heat of vaporisation. Ideally it should have some mechanism to let you know if the ambient temperature is approaching 35 deg cel. It must have a large reservoir to hold the 300 mls of liquid ether needed for induction of anaesthesia (cf. OMV's with halothane and trichlorethylene) and the subsequent maintenance phase.

Interestingly ether can be made at home. Just add sulphuric acid to ethanol. It's just two ethanol molecules joined end to end: CH_3-CH_2-O-CH_2-CH_3
(really only useful info for American TV series "Breaking Bad" fans)

Pharmacological properties of ether

CNS

Ether in low concentrations is a powerful analgesic. During inhalational induction there is often a marked excitement stage involving phonation and limb movement. Ether directly depresses neuromuscular junction transmission, thereby potentiating parenteral non-depolarising NMJ blockers. Ether depresses spinal reflexes, further reducing skeletal muscle tone. The sympathetic nervous system is stimulated, the level of catecholamines in the blood rising as the concentration of ether in the blood increases. As a result there is dilatation of the pupils and sweating may occur.

RS

Ether increases salivary secretions sufficiently to hinder inhalational induction of anaesthesia if atropine or hyoscine are not given beforehand. Bronchial smooth muscle is relaxed, but ciliary action is little impaired. Respiration is depressed only in deep ether anaesthesia. In light surgical anaesthesia, the abdominal muscles contract during expiration, and as anaesthesia deepens the abdominal muscles begin to relax, then the intercostal muscles. Beyond this point, respiration becomes rapid, shallow and jerky, accompanied by marked tracheal tug and exaggerated movements of the diaphragm. Finally the diaphragm becomes immobile; respiration stops.

CVS

Coronary arteries are dilated, but peripheral vascular resistance is maintained by systemic arterial vasoconstriction. Ether is a myocardial depressant. Deepening anaesthesia is accompanied by a progressive reduction in myocardial contractility and relaxation of vascular tone. However these effects are normally outweighed by the intense sympathetic activity which maintains or even increases systemic arterial pressure.

Other

Blood glucose rises, due to mobilisation of glycogen from the liver and consequent depletion of liver glycogen stores. Vomiting is no more common after a properly conducted ether anaesthetic than with any other agent. The uterus is relaxed. Ether freely crosses the placental barrier to the foetus, who can be depressed by prolonged ether anaesthesia.

Essentially ether is a great "sole agent" for general anaesthesia in austere environments:

- the patient is unconscious
- the patient has some pain relief
- the abdominal muscles relax enough for surgery without the need for muscle relaxants in a spontaneously breathing patient
- it's a bronchodilator, respiration is depressed less than other modern agents and V-Q mismatch minimised at a surgical plane of anaesthesia when oxygen supply is limited
- sympathetic activation means blood pressure is maintained in haemodynamically compromised patients

The well known disadvantages of ether (smelly, slow and nauseating) can be minimised by performing an IV induction to avoid an inhalational induction. The explosive risk is minimal if there is no diathermy and simple precautions are taken.

Clinical use:

Inhalational induction using an EMO:

- Atropine / ketamine premed
- Be patient - it will take at least 20 minutes
- Initially 3% (awake patients don't tolerate more than about 5%)
- Increase 1% every 5 breaths to 10%
- Then 2.5% every 5 breaths to 20%
- Back to 6-10% spontaneously breathing

IV induction and ether maintenance using an EMO

- 6-10% if spontaneously breathing (face mask or LMA)
- Initially 10% then 3-4% if ventilating with muscle relaxant

Ether planes of anaesthesia:
Respiration:
In light surgical anaesthesia, the abdominal muscles contract during expiration, and as anaesthesia deepens the abdominal muscles begin to relax, followed by the intercostal muscles. You can intubate when the abdominal muscles relax. Respiration is depressed only in deep ether anaesthesia. Respiration becomes rapid, shallow and jerky, accompanied by marked tracheal tug and exaggerated movements of the diaphragm. Beware of tracheal tug. Finally the diaphragm becomes immobile; respiration stops.

Pupils:
Pupils initial dilate then constrict
Deep surgical plane = start to dilate again
Pupils are midpoint and eyes pointing straight ahead in surgical plane
As patient gets too deep pupils dilate widely and are fixed

Minimising the explosion risk

- OK to use diathermy in ether/air as long as not thoracic, head/neck or neurosurgery
- With oxygen or nitrous oxide = explosive therefore NO diathermy
- All equipment 1.5 meters off the ground including oxygen concentrator
- Minimise static electricity
    - Humid
    - Conductive black rubber

Finally if you really want to mess with a primary candidates mind you can tell them about the Halothane-Ether azeotrope:

- 2:1mixture halothane/ether
- Azeotrope = composition is unchanged by distillation – boiling point becomes similar and the proportions in the vapour same
- Use like halothane
- MAC 0.7% (1-2% on your OMV)
- Respiratory and CVS ether benefits
- Non-explosive in oxygen but still flammable
- Analgesic halothane!

Obstetric anaesthesia

Eric Vreede

Each year approximately 350,000 women die of a pregnancy related complication; this is one death every 90 seconds. Although Maternal Mortality Rate (MMR) has decreased from 1990 – 2008 by 34%, the MMR is still the health indicator that shows the largest discrepancy between the rich and the poor world; 99% of maternal death occurs in the "Real World" and this translates in the fact that the MMR in the poorest countries is a factor 100 – 200 higher than in the richest countries. The remarkable successes in some countries are offset by a significant deterioration in others (e.g. Afghanistan now the worst).

The socio-economic and educational impact of each maternal death on the remaining family members is immeasurable, but significant especially in the poorer nations.

For example; mother dies ⚰ one of the children (most likely a girl) must look after the other siblings ⚰ she does not go to school ⚰ the cycle of poor education and poverty continues ⚰ she marries young and risks dying in childbirth ⚰ etc...

It has been known for some time that pregnant women die from complications of pregnancy that cannot be predicted nor prevented. They can however, be treated by Emergency Obstetric Care (EmOC) which consists of basic (antibiotics, oxytocics and anticonvulsants) and comprehensive EmOC (including blood transfusion and assisted/operative delivery).

Anaesthesia plays a vital role in the reduction of Maternal Mortality in the world; without anaesthetists and some form of anaesthesia caesarean sections would not be possible. Who would want to have a caesarean section without some form of anaesthesia??? Yet this still happens in the 21st century. 167 years after the first ether anaesthetic there is still no universal access to simple safe anaesthesia for caesarean sections.

Anaesthetists can play an important role in one of the major Public Health issues of the 21st century by delivering simple and safe obstetric anaesthesia and by training anaesthesia providers.

Eric Vreede

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Blood Supply

Steve Kinnear

Blood supply in developing countries is becoming an increasingly important issue.

Why does it matter ?

In 2012, the WHO published its latest Millenium Development Goals (MDG) Report . In it, the UN summarises the progress, or otherwise, that has been made in the last 12 years, towards improving the lot of the billions of people who are living in developing countries, and in particular the almost 1 billion who are still trying to live on less than $1.25 per day. The fifth goal was to reduce by three quarters, between 2000 and 2015, the developing world maternal mortality ratio.

Maternal mortality has nearly halved since 2000, but levels are far removed from the 2015 target. Not one of the major developing country regions has met this target. Southern and South-East Asia have got the closest.

In sub-Saharan Africa, maternal mortality is currently over 400 per 100,000 live births, down from 850 in 1990 (cf. Australia at ~ 8 per 100,000). Nevertheless, over 300,000 women die each year during pregnancy and childbirth, and over 99% of the deaths occur in developing countries.

The most common cause of maternal death worldwide is death from acute blood loss during/after delivery, accounting for 20 - 30% of all deaths, followed by sepsis, abortion, pre-eclampsia and obstructed labour (UNFPA data) - and the most common problem in this group is lack of access to a centre than can perform a blood transfusion.

The MDR listed eight goals. However another issue is starting to become a major problem – trauma-related death and injury" and addressing this problem has been called by some "the ninth goal". Road accidents and other forms of acute trauma have become a major cause of death in the many rapidly industrialising countries of the third world, particularly China and Thailand. There are many things that need to be tackled to arrest this epidemic, and one of them is rapid access to safe blood transfusion.

What are the risks ?

In developed countries, the risks to the patient of receiving a blood-born infection from a blood transfusion have progressively decreased. Nucleic Acid Amplification Technology (NAT) testing has dramatically decreased the "window of non-detection" in donated blood for hepatitis B and C and HIV. For HIV and Hep C the risk in Australia is now less than 1 in 1,000,000 per unit of donated blood, and about 1 in 760,000 for Hep B. Non-infective risks such as acute haemolytic reactions ~1 in 76,000, and transfusion-related acute lung injury (TRALI) ~ 1 in 80,000, have become more important. Furthermore most developed countries have voluntary donation programmes with policies aimed to significantly reduce the likelihood of infected would-be donors attending.

However donation practices, and testing techniques vary enormously in developing countries, from the quite good to the grossly inadequate. Furthermore, there are much greater rates of prevalence of the major blood-borne infective diseases. These factors combine to make blood transfusions a risky business in many developing countries.

A more in-depth analysis of this will be presented in the talk, but some of the key points are:

Hepatitis B prevalence rates are high in Asia and the Pacific region (5 -15%)

Hepatitis C prevalence rates are lower (1 to 10%), but notably high in Mongolia and probably PNG.

HIV prevalence rates are lower still, but much higher (5 to 20%) in many countries in Africa.

Syphilis prevalence rates are 0.1 to 3%, except in PNG and parts of Africa (2 to 7%)

Most countries have stoped paying donors, but many still push strongly for family members to donate, and some countries will not do screen donated blood for infective agents unless these tests are paid for.

Blood is in desperately short supply in many developing countries – but when it is given, its safety is often questionable. Africa has the most dangerous, and least screened, blood

The World Health Organisation has established the 5 basic conditions for promoting safe blood transfusion. They are:

1 Establishing a nationally coordinated service
2 Collecting blood exclusively from voluntary donors in low-risk populations
3 Testing all blood for appropriate compatibility
4 Screening every unit of blood for (as a minimum.) Hep B &C/HIV/Syphilis
5 Reducing the number of un-necessary transfusions

Hepatitis B is common, and is often screened for.

Hepatitis C is becoming a major risk and is often not screened for.

Of the 148 countries who responded to a WHO survey on this issue (2009), 41 countries were not screening donated blood for any/all of these infections.

If you are a young Caucasian woman and blood group Rh neg., try very hard not to be given a blood transfusion in any developing country, as it will almost certainly be Rh Positive blood. Rh negative blood is often simply not available.

Of the ~ 92 million units of blood transfused each year, half of these are in developed countries, home to about 15% of the population. The majority of developing countries are yet to adopt NAT testing.
Lack of effective screening of donated blood in developing countries is currently causing

- 15 million new cases of Hepatitis B / year
- 5 million new cases of Hepatitis C / year
- 160,000 new cases of HIV / year

Blood transfusion has now become the major cause of new cases of hepatitis C worldwide. Three out of 4 of these patients will get chronic hepatitis. Of those that get chronic hepatitis, about 5% will eventually get liver failure or liver cancer.

How do we assess the need ?

In a Developed country ….. (generally accepted guidelines) -
Consider a transfusion for a …

Healthy pt	when the Hb has fallen to 70 gm/L or is about to do so
Ischemic Heart Disease pt.	when the Hb " " 100 gm / L " "

In a Developing country:
Consider a transfusion when,

Healthy or otherwise	the patient is severely symptomatic some patients can tolerate Hb 4–6gm %, particularly if the anaemia is chronic.

In developing countries there are no hard-and-fast rules, and the need is balanced against the scarcity and risk of the supply.

As anaesthetists going to work in developing countries, it is important to know if patients who are being considered for surgery, elective or otherwise, are significantly anaemic.

Data will be presented in the talk that demonstrates that experienced health workers are not very good at diagnosing significant anaemia on clinical grounds. Point-of –care tests used in developed countries are very expensive. The UK-based charitable organisation TALC (Teaching at Low Cost)can supply a simple and very cheap point-of-care test developed for the WHO that quickly and estimates a patient's haemoglobin with reasonable accuracy. The test costs 4c per patient. This will be demonstrated during the talk.

How to do a basic transfusion

Rarely, a volunteer may find him / herself in the position of having to do his / her own grouping and cross matching of blood to perform a transfusion. This happened to me in one of my placements. In the talk I will take the audience the basic steps of how to do this.

Two rules:

1. In this situation, only the ABO blood group is grouped and matched. Virtually all Asians and Pacific Islander(93-99%) and Africans (97-99%) are Rh positive, so Rh grouping and matching is unnecessary .
2. The only match we are doing here is the **recipient's serum/plasma** against the **donor's red cells.** This is called a "forward" match.

   In brief, the steps are as follows.

A: Working out the (patient's) recipient's ABO blood group.
("Grouping the recipient's blood")

1. Get a sample of the recipient's blood and put it in a tube that stops it from clotting. Let it stand, or centrifuge it so that there are two clear layers, red cells at the bottom and plasma at the top.
2. Test some of the recipient's red cells against standard ABO group anti-sera Anti-A and Anti-B to determine it's ABO blood group: A, B, O or AB

Agglutination, or lack of it, will tell you what the recipient's ABO group is.

B: Select the appropriate units of blood from the blood bank to give to the patient, once his/her blood group is known, and check to see if they are indeed compatible.

("Cross-matching the plasma/serum of the recipient against the red cells of the donor units of blood")

1 Get a drop of washed red cells from each of the potential donor units of blood and put in labelled test tubes.

2 In each test-tube, put 3 drops of the recipient's plasma and then centrifuge the test tubes.

3 Look for agglutination. No agglutination means that donor unit is compatible. Agglutination means that unit is not compatible.

If there is no blood bank, you will have to choose possible donors, group their blood, and then based on their ABO group, choose the appropriate donor to do the cross-matching on. This was the situation I was in.

During the talk I will take participants through each step.

Emergency autologous blood

Here we are not talking about the process of using a sophisticated cell-saver, but the prospect of collecting the blood of an exsanguinating patient in a quick fashion, doing some simple thing to it, and then immediately re-transfusing it into the patient.

Whilst I have not had personal experience of this, there are a few papers that describe this practice with variable success.

The basic steps are as follows:

Firstly, there is pus or cancer cells in the blood, or the blood smells, do not re-transfuse. If none of these apply, proceed.

1 Using as sterile equipment as possible, suck, ladle, or scoop out the fresh blood and put into a container.

2 Filter the fresh blood through 4-5 layers of sterile gauze into a blood-bag containing citrate or dextrose. (If these bags are not available, the citrate and dextrose are easy to make up). The gauze filters out the macro-clots.

3 Clamp the big hole you made in the top of the blood-bag to put the blood in. Insert a standard giving set (170-200 micron filter) into the bottom of the bag, and start the transfusion.

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Tropical Medicine

Phil Blum with thanks to Josh Davis MBBS DTM&H FRACP Infectious Diseases Physician RDH

Tropical medicine for you and your patient

Phil Blum
With thanks to Josh Davis MBBS DTM&H FRACP Infectious Diseases Physician RDH

Overview.
Infectious diseases that your patients will have:

Worldwide disease burden 2008 WHO	**Annual mortality** Millions	**% Deaths**
Pneumonia	3	11.2
Diarrhoea	1.8	6.9
HIV/AIDS	1.5	5.7
TB	1	3.5
Malaria	0.9	3.3
Neglected tropical diseases	0.5	1.7

Children bear the brunt of disease in the real world. One thousand children, under 5, die every hour (10 million per year). In 2004, in Africa, 46% of all deaths were in children <15 years old cf. Australia where 1% deaths <15 years old. They die from pneumonia, diarrhoea, malaria, measles and HIV. Pneumonia is the prime cause of death in children, 1/12 – 5years. For every child that dies of pneumonia in the developed world, 2000 children will die of a LRTI, in low and middle-income countries, for want of oxygen and antibiotics

Commonly patients have multiple co-morbidities. A child may present for surgery underweight, with a worm load, a nasty productive cough and diarrhoea. They may also have a murmur from rheumatic heart disease.

Infectious diseases that you might get:

For every 100 000 travellers to less-developed countries for one month:

- 1000 will be incapacitated in their work either abroad or on their return
- 300 will be admitted to hospital
- 50 will have to be air evacuated
- one will die
- staying at home for a month = 1:130 000 fatal domestic accident

8% of travellers to the developing world will require medical care during or after travel.
Of these 8% the commonest diagnoses are shown below (NEJM2006;352(2):119)

1/ Systemic febrile illness (226/1000 patients)

- 40% no cause found
- 35% Malaria
- 10% Dengue

2/ Acute diarrhoea (222/1000 patients)

- 39% Unspecified (usually E Coli)
- 17% Giardia
- 12% Amoebic dysentery
- early antibiotic therapy is warranted particularly if you are working. Norfloxacin for 3 days is helpful but 3 days of azithromycin may be more effective in South-east Asia where quinolone resistance is more common.
- Dysentery is defined by invasion of the intestinal mucosa, with blood or mucus in the stool
- if no rapid improvement, get stool samples and consider amoebiasis.

3/ Dermatological disorders (170/1000)

- Insect bites
- Cutaneous larva migrans –Hookworm
- Animal bite requiring rabies prophylaxis
- Skin abscess
- Allergic rash or reaction

4/ Chronic diarrhoea (113/1000)
5/ Respiratory disorders (77/1000)
6/ STI's are common in returning aid workers.

Another study of 10 000 Swiss citizens travelling to the developing world for <3 months found:

- 15% had a health problem
- Giardiasis was the most common - 7/1000/month
- Amoebiasis - 4/1000/month
- Gonorrhoea - 3/1000
- Malaria - <1/1000

Note the most common causes of death in US travellers are cardiovascular disease and injury.

Prevention is better than cure

Many of these problems are preventable by:

- Vaccines
  - get expert travel advice
  - Up to date with DTP, MMR, Polio, Influenza, Hep B, Hep A, Typhoid
  - if prolonged and/or rural travel to affected areas, consider vaccinations for rabies, JEB, meningococcus, oral cholera vaccine and yellow fever.
- Mosquito prevention:
  - clothing – cover up with light coloured clothes
  - DEET repellent
  - Pyrethroid-containing flying-insect spray in living and sleeping areas during evening and night-time hours
  - Permethrin-impregnated bed nets
  - avoid hanging around when there are mozzies about (Anopheles = dusk/dawn, Aedes = daytime)
  - minimise standing water about your accommodation. Empty pot plant bases. Remove fallen palm fronds that pool water etc.

- food and water hygiene (hand washing, avoiding drinking untreated water. If in doubt, boil drinking water and avoid eating raw vegetables, seafood etc.)
- a small bottle of alcohol based hand wash is useful
- Malaria prophylaxis
- road trauma – wear a seat belt
- don't pat that cute little puppy / monkey / bat …..crocodile / lion
- don't have unprotected sex
- Post exposure prophylaxis

Some more detail on specific diseases:

Pneumonia

- Step pneumoniae most common cause
- Empyema and bronchiectasis common sequelae
- 2 million child die from pneumonia world wide.

  Causes:

  Malnutrition / overcrowding
  Indoor air pollution
  HIV
  Access to health care:
  - breast feeding
  - vaccinations – HiB, pneumonoccal, pertusis, measles, influenza
  - antibiotics
  - oxygen

HIV

Your patient:

- 33 million worldwide living with HIV infection
- 2 million deaths in 2007
- Estimated HIV prevalence by area (WHO 2005):
  - Very High
    - South Africa 19%
  - High
    - Parts of South East Asia
      - Cambodia 3%
      - Thailand 2%
  - Moderate
    - Oceania 0.5-1% but rapidly increasing in PNG
    - South America
  - Low
    - Australia <0.5%

Implications for anaesthesia:

- Opportunistic infections common if not on ART
  CD4 count<350/mm^3 -Bacterial pneumonia, oral thrush, shingles
  CD4 count <200/mm^3 - PCP, oesophageal candidiasis, G-ve bacteraemia, TB
  CD4 count <50/mm^3 - CMV, MAC, Cryptococcosis, Lymphoma
- ART should be continued perioperatively if possible
- Drug interactions if on ART
  - Protease inhibitors (eg. Lopinavir, Ritonavir, Saquinavir) inhibit Cytp450, thus impair metabolism of midazolam, fentanyl, lignocaine
  - Nevirapine induces Cytp450

HIV

Yourself

- risk of transmission from a hollow-bore needle percutaneous exposure ~0.3%. Lower for solid needle. Exposure of blood to mucous membranes or non-intact skin ~0.1%. No risk of exposure to non-blood stained urine or saliva.
- wearing gloves decreases transmission risk.
- if significant exposure to known HIV positive patient
  - Wash site immediately with soap and water
  - Begin post-exposure prophylaxis ASAP (within 72h, but preferably within 4-8 hours).
  - If possible, get baseline serology on yourself and the patient for HIV, HBV and HCV
- if significant exposure to patient with unknown HIV status, begin PEP if in a high prevalence (>1%) country, or the patient has risk factors. Test the patient if possible and cease PEP if the test is negative by a reliable method.
- **seek expert advice** – eg. ID service at your hospital of origin in Australia
- basic PEP regimen: Truvada (tenofovir/emtricitabine) i tablet daily if unknown source. Alternative=Combivir (zidovudine/lamivudine) i BD (more side effects –eg. headache, nausea, anaemia). Take for 28 days.
- expanded PEP regimen: If source known HIV positive and high-risk exposure, then add a protease inhibitor: either Kaletra (Lopinavir/ritonavir 200/50mg ii BD) or Atazanavir 400mg daily. There is not much evidence for this, and it is probably of marginal additional benefit – thus if not available just use the basic regimen.
- DO NOT USE Nelfinavir or Efavirenz as part of PEP (toxicity).

- if source patient is on ARV already, talk to expert about what to use for PEP (there may be transmitted drug resistance)
- if going to a high-prevalence country, bring a course of Truvada with you if possible; some hospital pharmacies will provide it on the understanding that you will give it back if not used.
- Think about HBV and HCV too: Ensure you are HBV immune before travel. HCV – not much you can do except avoid exposure. If you develop acute HCV hepatitis, can wait for 12 weeks and if still positive, should consider PEG-interferon Rx (back in Australia)

TB

Your patient

- 1/3rd!! of the world have latent TB. Virulence of TB may be changing to adapt to a crowded world. Latent TB may be progressing to active TB more often and more rapidly.
- now often associated with HIV co-infection. Treating HIV in the presence of TB and other opportunistic infections can cause IRIS – immune reconstitution inflammatory syndrome. Extrapulmonary TB more often associated with HIV co-infection.
- MDR-TB (Multi drug resistant)
  - due to inadequate treatment
  - Most in China and former USSR
  - resistance to isoniazid and rifampicin\
- XDR-TB (Extensively drug resistant)
  - becoming more prevalent
  - resistant to MDR plus any fluoroquinolone (eg ciprofloxacin) and any of the three parenteral drugs (amikacin, kanamycin, caspreomycin)
  - first reported 2006. Now in 55 countries
  - where use of second-line drugs have been widespread and poorly managed
  - drug susceptibility testing slow, costly, unreliable
  - patient often die before susceptibilities determined
  - mortality if HIV co-infected 96%
  - a possible return of TB lobectomies

TB

Yourself

- make sure you know your status (mantoux or quantiferon gold) BEFORE travel and repeat 3 months after you return
- wearing of n95/P2 masks desirable but not always practical in high-prevalence areas
- BCG vaccination controversial – does not protect against infection, but does reduce chance of CNS and disseminated disease. Affects BCG result. Recommended in mantoux-negative (<5mm) people under age 35 who will be spending >3 months in a high-risk country or situation.

Malaria

Your patient

This is a parasite that has been evolving with us for tens of thousands of years. Incidence massively increased as we started to stay in one place and farm. It is a master at evading our immune system. A large group of semi-immune individuals develop in endemic areas. Adults have a large chronic parasitic load in their blood that infect mosquitos. 10% of their RBC's may be infected and yet they appear well. It kills mainly children and those where immunity changes eg pregnancy. If you are semi-immune and you leave an endemic area for a time and then return you are at increased risk of developing clinical manifestations of acute malaria.

P. falciparum is particularly nasty. Vivax is polite enough just to infect your reticulocytes. Falciparum infects all RBC's. The spleen is the main defense against malaria. P falciparum evades even the spleen by attaching itself to the endothelium of the microcirculation. This causes end organ ischaemia and multi-organ failure. Every time a new group of red cells explodes and release more parasites into the blood, more microcirculation is blocked up as the falciparum sequesters there. That is why Falciparum malaria is such a medical emergency. Any delay in the administration of anti-malarials adds to the irreversible parasite load in your end organs including your brain. Nice!

- 5 species infect humans
    - Plasmodium falciparum, vivax, ovale, malariae, knowlsei (Monkey malaria)
    - P.falciparum responsible for majority of deaths
    - P.vivax an important cause of disease burden in Oceania/SE Asia – chronic anaemia
- Africa – falciparum>>others – due to genetic changes in humans eg duffy antibody, G6PD deficiency which offers vivax malarial resistance; SE Asia and Oceania about 50% falciparum
- "Severe/complicated" malaria = P.falciparum plus one or more of : coma, renal failure, shock, ARDS, severe anaemia, acidosis.
- often also have low platelets, jaundice, hypoglycaemia
- a relatively cheap rapid antigen blood test is highly sensitive and specific for P.falciparum
- in highly endemic areas, severe disease mainly in young children – if you survive to adulthood, you are semi-immune – can have high parasitaemia with no symptoms
- in low or seasonal endemic areas, severe disease affects adults and kids
- Severe malaria has coincident gram negative bacteraemia in up to 30%
- Rx of choice severe disease= IV artesunate 2.4mg/kg BD for one day then daily to total >=3 days, then a longer active oral agent (eg. doxycycline 7 days or co-artemether 3 days).
- Artesunate shown to reduce mortality by 36% compared to IV quinine – Lancet 2006

- Artesunate also kills the gametocytes so a biting mozzie can't get infected. So using artesunate actually has an effect on overall incidence of malaria over time

Malaria
Yourself

- Non –immune travellers to endemic areas may become profoundly unwell with less than 1% of their RBC's infected
- Malaria in travellers usually due to lack of or inappropriate chemoprophylaxis – risk of catching malaria from one month of travel without chemophylaxis in Oceania is 1:5
- choice of chemoprophylaxis depends on age, destination, time of year, duration of visit, activities undertaken, pregnancy
- presents typically as fever (intermittent or periodic), chills, headache, N&V, abdo pain, myalgia but also cough, arthralgia, diarrhoea.
- chemoprophylaxis options are:
    - Medium-High risk area – take prophylaxis: Doxycycline daily OR Malarone (atovaquone proguanil) daily. Start 1-2 days before (doxy/malarone). Continue 4 weeks after doxy; 7 days after (malarone)
    - Mefloquine (Lariam) – go crazy on your holiday
    - Low risk area – take prophylaxis as above OR have a standby Rx course of co-artemether with you +/- access to local diagnostics
- treatment if you get non-severe malaria:

    Co artemether(Artemether/Lumefantrine) = preferred agent. Artemisinin-based combination therapies (ACTs) to maximise efficacy and minimise drug resistance

    - 4 tabs BD for 3 days.
    - If on mefloquine prophlaxis, don't take this (mefloquine plus lumefantrine can have additive cardiotoxicity; prolonging QT interval). Take malarone 4 tabs daily for 3 days
    - Both of these drugs are safe for children down to 10kg. Both should be taken with fatty food or milk.
- if you get a fever within 3 months of returning to Australia, get a malaria antigen test plus blood film done within 24 hours.
- because you can be quite sick with minimal parasite load consider 4 blood films within 2 days if there is a high index of suspicion.
- consider taking a treatment course of co-artemether with you, as these drugs are often counterfeit in SE Asia.

Some notes on the flaviviruses:

Flaviviruses are a group of arthropod borne diseases that tend to make your bleed or infect your brain (or both if you are lucky).

Dengue

- Flavivirus endemic throughout South-east Asia
- daytime biting Aedes aegypti mozzie
- mainly in urban areas with high population densities
- 40% world's population at risk from Dengue
- 0.5 million require hospitalisation – 2.5% mortality
- less than 2 weeks incubation
- non-specific flu-like symptoms plus retro-orbital pain, transient improvement then, at 3-5 days maculopapular rash with worsening of symptoms
- Dengue haemorrhagic fever
    - Thrombocytopaenia (<100 platelets) with plasma leak syndrome (haemoconcentration, pleural effusion or ascites) plus bleeding tendency/bleeding
    - Add shock, ARDS = Dengue shock syndrome
    - more common in children
    - more common if had another Dengue serotype before
    - previous Dengue thus a relative contra-indication to travel to endemic area– but only mildly increased risk. If go then should be much more careful about mozzie avoidance.
- Serological and PCR on blood/CSF diagnosis

Yellow fever

- endemic throughout central Africa
- spread by Aedes aegypti in urban settings
- most people develop a short viral illness with vomiting
- rarely patients develop a coagulopathy and shock similar to Dengue Shock Syndrome, but unlike Dengue, liver failure is prominent – hence the "yellow"
- 20% mortality if develop acute hepatitis
- yellow fever vaccination is effective for 10 years

Murray valley encephalitis

- included in this discussion as is also a flavivirus but is rare (and interesting)
- endemic through north-western Australia
- most people infected are asymptomatic
- a small minority develop clinical symptoms of encephalitis
- 1/3rd patient with clinical symptoms will recover without sequleae. 1/3rd will have permanent neurological sequleae, 1/3rd will die.

Japanese encephalitis

- another flavivirus
- most important cause of viral encephalitis in Asia
- risk really only for people spending a long time in Asia
- like MVE most infection are asymptomatic (over 99%) but symptomatic disease has a high fatality rate
- vaccine for those spending extended periods in endemic areas

Some notes about Chikungunya

- Chikungunya is an arthropod borne (Aedes aegypti) Alphavirus initially endemic to West Africa but now multiple massive outbreaks have been described around the world since 2004 – including India, China and SE Asia.
- Ross River Fever and Barmah Forrest Fever are also caused by Alphaviruses
- can also be transmitted by blood exposure to health staff and vertical transmission to neonates
- thousands of cases have now been identified in returned travellers
- acute febrile polyarthritis
- incubation period 2-4 days
- arthritis 2-5 days following onset of fever
- symmetrical polyarthritis includes hands, wrists and ankles
- pain is intense and disabling (Chikungunya in Tanzanian means "that which bends up")
- associated with maculopapular rash in around 50% cases
- polyarthritis persists for 6 months in 50% cases
- severe disease can occur in the elderly and those with chronic health issues and includes:
    - Respiratory failure
    - Myocarditis
    - Menginoencephalitis
    - Renal failure

- investigations show lymphopaenia, thrombocytopaenia and elevated LFT's
- diagnostic serology –IgM and IgG anti-Chikungunya virus antibodies
- treatment is supportive only. No vaccine is available.

The neglected tropical diseases:

- more than one billion people are affected by the neglected tropical diseases
- preventable infectious diseases neglected by media, government and health organisations
- the disease burden from these diseases, as measured by disability adjusted life years lost, equals that of HIV/AIDS, TB and Malaria combined.
- inexpensive oral therapies exist to treat many of these conditions
- the list is growing. Current 17 on the WHO list.
- these diseases include :

Worms: Round /Flat : intestinal or tissue – nice!

- Roundworm (Ascariasis)
- Whipworm (Trichuris)
- Hookworm (Ancylostoma, Necator)
- Schistosomiasis
- Lymphatic filariasis (Elephantiasis)
- Onchocerciasis (River blindness)
- Guinea worm (Dracunculiasis) – nearing eradication

Protozoa:

- Chagas disease – (American Trypanosomiasis)
- African trypanosomiasis (African sleeping sickness)
- Leishmaniasis – Cutaneous or visceral

Bacterial

- Trachoma – leading cause of preventable blindness
- Leprosy
- Buruli ulcer (Mycobacterial)

Viral

- Dengue
- Rabies

Rabies

- caused by a number of neurotropic viruses in the Rhabdoviridae family, Genus Lyssavirus
- virtually uniformly fatal
- 55 000 deaths per annum in Africa and Asia
- Rabies virus is shed in saliva. Thoroughly wash bites and scratches with soap and water. Consider using povidone-iodine if available. Wound cleaning can decrease transmission rate by 90%.
- inoculated virus enter peripheral nerves and migrate centrally
- initial prodromal flu-like illness lasts approximately one week
- paraesthesia, itching, burning, numbness may radiate proximally from the bite wound
- classic clinical features of encephalitic rabies include:
    - hydrophobia
    - aerophobia
    - opisthotonos
    - autonomic instability (including hypersalivation) and arrhythmias
    - dysarthria, dysphagia, diplopia,vertigo
    - agitation and combativeness
    - hallucinations and disorientation
- eventually coma, flaccid paralysis, respiratory and cardiovascular collapse
- 20% patients present as paralytic rabies which can mimic Guillain-Barre syndrome

Rabies vaccine and immune globulin (passive immunisation)

- Rabies vaccination and passive immunisation is effective
- Rabies vaccine is used for preexposure prophylaxis given IM - 3 doses (Day 0,7,21)
- protective antibodies are produced within 7-10 days and last years
- if a vaccinated person is bitten then urgent postexposure prophylaxis consists of:
    - 2 doses of IM rabies vaccine ASAP (Day 0 and 3)

- if no previous rabies vaccination has been given then urgent postexposure prophylaxis consists of:
    - 1 doses of IM human rabies immune globulin (HRIG)
    - 4 or 5 doses of IM rabies vaccine, which needs to be refrigerated (Day 0, 3, 7, 14, 28)
    - note that HRIG and might be hard to get in developing countries as ERIG (equine RIG) is cheaper but associated with more adverse reactions

Another "neglected tropical disease" is road trauma. Road travel can be the most dangerous part of your mission.

There are some excellent web based resources to obtain more specific information about disease prevalence at your destination:

- The WHO "green book", International Travel and Health. http://www.who.int/ith/en/. Updated each year. Free to access/download.
- The CDC "yellow book", Health Information for International Travel. http://wwwn.cdc.gov/travel/content/yellowbook/home-2010.aspx. Free to access - good info on country-by country need for vaccines/malaria risk.
- "Smart traveller" – the Australian Government travel advisory service. http://www.smartraveller.gov.au/.
    - UpToDate Online – if your hospital doesn't have this you might be able to hassle a physician friend to help you access this very useful medical site.

Why we should teach

Wayne Morriss

The reasons to teach

George Bernard Shaw wrote:

He who can, does.
He who cannot, teaches.

But does this make any sense in medicine? To be a good clinical teacher, it is important to be a good clinician. It is also important to learn and apply basic educational principles.

Why should we teach? Do we have an ethical obligation to teach medical students, junior doctors or specialist trainees? Does this extend to our colleagues when we work overseas?

What are some of the practical benefits of teaching? We all benefit from having safe, well-trained registrars. These same registrars may be looking after us tomorrow after a car crash or in a few years' time when we're having our cataracts done.

There are also many benefits from a personal point of view. Teaching can often be a deeply satisfying experience. It often makes us think about what is important about a topic and it improves our own understanding. Teaching may also help us to development new skills, e.g. communication and presentation.

Barriers to teaching

It's not always easy to teach. It takes time and effort to teach well. Our efforts are not always acknowledged.

In the Real World, anaesthesia education may be seen as a low priority because of the pressure of clinical work. So, paradoxically, teaching may be very limited when there is a desperate need to train more anaesthesia providers.

Making a difference

A Chinese philosopher said:

Give a man a fish and he'll eat for a day.
Teach a man to fish and he'll eat for the rest of his life.

This quote resonates strongly in the Real World. As part of a visiting team, you may provide excellent anaesthetic care for one or two weeks, but what happens when you go home? Can you add value by teaching others during the visit? Transfer of knowledge and skills will probably have a much greater impact on the overall health situation in the medium and longer term.

During the visit, teaching can take many forms – simply involving the local anaesthetist in the list, teaching special skills, reviewing other cases, presenting at a department meeting, to name a few examples. It is important not to let the drive to do more cases totally obscure the need to develop local capacity.

Back to GBS

In my view, George Bernard Shaw got it wrong. To be a good clinical teacher, it is necessary to be a good clinician. Good teaching has many rewards – for our patients, our colleagues and ourselves.

Those that can, do.
Those that can do better also teach.

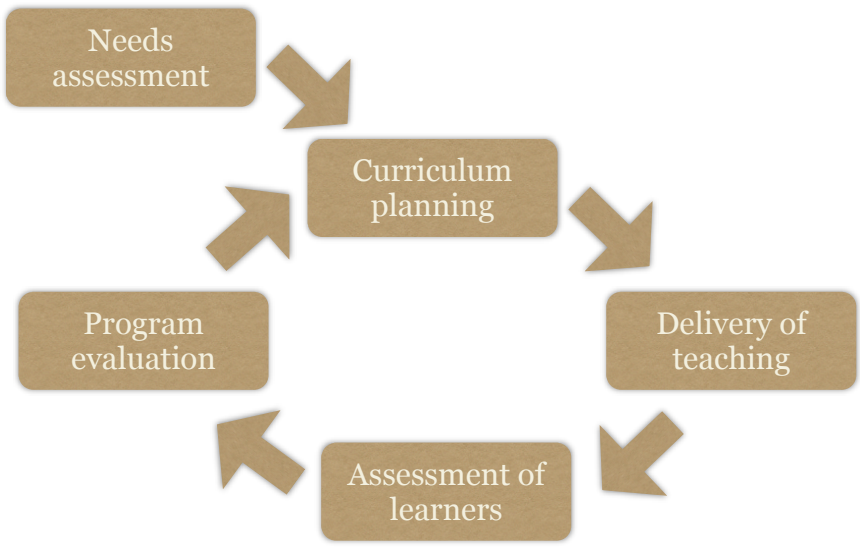
Education in low resource settings

Dylan Bould,

Suggested learning objectives:

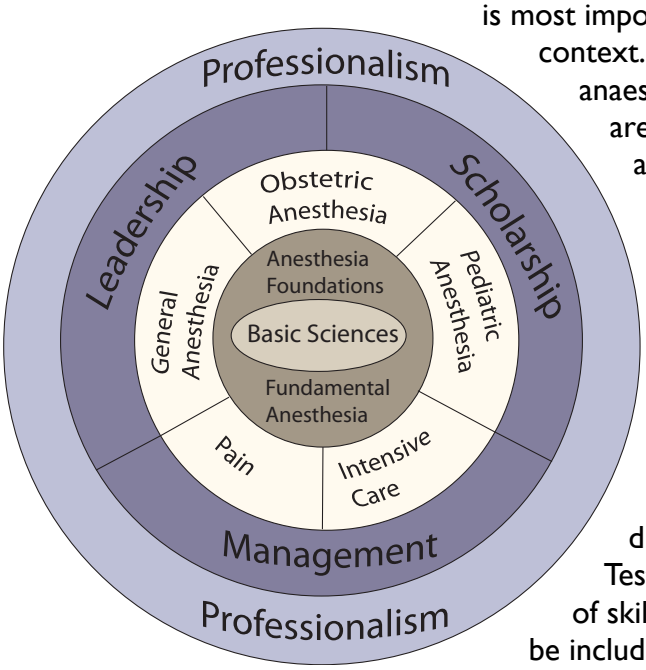
- To explore the reasons why you may want to prioritize education in your work in the "Real World" rather than focus on service provision
- To review basic educational principles when setting up a program of any scale - needs assessment, curriculum, teaching and learning, assessment, program evaluation
- To explore differences in teaching and education in low-resource settings

Education in low-resource settings should follow the same basic educational principles that you would employ in setting up an educational program in Australia.



Everything should start with a robust needs assessment – you really can't get too much information before starting. Who are your potential learners? Physicians, nurses or clinical officers? What is their current level of knowledge? What aims are feasible within available resources? Have some clear goals - don't try to do too much or too little

Don't try to reinvent the wheel! There are likely other similar programs that have curricula that can be borrowed for your needs, and at a push you can adapt curricula from high-income countries although it is most important that the curriculum is appropriate to the local context. The curriculum for the University of Zambia anaesthesia program is a "spiral curriculum" where different areas are revisited each year beginning with basic science and clinical knowledge and working through specialty modules such as pediatric anesthesia and obstetrics (that constitute much of the workload in low and middle-income countries). We emphasize "soft skills" such as leadership from an early stage and aim to make our trainees patient safety specialists rather than simply anaesthesia technicians.



Active methods of teaching and learning work best, avoid lecturing and try tutorials, case-based discussions, screen-based or low-fidelity simulation. Testing learners has been shown to increase the retention of skills and knowledge and "test-enhanced learning" should be included in the plan for teaching and learning.

In the program in Zambia that I work with we have focused on a high standard for assessment, including bringing external examiners to ensure the exams are up to some international standard. Assessment drives learning – we know from our own experience that is something is included in a high stakes assessment then trainees will prioritize acquiring that knowledge. If it is not included in an assessment then the area will tend to be forgotten no matter how many time you say that it is essential. We have had some Zambian trainees who after 2 years have functioned at the level of passing UK residents in their primary FRCA exam and I believe that this kind of assessment is key to truly building capacity in anaesthesia that is sustainable, as these young motivated anaesthetists will ultimately become the trainers themselves and will themselves expect high standards (in exams and clinical care).

It is important to build program evaluation in from the beginning – to assess how well you are doing in your educational program and allow you to complete the cycle going back to re-planning your curriculum, and onwards.

Reflections, Serendipity and Development

Haydn Perndt

This is the fifteenth Developing Country course to be held in Australia and New Zealand and also almost thirty years since I had my first developing country medical experience. It is interesting to reflect on thoughts occasioned by that first two-year stint as a volunteer on the island of Espiritu Santo.

Some of my thoughts at the time are embarrassingly naïve; some of the inspirations were remarkably long lasting. The consequences of that serendipitous leap into the unknown are still being played out.

This talk will hopefully find resonance with participants wondering if there is life after the FANZCA.

The difficult airway

David Pescod

Introduction

3 billion people live in poverty; of those 2 billion live in our region of South East Asia and East Asia Pacific.

In our region, the real world population is resource poor but disease rich. The minority of patients who do have access to health care will present late with gross pathology to a health system that has no capacity.

In our world, we have ready access to fibreoptic bronchoscopes and other advanced airway devices, which confer significant advantages with difficult airway management. They may require minimal regional anaesthesia and sedation, provide the anaesthetist with the ability to see around corners and require minimal cervical spine movement and minimal mouth opening.

However there are limitations: extreme urgency, uncooperative patients, fixed laryngeal obstruction, blood, secretions and vomit obscuring vision, expensive purchase, maintenance and sterilization. In the real world, expense, sterilization and maintenance are insuperable

In resource poor countries, the difficult airway can be safely managed without advanced or expensive equipment by adopting several alternative airway techniques. More imperative than the choice of airway technique is airway management planning. Most importantly, airway management planning in the real world must be thoughtfully constructed.

Airway techniques.

These real world skills are easily learnt, success depending on patience and care, however, in our world, with easy access to advanced airway devices, anaesthetists providing anaesthesia in the real world may ask "should and how can we teach and maintain our skill with these alternative techniques in our resource rich world?"

The awake translaryngeal airway techniques include: supraglottic airways, blind nasal intubation, retrograde intubation and laryngoscopy. (I frequently use awake direct laryngoscopy, without intubation, for intubation assessment only). Obviously awake translaryngeal airway techniques require good airway anaesthesia and there are many ways to anaesthetise the airway including direct application with spray or gel, indirect application via aerosol, gargling or aspiration and nerve blocks. Very briefly, in my practice I find that for the majority of patients, indirect topical anesthesia (nebulizer at low flow rates) plus direct topical anaesthesia under vision is sufficient to allow direct laryngoscopic assessment. Of course, awake intubation may require additional anaesthesia and I use a trans-tracheal injection.

I prefer to use 4% lignocaine. As doses of up to 10 mg/kg have been demonstrated to be safe in anaesthesia of the upper airway, this allows me to use volumes up to 1/4 of the patient's body weight.

When a nebulizer is not available and for direct topicaliastion I like use a commercial mucosal atomization device (MAD®) or a DYI atomizer (syringe of local anaesthetic, oxygen tubing, three way tap and cannula).

Airway Management Planning

My approach to airway management in the real world is identical to that in our world with first assessing the entire airway, (that is; the ease of bag mask ventilation, ease of placing a supraglottic airway, ease of direct laryngoscopy and ease of a surgical airway) and then creating a management plan, however, in the real world there are two other main factors beyond just the physical airway which heighten my assessment, modify my plan and change my decisions.

These two main factors are: (1) a poverty of resources and (2) the need of the patient.

In the real world, especially with our brief confronting exposure, the desperation of need easily clouds sensible decisions and may encourage courageous planning. The poverty of resources is more than a simply lack of drugs, equipment, assistance and backup. Also, in the real world, I have a poverty of experience with these extreme cases coupled with a poverty of maintaining alternative airway skills whilst working in our world.

In planning airway management in the real world we must not only consider how to avoid a disaster but also what resources are available if one occurred. My practice in the real world is to be conservative with only a plan A for airway management and a rescue plan. Both refusal and elective awake tracheostomy may be very wise airway management plans.

Retrograde intubation

Retrograde intubation has been used in awake, sedated, and anaesthetized patients. In both adult and paediatric patients. It is contraindicated in the presence of un-favourable anatomy, laryngotracheal pathological conditions, significant coagulopathy and local infection.

A retrograde intubation may be performed with a commercial kit or from locally available scavenged equipment.

Saline is drawn up into a syringe and an initial percutaneous puncture through the cricothyroid membrane is made with a size 16g or 14g introducer needle and cannula at 30 to 40 degrees to the skin in a cephalad direction. Aspiration of air (bubbles) confirms correct placement. (Ideally the plunger is fully withdrawn and released. If the cannula is in the trachea, the plunger will not be pull back by negative pressure). The cannula is advanced and the needle and syringe are removed. A wire is then passed up the trachea until it appears in the mouth or nose.

The cannula is removed and the wire is clamped at the skin of the neck.

The wire is pulled taught (and ideally a guiding catheter is advanced anterograde over the wire), until tenting is noted at the cricothyroid puncture site. The endotracheal tube is then passed over the wire (and guiding catheter) into the trachea until resistance is felt at the level of the cricothyroid puncture site.

The wire is unclamped and the wire and guiding catheter is removed from above
the endotracheal tube. As the last portion of the wire is removed, the endotracheal tube is further advanced into the trachea. Alternatively the wire is held taught until resistance is felt at the level of the cricothyroid puncture site and then the wire
is gradually released as the tube and the wire is advanced into the trachea. An epidural catheter may be superior to a guide wire as it bends more easily and is less traumatic.

The two main problems are:

(1) The endotracheal tube is far wider than the wire and may catch on the epiglottis or laryngeal inlet. Using a guiding catheter (or a small endotracheal tube) reduces the difference in size between wire and endotracheal tube. Placing the endotracheal tube over the wire with the bevel facing posteriorly (backwards curve) may also help.

It is essential that resistance at the epiglottis be not mistaken for the endotracheal tube being in the trachea at the end of the wire.

(2). The endotracheal tube may inadvertently slip into the oesophagus after withdrawal of the guide wire, due to the short distance between the cricothyroid puncture site and the vocal cords. This is a serious possible hazard of the retrograde method.

If the guide wire is passed through the side hole (Murphy's eye) of the endotracheal tube rather than the distal end, an extra 1 cm of endotracheal tube can be placed below the level of the vocal cords before the guide wire is removed.

Another technique is to pass another wire or catheter or a gum elastic bougie down the endotracheal tube when it is in its final position before the guide wire is removed. This helps direct the tube further down the trachea and prevent oesophageal displacement. (If the catheter has the capacity to monitor expired carbon dioxide then its correct placement can be confirmed before advancing the endotracheal tube).

If the tracheal puncture is made more distal (at the level of the first or second tracheal ring) then the distance between the puncture site and the cords is increased however this technique may lead to a higher bleeding and complication rate.

The most common complication of retrograde intubation is a sore throat. More significant complications are rare and include failure to intubate the trachea, infections, bleeding, subcutaneous emphysema and injury to vocal cords and the upper airway.

Blind nasal intubation

Blind nasal intubation is an option whenever oral access is difficult or even impossible. It is usually performed with the patient awake and the airway anaesthetized by regional anaesthesia though it can be performed under general anaesthesia.

The best results are obtained by a combination of regional block and sedation, which aims at decreasing patient anxiety but allows patient cooperation and always maintains a patent airway. The airway from the nares to the trachea requires regional anaesthesia.

Absolute contraindications to elective awake intubation include allergy to the local anesthetic and refusal or incapacity of the patient to cooperate with the procedure. It must be used with care in patients with a bleeding diathesis. Base of skull fractures, severe maxillofacial fractures and known or suspected nasal obstruction are other contraindications.

Blind nasal intubation is usually performed with the patient supine and the head in the sniffing position though it can be successfully performed with the patient sitting up. It is usually easier for the right-handed anaesthetist to use the right nostril though the most patent nostril should be chosen.

It is important to know how the endotracheal tube connector is orientated with respect to the curvature of the endotracheal tube.

Slowly and gently the endotracheal tube is advanced along the floor of the nose until it enters the nasopharynx. The tube is orientated towards the larynx. This would
be slightly to the left (clockwise rotation) for a tube entering the right nares. The endotracheal tube is slowly advanced forward listening for maximal breath sounds.

The endotracheal tube will be in one of four positions:

Trachea: breath sounds continue through the tube, the tube continues to advance, and patient coughs

Anterior: breath sounds continue through the tube, it cannot be advanced, cough heard mainly through the tube. The tube should be withdrawn and re-advanced with the patient's head and neck slightly flexed.

Oesophageal: breaths sounds stop, the tube continues to advance, and there is no coughing. The tube should be withdrawn and re-advanced with the neck extended
or apply posterior pressure to the larynx or largely inflate the cuff and advance until resistance is felt and while maintaining some advancing pressure on the tube, slowly deflate the cuff. If the endotracheal tube continues to enter the oesophagus, it can be left there and a second tube is inserted through the other nostril.

Pyriform sinus: breath sounds through the tube stop, the tube cannot be advanced, and there is no coughing. The tube should be slightly withdrawn to a point where the breath sounds can be heard again and rotated towards the midline and advanced.

Awake blind nasal intubation is a safe, simple and efficient technique. It requires a calm and tolerant patient and excellent regional airway anaesthesia or can be performed with the patient asleep.

Adaptation challenges

Phil Blum with a big thanks to Haydn Perndt

Working in a resource poor environment is challenging. An active process of adaptation to the new environment must occur. Internal needs conflict with external demands producing stress. Stress drives us to adapt. A little bit of stress is useful in driving change eg making you study for an exam. Too much acute stress is obviously not helpful eg being unable to talk in an exam viva.

Being able to reflect on these internal needs and external demands facilitates effective adaptation. This reflection hopefully can start pre-deployment. Why am I going? What are my expectations and what am I likely to achieve? What obstacles am I likely to face? Be aware of what internal pressures you create. Accept those external pressures that you can't change.

Personal internal needs may include:

- Do a good job
- Not look foolish
- Not look under-skilled
- Be valued
- Be accepted and liked
- Religious or spiritual needs

External pressures may include:

- Communication issues
- Cultural differences
- Equipment and infrastructure differences
- Resource limitation
- Climate, different foods etc
- Boredom
- Other team members
- Level of organisational support

The other people in your team may be one of the most psychologically stressful factors. They may (also) be mad, bad or sad. Ask yourself why are they on this mission?

External pressures during a sudden onset disaster are amplified and include:

- Witnessing overwhelming suffering
- Treating trauma victims is tough - particularly children
- Care for victims of violence is stressful
- Often significant risk of personal injury
- Personal health and security
- Insoluble moral and ethical dilemmas
- Feeling that medical work was a relatively minor part of the larger problem
- Unsatisfactory resolution of problems
- No real sense of "mission accomplished"

It is worth thinking about your home situation before you go. Ideally you should be physically and mentally fit. You don't need added stressors from home while you are in country. Pre deployment it is worth considering:

- Financial, emotional, legal, social responsibilities
- Exploring hypotheticals: sickness, financial, abduction
- Reassurance and communication is vital
- Discussions with partner paramount
- Involve children early in the decision to go

Thinking about what your usual coping strategies are before you go and having a plan to deal with likely stressors are key. Personal relaxation strategies may include:

- Taking a favourite books /e reader / tablet
- Internet access to maintain connection with family / friends
- Exercise (may not always be possible)
- Insight /empathy / humor / communication
- Trying to "stay positive"
- Having realistic expectations and goals

It is important to note that adaptation takes time and things might get worse before they improve. Many volunteers talk about feeling quite low a few months into a long term mission. Being aware that this is common and being able to "phone a friend/mentor" for some general advice and encouragement during this time is helpful.

Being cognisant of maladaptive behaviour in you, or if you are a leader, your team, is also vital to protect yourself, your staff and your patients. Symptoms and signs that you are not coping include:

- Physical
  - intense fatigue
  - headaches
  - sleep disturbance
  - appetite change
- Emotional
  - constant anxiety
  - desire to be alone
  - cynicism, negativity
  - suspiciousness, paranoia, feeling threatened
  - feeling pressured and overwhelmed
  - diminished pleasure, loss of sense of humour
  - hiding emotions
  - sadness, discouragement, depressive ideas
  - feelings of guilt and remorse
- Cognitive
  - concentration problems
  - obsessive thinking
  - increased distractibility and inattention

  - decision making priority problems
  - diminished tolerance for ambiguity
  - rigid inflexible thinking
  - avoiding thinking

- Behavioral
  - irritability
  - anger displacement
  - absenteeism
  - unwillingness to take leave / hyperactivity
  - substance abuse, self medication, alcohol intake
  - disregard for security, risky behaviour (including sex)

- Spiritual, philosophical
  - doubt of core values or beliefs
  - questioning major life areas
  - profession /employment issues
  - lifestyle
  - disillusionment
  - self preoccupation

Over time external pressures that can't be minimised can induce chronic stress in volunteer workers. This chronic stress in turn may develop into burn out which is common and under recognised. Many symptoms and signs of maladaption and burnout are shared.

Post deployment briefing is important but shouldn't be forced onto individuals. Commonly there is a period of adaptation back into your routine world on return. External stressors during this time may include:

- No-one to really understand what you went through
- Don't want to traumatise / burden relatives with what you saw
- People only interested in a 2 min summary of 2 years work
- Resuming work in a resource rich environment
- Putting in your first epidural after 2 years

Symptoms and signs that you may need help post deployment include:

- If you want it
- A close friend suggests you have "changed"
- Intrusive thoughts, images, smells etc
- Relationship problems
- Sleep or concentration difficulties
- Being over anxious or depressed
- Drinking or taking drugs to excess

Preparing to go, longer missions

Haydn Perndt

Successful working experiences in developing countries depend largely on preparation and a degree of good luck as to where you end up going. A lot of the preparation is personal. After the FANZCA five years there is probably a need for some unlearning rather than learning to help cope with the real world of anaesthesia.

Preparations fall largely into the existential or practical. Some introspection as to why you are going and what you expect is useful.

The nature of the longer mission will largely dictate the detail of your preparations.

What to do if you can't leave your "Lover, Lotus, Loan repayments and Long Service leave entitlements" (the 4 Ls and the 3 Ms of the Longer mission)?

Rwandan Training Program

Tom Coonan

The National University of Rwanda, Canadian Anesthesiologists Society International Education Foundation, And American Society of Education Global Humanitarian Outreach Partnership

In 2006 Rwanda had a single permanent anaesthetist, Dr. Jeanne d'Arc Uwambazimana, a genocide survivor. A strategic plan was developed by Dr. Uwambazimana, the Rwandan Ministry of Health, the NUR, CASIEF and the ASA, in negotiation with Dr. Angela Enright, Head of CASIEF and the Education Committee of WFSA.

The goals of the program were clearly outlined from the outset: the establishment of anaesthesia capacity, the education of future leaders of Rwanda anaesthesia, the delivery of education in a relevant contextual model, and the encouragement for program graduates to remain in Rwanda. A funding dynamic was established which entailed salary support for Rwandan residents and housing for volunteers from the government of Rwanda, and travel and immunization expenses for volunteers from CASIEF. Volunteers self funded their provisions and received no salary compensation - the usual rotation was one month.

CASIEF funds came from donations by the Canadian anaesthesia community. Most volunteers have been from Canada, some from the US, and there have been volunteers from Australia. It is also very common for Canadian residents to accompany faculty on rotations, and the volunteers are generally coordinated by Dalhousie University in Halifax. For the last four years, most Rwandan residents have been coming to Canada for a 3- 6-month experience. In addition senior Canadian residents commonly accompany faculty to Australia

The Program evolved very quickly after inception and within a relatively short time there were volunteers for most months of the year. Academic administration of the Program was initially by the CASIEF Board of Directors, a less than ideal dynamic in every way, but this all changed with the appointment of Dr. Theogene Twagirumuga as in-country Program Director in 2008. Dr. Twagirumuga spent three months as a visiting professor at McGill University in Montreal in preparation for his educational responsibility

The resident curriculum initially reflected Canadian training methodology and this proved less than truly appropriate for the learning context in Rwanda. With the appointment of Dr. Twagirumuga, a working curriculum committee was established with Dr. Twagirumuga and CASIEF, and this has advanced very nicely. There is now a highly structured program organization and on-going strategic planning process. There are monthly examinations and clinical evaluations that involve local and visiting faculty. The formal teaching curriculum takes place on a committed educational day, is tutorial in nature, and case based. Residency in Rwanda is four years and entails a European MMed requirement with thesis. It is usual for residents to be assisted by Canadian faculty in their theses.

An NUR Faculty of Medicine low fidelity, multidisciplinary simulation center has been established with a very generous Grants from the Canadian Government and collaboration between the NUR, Dalhousie University, the University of Alberta and the Scottish Clinical Simulation Center. This is having a major impact on training.

There are now 12 physician anaesthetists in Rwanda, 10 residents, and about 200 anaesthesia clinical officers for a population of 12 million. The residency-training program assists with the training of clinical officers, but the latter program is administratively and strategically independent.

Lessons have certainly been learned over the last seven years. These include the critical importance of local leadership, infrastructure and the formation of partnerships; the requirement for commitment and consistency; the necessity of avoidance of assumptions around knowledge and practice; the reality that teaching must be interactive; the imperative for team building (with a special emphasis on clinical officers); the significance of realistic expectations; the importance of training for sustainability; and the necessity for emphasis on knowledge transmission, not equipment. The promotion of non-technical skills is also of critical importance.

Within the last year, a Human Resources For Health In Rwanda program has been established. This is an immense (hundreds of millions of dollars) seven year initiative involving the US government, Clinton Foundation, and nine eminent US universities. Anaesthesia is a target specialty: equipment and other supplies will be enhanced, and four American anesthesiologist teachers will be placed on site each for a one year term. As of the moment, the American anesthesiologists are working within the structure of the established teaching program.

Establishing an anesthesia residency program in a developing country.

Dr. M. Dylan Bould, (with thanks to Dr Theogene Twagirumugabe, Dr. Patricia Livingston and Prof. John Kinnear for their contributions to this text)

Notes on establishing effective partnerships for post-graduate anesthesia training with low- and middle-income countries

Partnerships between institutions in the global North and South are a successful model for the development of sustainable postgraduate training programs in the developing world. This article aims to assist medical educators who are considering embarking on a collaborative postgraduate training program in the developing world. We have identified key issues from personal experience working within partnerships between institutions in high-income countries and institutions in low- and middle-income countries. These experiences include visits to the host institutions, debriefing of visiting and host faculty, faculty development meetings and program evaluation. We provide learning points for establishing a collaborative postgraduate training program in low-income countries in which there is little or no postgraduate medical training in a specialty including the importance of planning for sustainability, while remaining flexible and pragmatic in the short term. Key issues for sustainability include building skills for teaching, management and leadership in postgraduate trainees, focusing on systems-based practice, and planning for the gradual handover of the program to graduates of that program. Partnerships can result in mutual benefit and learning for both faculty and trainees from both the host and the visiting countries.

Introduction

Low- and middle-income countries (LMIC) suffer a disproportionate amount of the global burden of disease and this is especially true in sub-Saharan Africa where almost half of deaths are in children less than 15 years old.[1] There is a growing burden of non-communicable disease including surgical illnesses.[2] Unfortunately, the global health workforce density is lowest where it is needed most.[3] For instance, Rwanda has 0.024 physicians per 1000 population compared to 2.74 in the United Kingdom.[4] Many essential components of care, such as anesthesiology, are in crisis[5] and major investments in personnel are required in order to build the infrastructure that will enable the billions of dollars of aid, aimed at targets such as the Millennium Development Goals, to be effective.[6]

One part of the solution is building capacity in medical education in LMIC. Partnerships between institutions in the global North and South are a successful model for the development of sustainable postgraduate training programs.[6,7] One example with which the authors (TT, PL) have specific experience is the Rwandan Anesthesia Program partnership with the Canadian Anesthesiologists' Society International Education Foundation and the American Society of Anesthesiologists Overseas Teaching Program.[8] This is a 4-year postgraduate training program based largely on volunteer visiting faculty from North America with short international rotations for Rwandan trainees. Training is structured as a Master of Medicine (MMed) with a thesis defense in the final year.

Although partnerships for global health education are increasingly common, relatively little literature exists on lessons learned and what works well.[9,10] We identified key learning points from personal experience working within partnerships between institutions in high-income countries and institutions in low- and middle-income countries, including visits to the host institutions, debriefing of visiting and host faculty, faculty development meetings, program evaluation and collaborative discussion between our programs. Based on our experiences and co-learning during anesthesia MMed programs in sub-Saharan Africa we provide key learning points for establishing a collaborative postgraduate training program in the developing world in countries in which there is little or no postgraduate medical training in a specialty.[9]

Clearly establish the needs of the host country.
The initial request for partnership should come from the host country6 and the teaching program must respond to locally articulated needs.[10] This process begins with an invitation from the host country and is followed by a formal needs assessment by the both the visiting and local faculty. This should include an assessment of existing strengths and weaknesses, including support by the local ministry of health and universities, current resources for faculty and students, numbers of students, facilities for didactic sessions and the presence of other partners who might affect the teaching program. An assessment of safety and political stability is important to the sustainability of the program. The goal of the needs assessment is to clearly identify enablers and obstacles to successfully fulfilling the mandate of the teaching program. In the University of Zambia anesthesia MMed program the needs assessment phase included visits to both the University of Zambia affiliated hospital in the capital and to numerous hospitals in the provincial capitals in order to build a national picture of anesthesia needs.

Establish a memorandum of understanding.
A memorandum of understanding (MOU) is a bilateral or multilateral agreement that is not necessarily legally binding but which sets out a common understanding of how a program should proceed. The MOU may cover accommodation, transport, teaching facilities, the scope of the partnership, responsibilities, accountability and resolution of any issues that may arise.

The request for educational support by the hosts should be at the highest level to ensure that the program is sustainable. Ideally the collaboration should be at governmental level with involvement of ministries of education and health. High-level support allows the project to be accepted at a grass roots level and to attract both faculty and grants. From the educational point of view it is important that established academic institutions support the project on both sides of the partnership. Ideally, the MOU should be signed by all parties involved in the relationship, which may include the university, the hospitals involved, the Ministry of Education and the Ministry of Health.

The anesthesia teaching programs in both Zambia and Rwanda have been established with support from respected academic and professional organizations. The University of Zambia MMed project is backed by the University of Zambia School of Medicine, the Royal College of Anaesthetists of the UK, and the Association of Anaesthetists of Great Britain and Ireland. The anesthesia teaching program in Rwanda was established based on a MOU between the Rwandan Ministry of Health, the National University of Rwanda, and the Canadian Anesthesiologists' Society International Education Foundation.[8]

Identify clear program goals.
Collaboration is key to identifying the goals of the program. It is generally futile for the visiting faculty to impose their "big idea" on the host, since this is unlikely to be appropriate for local conditions. The program should be designed to meet the needs of providers in the host country rather than adopting a model from a developed world context, although the program should strive to maintain international standards such as those of the World Health Organization. In our programs we have aimed to identify goals that have a maximal effect on patient safety within the limited resources of the host institutions.

Broad engagement of participants is an excellent hothouse for ideas. Diverse and even conflicting ideas should be invited and actively considered. This is a major value of faculty members who are geographically remote from each other (distributed faculty), and who have links with other similar programs.

There must be realistic short- and medium-term goals, and these should be specific and achievable (SMART objectives - Specific, Measurable, Achievable, Relevant and Time sensitive).[11] Re-evaluation should occur at approximately 12-month intervals so that appropriate goals can be reset if necessary.

The exit plan should be considered from the very inception of the program. This must include faculty development of local staff and graduates to become the educators and leaders of the program as the visiting faculty eventually withdraw.

Understand the pace of change.

The project needs to remain flexible, responsive and adaptive in the early days of its development.[6] Although an overall 'vision' may indicate long-term end-points, the path to achieving that vision may be unclear early on. A conscious policy of 'muddling through' is required to negotiate the frequent obstacles that are encountered. This is particularly so where clinical practice paradigms are conflicted, for example innovations such as the patient safety movement are now so ingrained in clinical practice that it is easy to forget that this perspective is actually relatively new to developed world medicine and is learned behavior. It is important to be pragmatic and adaptable, accepting incremental changes within the context of limited resources and understanding that "perfect" is the enemy of "good". This includes managing the expectations of visiting faculty who may have a relatively short and intense experience in the LMIC and may find it difficult to see that this is business as usual in the host country and not understand why change doesn't happen more quickly.

Take time to establish relationships that form the basis of a well functioning partnership.

It is impossible to overstate the importance of relationship-building in global partnerships for medical education.[10] Close, trusting relationships between partners will be helpful in allowing honest communication. This takes time until trust and loyalty are well established. Feedback should be bidirectional. It is important to encourage local staff to vocalize their expectations and provide feedback on visitors' performance.

Clearly, visiting faculty and trainees must learn and respect the local culture. Hierarchy, formality and manners may be particularly important in the partner LMIC. Visitors have been invited to assist but must avoid paternalism and recognize their own potential for cultural imperialism.[12]

Develop clear coordination and communication strategies

Communication is essential between host and visiting faculty leaders to orient teachers, keep students engaged with the curriculum, and manage the program. Our experience has shown continuity can be particularly challenging with visiting teachers who may come from centers that are geographically remote from each other. Issues that arise with one teacher may not be communicated to the next, including what has been taught, what worked well or poorly, and the strengths and weaknesses of students. Continuity is improved by strong presence from local faculty and adherence to a well-organized curriculum. In both the Rwandan and Zambian anesthesia training programs a local and a visiting program lead work closely together to provide information to visiting faculty. Returning teachers are especially valuable as they are able to be effective with minimal orientation. Technology can also be useful to overcome the limitations of faculty from diverse centers. For example, the University of Zambia anesthesia program has made much use of a shared online drive system[13] for communication among visiting faculty or between faculty and students. Encryption is needed for any sensitive information. Secure websites, wikis and blogs are other technology solutions to facilitate communication.

Because of the challenges for a program with widespread faculty, it is valuable to plan a clear communication strategy early in the program. Hosts and visitors should each have a representative who will take the lead in communication with the other partner and with members of the group. Communication planning should include designation of responsibility for volunteer orientation (briefing and debriefing), logistics, and a scheme for updating the organizations and institutions involved in the partnership.

It is important to also consider communication with other teams outside your program. There are problems when teams arrive unexpectedly and overwhelm local resources. Find out who else is visiting the host institution and try to work together with them. There might be duplication of efforts such as having several universities all wanting to teach general surgery training in the same place. Some programs may be more valuable to the local country than others. Central coordination will help empower local medical educators to work with the programs that are most valuable and not feel obliged to agree to accept missions of little benefit. The University of Zambia anesthesia MMed program found synergies with other Lusaka-based collaborations, which shared the same broad aims, including Mercy Flyers, the Out to Africa program, Lifebox, and the SAFE Obstetric Anesthesia Course.

Curriculum design should be appropriate for the local context.

Disease spectrum and treatment options will be quite different between LMIC and high-income countries, so curricula must be designed to be appropriate for local context.[9] In the case of the University of Zambia MMed program, an assessment framework that was initially adopted from the UK and based on formative workplace based assessments failed because it did not take account of University of Zambia requirements for summative in-course assessments to measure progress.

Curricula should be designed to build upon existing knowledge and cultivate the skills required in the local environment. The curriculum should be comprehensive and include all elements of the teaching program: timeline, teaching and learning strategies, assessment, and program evaluation. Curricula should continue to evolve based on program evaluation and feedback.

We have found that trauma, general surgery, obstetrics and pediatrics form the majority of surgical work in LMIC. Late presentations are the norm and the severity of disease at presentation often provides rich learning opportunities for visiting faculty and trainees. HIV, malaria and tuberculosis are frequently seen co-morbidities and account for a significant number of deaths. Communicable tropical illnesses are common although in LMIC there is an increasing burden of non-communicable disease such as hypertension, diabetes and coronary artery disease. The curriculum must train for the future and include exposure to diseases and techniques that anticipate improvement in the health system. Residents training in a LMIC may need additional skills to those required in a developed country. For example, they may need to provide safe care with insufficient resource and undertake administration for a relatively new specialty.

Design a program that will be sustainable for the hosts and visitors.

It may be decades before a program in a LMIC can be fully self-sufficient.[14] Consequently it is vital that the program be sustainable for both hosts and visitors. Visiting faculty and their trainees must not be a liability for the partner country. They should arrive well oriented and prepared for their mission. Similarly, to avoid burnout, volunteers should not be asked to commit for an extended period of time or to endure living conditions that would be onerous. The pool of volunteer teachers should be sufficient to provide needed educational services. There are advantages and disadvantages to both short-term and long-term visits. Brief visits allow a wide range of expertise from many visiting faculty members; longer visits provide continuity of mentorship. A hybrid system may be a solution. The University of Zambia MMed program is now using longer-term visits with senior trainees, who stay in Lusaka for six months at a time. They are supervised by visiting consultants who make shorter visits. Collective learning is facilitated by post-visit debriefing sessions with visiting faculty. The experiences of working and teaching in a LMIC can be stressful for visiting faculty who may feel that they are out of their depth and need both feedback and reassurance.

Ultimately, the aim of the program should be that visiting teachers be phased out as the local faculty increases in number and capacity to run the program without assistance.[15] The process begins with ensuring that local faculty members are actively involved in all aspects of the program. There should be

co-teaching with local faculty who nurture teaching skills, such as mentoring, assessment and regular feedback.

Strategize equipment donation.

The tension between sustainability and short-term goals is seen when visiting faculty want to bring equipment with them for a technology-dependent specialty such as anesthesiology. Visiting faculty may want to contribute materially, enable parts of the curriculum that require a technology, or simply feel safer in their own comfort zone. Bringing high-tech equipment that cannot be maintained is not a long-term solution to resource limitations. Donations must be organized based on local needs and capacity, which requires coordination between visiting and local faculty. The program should look beyond this short-term solution and find ways that the host country can provide a realistic range of drugs and equipment. An example that illustrates the complexity of bringing equipment and drugs to LMIC is seen when visiting teachers bring portable ultrasound machines to teach regional anesthesia, a practice that has many advantages for a low resource setting. The problem is that unless these machines continue to be available after the visiting faculty departs it will be impossible to maintain these skills. It is important to teach techniques that are realistic. For instance, it is problematic teaching the placement of epidural catheters without also training ward nurses in managing patients with epidurals.

It is also important to consider the ethical and moral dimensions of equipment donation, especially for single-use and out-of-date equipment. Close and sensitive discussions between the partners will help to clarify equipment needs.[16] Also, when equipment is donated, issues of maintenance and repair must be considered from the outset to prevent the equipment falling into disuse and joining one of the ubiquitous graveyards of useless donated equipment. A better long-term strategy is to work with the host institution or government to develop a sustainable way of the host nation providing equipment that meet minimal standards.

Begin collaborative research early.

Research from low-income countries is poorly represented in the peer-reviewed literature due to overwhelming clinical demands for practitioners in LMIC and lack of resources and research training in these countries.[17] Therefore research questions unique to low-resource settings remain unanswered. A long-term strategy to improve health care in the host country includes making research capacity an essential early goal.[18] Research activities give credibility to the project, spread awareness of global health issues and provide a means of sharing experiences with colleagues.

In the anesthesia training programs at the University of Zambia and National University of Rwanda the MMed thesis is the focal point for student research. The thesis encourages students to work with both visiting and local faculty on research ideas appropriate to the local context, including outcomes measurement, epidemiological research, quality improvement and risk management. This collaborative supervision follows the project from development of the research idea to defense of a thesis that is expected to be of a publishable standard.

Develop an early strategy for program evaluation.
Evaluation of the program, curriculum and teachers is vital. This was a lesson learned by the National University of Rwanda anesthesiology MMed program, which did not include program evaluation at its inception; it was challenging to implement after the fact. When program evaluation is not included from the beginning, habits develop that are difficult to change later. Including evaluation from the outset conveys the message that refinements will continue to occur.

Clear program goals will help guide evaluation. Program evaluation can be thought of in terms of the Kirkpatrick's hierarchical framework of reaction, learning, behavior and results.[19]Reaction of learners to the program includes student assessment of teachers and feedback to them but can be performed more comprehensively as a 360° stakeholder evaluation. Demonstration of learning can be achieved through the formal assessment processes of the program, such as examinations and workplace-based assessments. A key measure is the number of students who pass and fail each year. Quantifying true changes in behavior outside of formal assessments is more challenging. A recurring issue is the tension between formal and informal curricula. Students may learn from practitioners who are not actively involved in the didactic program and receive different messages from visiting faculty. In countries such as Rwanda the shortage of mentors inhibits role modeling needed to transfer theoretical learning to clinical practice. Trainee behavior is affected by this tension, which is sub-optimal for patient safety. This can be solved by a hybrid approach combining both short and long-term visits. Furthermore, in order for behavior to change, the learner must not only know what to know and how to apply it but must also work in a supportive climate and be rewarded for change. The final level, results, is therefore essential in order to demonstrate that teaching and learning is positively impacting patient outcomes. Audit of morbidity, mortality and other patient outcomes provide evidence that desired results have been achieved. Additional outcomes at the level of results may reflect the academic goals of the program. These include the number of research papers or presentations produced by local staff,[14] outreach to other institutions, and education sessions organized for continuing professional development.

Disseminate lessons learned
While collaborative programs are a great opportunity for education research, there are few studies on how best to organize post-graduate medical training in low- and middle-income countries.[9] It is important to share educational models that work well so that educators working on other similar programs do not have to re-invent the wheel. It is of value that similar programs have heard of each other. For example, the University of Zambia anesthesia program started up with little knowledge of other similar programs in the same region, which prevented learning from the experience of those programs. Dissemination of effective educational models is a form of scholarship which is arguably an academic endeavor as valuable as research.[20]

Conclusions

From these learning points, there are several key recurring issues that are important to the success of establishing an effective partnership for post-graduate medical training in low- and middle-income countries. Probably the most important theme is a focus on sustainability from the beginning of the program. Global partnerships for anesthesia education have the potential to transform healthcare systems in LMIC as demonstrated by the (until recently) externally supported anesthesiology program in Nepal.[14] In contrast to short-term clinical missions this kind of transformation can be self-sustaining and the effects can reach much further than contact with visiting faculty.

However, postgraduate anesthesia training takes a long time and it will be many years before graduates have sufficient clinical and academic experience to feel confident in leading a post-graduate training program without any external support. Overwhelming clinical demands and lack of resources may

further lengthen the time before a program becomes truly self-sustaining. When starting out on such a partnership each partner must expect that the commitment will more likely be measured in decades than years and plan the program accordingly. In order to build capacity as rapidly as possible an exit strategy for visiting faculty must at least be part of the discussion from the inception of the program and essential non-clinical skills such as management, education, research and quality assurance must be emphasized from the beginning.

Although long-term vision is essential, rapid change is unlikely, especially in the ability of programs to positively influence medical culture and systems of care for the benefit of patient safety. Flexibility, adaptability and pragmatism are key to achieving ongoing short-term goals. Even after a thorough needs assessment there will inevitably be a huge amount that is unknown. Over the first few years, experiential learning by both visiting and host faculty will refine the program.

Finally, although the training needs of the host country must always supersede those of visiting faculty and their trainees, partnerships are characterized by mutual benefit. Local faculty and trainees will benefit from mentorship and support in developing clinical excellence. Visiting faculty will learn much from visits to LMIC including exposure to diseases and presentations that are rare in high-income countries. There will also be valuable lessons in developing educational programs, the management of healthcare systems, and the allocation of scarce resources that are transferable to practice in relatively under-resourced areas within high-income countries. Recognition of the importance of mutual benefit engenders respect and encourages independence in host faculty and trainees and a feeling of ownership of the program.

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Volunteer Working Opportunities Overseas

Steve Kinnear

Overseas aid and development is the biggest industry in the world, eclipsing tourism, information technology and mining. In the financial year ending June 2013, the Australian Government, through its official aid agency AusAID, spent A$5.2 billion on overseas aid. This was approximately 0.35% of Federal Government's gross national income. This does not include non-government funds raised in the community.

There is a bewildering array of organizations through which the would-be overseas aid worker can apply to work.

Before going away, you need to ask yourself some key questions, most of which will be considered in various ways during the course.

Why do I want to go ?
How long do I want to go for ?
Do I want to go alone, or take my family with me ?
What do I hope to achieve ?
Am I expecting / hoping for western-style remuneration for this ?

If you want to go for weeks to months, then you are talking about the aid being "service".
If you are willing to go for year/s, "development" is possible.
Both are needed and valuable, but it's helpful to have realistic expectations.

Some of the working options include:

Weeks:
Refresher courses in the Pacific region (Overseas Development and Education Committee)
Pacific Island Project (Royal Australasian College of Surgeons)
Interplast
Primary Trauma Care (ODEC)
Operation Smile
OSSAA
Others (eg. posted on ASA ODEC website)

Months:
Teaching fellowships for the Pacific Anaesthetic Training Programme (ODEC)
Health Volunteers Overseas (HVO)
International Committee of the Red Cross (ICRC)
Medicin Sans Frontieres (MSF)
Christian humanitarian organisations (Caritas, SIMAID etc)

Year/s:
Australian Volunteers for International Development (AVID)
UN Volunteers (UNV)
Christian humanitarian organisations (Caritas, SIMAID etc)
One or more of the teaching Faculty for this course have had experience with almost all of the organisations mentioned above.

For most course participants, leaving home for weeks to months is the most realistic option. Consequently, I will focus most of my attention in this talk on the organisations that allow volunteers to work in this time-frame.

Planning the short surgical trip

David Pescod

The Essential Checklist

Aims and objectives	What are you trying to achieve?: personally, professionally, capacity building +/- service
Insight	What are your strengths and weaknesses, learn about psychology of adaption, be prepared
Knowledge	The country (www.dfat.gov.au, tripadvisor, lonely planet, previous anaesthetic visitor, ASA & ANZCA ODEC members), safety and customs, the organisation, the patient population, the environment, the anaesthetic kit, the surgeons
Attitude	Be mindful of responsibility, listen and learn, ask how do you do it rather why don't you do it like I do, be humble
Teaching	Prepared USB, paper, books, www.developinganaesthesia.org
Anaesthetic survival kit	Air viva, rescue airways, GEB, (single use) Favourite rescue airway device Pulse oximeter ($30) Antibacterial hand wash Headlight Anaesthetic contact at home (skype) Checklist
Personal survival kit	Health risks, vaccinations, music, camera, communication, toilet paper, power adaptors, chargers, headlight Notify medical defence organisation
Gifts	Air viva, pulse oximeter, USB teaching, books Tim Tams for the nurses. Toys

Many groups are working in resource poor countries. Some are very large organizations such as Red Cross, Oxfam, MSF, others are smaller such as Interplast and others are privateers. The larger organizations must act by a code of conduct set by the government and comply with all international regulations (ACFID). Privateer groups may try to fly beneath the radar. Be warned, despite their great intentions, if something goes wrong you will need the assistance of the Australian government and your medical defense. AVANT and other insurers are very keen to support us if we are working with legitimate aid groups.
For example, Interplast has codes of conduct for volunteers, working with children checks, photography protocols, referee checks, only work with an invitation from the host government and hospital, notify DEFAT and the local Australian representative in country and also, very importantly, have long term plans for each country and understand the impact that an aid mission has locally.
Ensure that the other participants are "qualified". I have provided anaesthetics for a group who though they all held Australian medical and nursing qualifications, all no longer actually practiced. Nurses where now administrators and the surgeon did not perform that type of surgery back in Australia.
Be aware of medical tourism. Australians generally have an excellent reputation for quality and consideration. If in doubt (or even if not in doubt) speak with some one who has some experience with anaesthetic overseas aid.

Choose your team with care. Medical missions are intense work in difficult environments. (Especially if there are two surgeons and only a single anaesthetist, the "surgical" cases are often "unique" to the surgeons who may be very enthusiastic for the operative challenge, encouraging each other). Anaesthesia maybe stress full, the patients are confronting and the environment can be unpleasant.
You need to be very safe in patient selection. Investigations may be minimal or none. Stand your ground. There will be plenty of other deserving and less challenging patients. Some patients cannot be safely anaesthetized. There is no backup when it all goes wrong. Think about what are your options for when something does go wrong. Be aware that there may be no one else to help with the failed intubation, no one else to help with the massive transfusion, no one else for the cardiac arrest, you cant ring up blood bank for some cryoprecipitate and platelets, you cant get a blood gas, there is no amiodarone, and if the patient needs post operative ventilation you may need to squeeze the bag. There is no HDU/ICU. You do not want a death.

The anaesthetic kit you are provided with has been developed over years and is a compromise of cost, size and safety. The kit cannot contain all the new toys or all the drugs. Read the information provided by the aid group, especially what is in the anaesthetic kit. Think about anaesthetic complications (hypotension, hypertension, arrhythmias, ischaemia, hypovolaemia, bronchospasm, difficult airways, failed intubation etc.). Think about how you can use the kit to deal with these. (This will heighten your radar for potential complications and reduce your threshold to say no).

The anaesthetic environment will may be austere. Always check that there is adequate supply of oxygen, that you have a self-inflating bag/mask and a rescue airway. Never assume. Anaesthetic machines may not have oxygen failure alarms or anti-hypoxic devices. The oxygen flush may not work. The suction may not work. The sevoflurane vaporizer may not contain sevoflurane (usually halothane). There may be no defibrillator. There may be no second cylinder of oxygen. The man with the spanner might be at the market. The power will go out. Often there is no true recovery. Patients are often rushed back to the ward.

The anaesthetic kit will be your responsibility. It will all be packed tightly and neatly into metal boxes (not conveniently laid out in multiple draws of a cabinet within easy reach). Don't trash the boxes on day one. Plan each anaesthetic carefully and fully. Usually the majority of your kit will be stored in another room and you may not have an assistance to run back and forth for that extra syringe or needle.

You may wish to prepare a laminated checklist of essential anaesthetic elements to check before each anaesthetic (a bit like a pilot pre-take off checklist):

Oxygen, spare oxygen, self-inflating bag, oxygen failure alarm, anti-hypoxic device, oxygen flush, GEB, primary airway, alternate masks, alternate guedels, rescue airways, surgical airway kit, suction, stethoscope, all monitoring, all iv fluids, all syringes, all needles, all anaesthetic drugs, all rescue drugs, antibiotics (you may like to take your own fishing tackle box) marking pen, gloves, hand cleaner, spare iv cannula.

Local medical practices will be, at least at odds with how we practice and sometimes blatantly dangerous. Be respectful, locals usually don't choose to practice medicine badly; their behaviour will be a product of the environment, resources and education. Listen and learn. Ask more questions than giving advice. Ask how rather than why. To be an effective educator and to effect lasting change you must first understand why a aberrant practice exists. Once you have the knowledge then you may be able to provide a solution, which is attainable within the environment or at least respect the locals for their ingenuity.

Remember that you are a guest for a couple of weeks. Confronted by a tsunami of desperate and deserving cases (many of which we don't have the opportunity to be involved with in our own country) we wish to do as much as possible. We will return to the comfort of our homes at the end of the mission. Remember, we must be aware of the stress that we place on the host hospital during the mission and afterward. Good organisations will have minimal impact on host hospital supplies; poor missions may devour an entire year of supplies.

Equally we must be aware of the stress on ourselves. More cases, more numbers, more bragging rights but also more stress, longer hours and more risk of an adverse outcome in an environment designed to cause adverse outcomes.

Plan the operating day lists mindfully. It is difficult, especially given the potential volume of cases and our enthusiasm. Remember that lists may not run as smoothly as home. Beware of "pacific" time. Recovery may need to be the responsibility of the anaesthetist or at least patients may need to be more awake before discharge to local nursing care. Sterilisation capacity may further slow turnover.
It is wise to plan conservative lists especially for initial and final days. Major cases should be attempted only after the local system has been tested but also should have sufficient lag time to deal with complications. Other deserving cases will appear during the time. Cases cannot be continually stacked in. Be very mindful of excessive working hours. Host nurses and others may not be use to or appreciative of very long days. Nursing levels on wards may be very minimal afterhours, nurses may not receive pay for overtime, walking home after dark may not be safe for local nurses and they may be the only care givers at home.

Finally, be respectful of local behaviour. Locals may be more or in some cases less religious than volunteers. They may have a different attitude to alcohol and loud behaviour. In theatre infection control practices may vary. They may seem to be little regard for the management of sharps and infectious material but entering theatre without the correct clothing/shoes may be considered poor behaviour. Host staff may not be use to loud music during operating and equally may not appreciate your ability to multi-skill anaesthesia and an i-pad.

Remember, that hopefully, your mission will be one of a long-term plan for that country. Difficulties with your mission can adversely affect future missions.

We very rarely have complications at home and when we do we have extraordinary backup. Do not develop a relaxed attitude. Medical missions, by their nature, are a minefield of disasters.
Safety is paramount. The best anaesthetic is the one you are most familiar with, however you won't be armed with (sevoflurane), desflurane, remifentanil, syringe drivers, BIS monitors, ultrasound, advanced airway devices and fibreoptic bronchoscopes. As the gap in anaesthetic resources and education widens between resource poor and resource rich countries, the difficulty of delivering safe anaesthesia will increase. As mentioned the equipment provided is an educated compromise between safety, cost, practicality and education. Unless specified as a pure service mission for a specific problem such as a noma, missions always deliver education. We should always strive to capacity build so we argue that we should be utilizing anaesthetic techniques which can be learnt and used by local anaesthetic providers such as awake direct laryngoscopy under local anaesthetics or blind nasal intubation but you can argue then is it safe to undertake anaesthetic techniques that we don't use at home.

Though anaesthetists increasingly demand a more sophisticated kit it is important to question why, on a routine service mission, choose these cases that require more sophisticated anaesthesia. These cases are inherently more risky in an environment that has no resources to cope with complications.

In our region the real world population is resource poor but disease rich. The minority of patients who do have access to health care will present late with gross pathology to a health system that has no capacity. Medical missions are intense work in difficult environments; so why go? It can be stressful, confronting, disappointing or frustrating?
We will all have our own reasons.

Personal Equipment for Emergency Missions

Haydn Perndt

This list is intended for short emergency humanitarian missions but also perhaps can be an aide memoire for longer trips.

It is not meant to be exhaustive and everything listed won't necessarily be needed.

Confirm with the agency that is employing/sending you in regard to: salary / "per diem", insurance, local transport and accommodation arrangements including meals, drinking water and clothes washing facilities

Communication: cheap phone, local sim card, smart phone (your corporate memory), international sim card or satellite phone, internet, computer, power cord, CD blanks, USB memory sticks, local dongle, international data, iPad or similar, charger(s) power board/double adaptor, international plug adapter

Money: local currency, US dollars including small denominations, credit/cash cards

Paperwork: travel documents – passport with minimum 6 months validity, visas, tickets. International Driving License. "Team" identification document, letter of introduction
Copy of travel documents, credit card details stored separately
Immunization book / record. Medical and dental documents
Recent blood test results: Blood Group, HIV, Hepatitis antibodies, G6PD (primaquine post vivax)

General:
Back pack, pack liner or heavy-duty plastic bag
Day pack/ camel bak combined
Fanny pack
Combination padlock(s) keyed alike
Head light and spare batteries / rechargeable batteries, solar panel & light
Leatherman / Swiss army pocketknife
Cable ties, in several sizes.
Snap lock plastic bags in a range of sizes
Plastic bag for storage of clothing
Black gaffer or duct tape
Sewing kit: needles, scissors, thread and buttons
Water purification
String, rope or nylon cord
Spare plastic bags for wet gear
Rubbish bags
Rubber bands

Personal Clothing:
Ensure all clothing is culturally appropriate. Work day and relaxing, possible official occasion. Quick drying, minimal wrinkles, layers if cold. Long sleeves especially for tropics. Thermals, polar fleece and sleeveless thermal / down vest / jacket for cold climate
Vest with lots of pockets and role identification
Long sleeved loose shirts x 2- 4
Long Pants x 2
Shorts x 1 for exercise

T-shirts x 4
Socks
Underwear
Handkerchiefs
Sarong (very versatile: sheet, dressing gown, towel, skirt, sun protection etc)
Bathers. Check local dress code for swimming
Pyjamas. Scrubs work well
Boots or very "sensible" shoes
Sports shoes for exercise
Rubber thongs to wear when washing

Personal Protective equipment:
Hat(s): sun protection and / or warm hat
Waterproof jacket +/- pants/poncho/umbrella
Sunglasses and cord
Ear plugs / hearing protection
Leather gloves / fleece gloves

Eating and drinking:
Plate
Knife, fork & spoon
Travel coffee plunger/ thermal cup combination doubles as a bowl
Chux / green scrubber x 1-2 for washing/drying
Water bottle
Tea bags and /or good coffee
Emergency nibbles: sesame / honey / health bars / chocolate

Sleeping:
Silk sleeping bag liner: or cotton liner+/- sleeping bag
Self-inflating mat, camping pillow
Eyeshades
Or single bed doona cover, sheets / pillow case
"Mozzie dome", self standing with floor and zips
Insect killer spray for inside dome
Plug-in repellent atomiser

Personal Hygiene and health:
Folding shovel
Toilet paper / travel tissues in small plastic sachets
Alcoholic hand wash 125ml
Wet ones/ baby wipes in a travel pack
Travel towel
Face washer
Wash-bag with hook to suspend, and small mirror
Shampoo, conditioner
Razor, spare blades, shaving cream
Liquid soap in plastic pump pack or tube
Toothbrush, dental floss and toothpaste
Comb, tweezers, nail scissors/clippers, nail file
Deodorant
Foot powder

Cotton buds & balls
Personal hygiene items for women
Sunscreen SPF 30+
Insect repellent: 30 – 50% DEET
Water purification tablets
Washing powder/ travel wash liquid in a plastic tube
Laundry bag, mesh or cotton
Stretchy twisted elastic travel clothes line, clothes pegs

Medical kit:

Theatre:
Scrubs: 3 sets
Eye protection
Disposable gowns: up to 5 in personal kit
Own size sterile / unsterile gloves x 1-2 boxes
Theatre shoes
Skin marking pen to write on patients and dressings
Pen on lanyard
Notebooks, spare pens