AQUA 2022

Annual Queenstown Update in Anaesthesia

Programme & Abstracts

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Welcome to Queenstown

Dear AQUA Delegate,

Welcome! We are delighted to be back in Queenstown with AQUA 2022 after a tumultuous time with Covid disruptions.

With border restrictions easing and gathering limitations lifted, it is exciting to deliver this year's conference in a familiar format. Everyone seems excited to be back to some sort of normality, so much so that AQUA registrations reached capacity in record time and our workshops also filled exceptionally fast this year.

The 2022 scientific programme contains a broad range of clinically-focused updates. In addition, we have a number of exciting new topics. Dr Mataroria Lyndon will be speaking on Māori health and equity, Dr Rob Burrell will be speaking about Anaesthesia and the environment and Professor Rod Jackson will present updates on the coronavirus pandemic. Our international speakers include Professor David Canty, who will deliver two POCUS related talks and Dr Brigid Brown will speak about anaesthesia in developing countries.

The 2022 programme includes Bats on Ice (regional anaesthesia workshop), two POCUS workshops on Friday afternoon and two Anaphylaxis workshops on Saturday afternoon.

This year's social programme has the AQUA BBQ at Coronet Peak on Friday evening, and the AQUA Conference dinner at the Skyline Restaurant on Saturday. We look forward to seeing you there!

A special thank you to our sponsors for their continued support of AQUA.

We hope you enjoy the conference.

JeeYoung Kim
Mark Welch
Neil MacLennan
Rachel Bell

AQUA Organizing Committee 2022

Faculty

Dr Shelia Hart	Specialist Anaesthetist, CCDHB / President, NZSA
Dr Mataroria Lyndon	Equity Lead at Mahitahi Hauora PHO, Clinical Director at Tend Health, Senior Lecturer at University of Auckland
Assoc Prof David Canty	Associate Professor of Anaesthesia, Monash University, Melbourne
Dr Conrad Engelbrecht	Specialist Anaesthetist and Pain Specialist, Waikato Hospital
Dr Katia Hayes	Cardiothoracic Anaesthetist, Auckland City Hospital, Chair of Transfusion Committee
Dr Karen Pedersen	Specialist Anaesthetist, Auckland Anaesthetic Allergy Clinic, Auckland City Hospital
Dr Kerry Benson-Cooper	Intensive Care Medicine Specialist, Auckland City Hospital
Dr Rob Burrell	Specialist Anaesthetist, Middlemore Hospital, Chair of NZSA environmental and sustainability network
Prof Tim Short	Specialist Anaesthetist, Auckland City Hospital and University of Auckland
Dr Elsa Taylor	Specialist Anaesthetist, Starship Children's Hospital
Dr Fiona Stewart	Cardiologist, Auckland City Hospital
Prof Rod Jackson	Professor of Epidemiology at University of Auckland, Director of EPIQ
Dr Brigid Brown	Specialist Anaesthetist, Flinders Medical centre and Pulse anaesthetics

Anaphylaxis Workshop -

Dr Karen Pedersen	Specialist Anaesthetist, Auckland Anaesthetic Allergy Clinic, Auckland City Hospital

POCUS Workshop -

Assoc Prof David Canty	Associate Professor of Anaesthesia, Monash University, Melbourne

Local Organising Committee -

Dr Neil McLennan	Specialist Anaesthetist, Auckland City Hospital
Dr JeeYoung Kim	Specialist Anaesthetist, Auckland City Hospital
Dr Mark Welch	Specialist Anaesthetist, Auckland City Hospital
Dr Rachel Bell	Anaesthesia Fellow, Auckland City Hospital

Event Manager -

Joanne Martin	Director, Professional Events Management Ltd

Social Programme

THURSDAY, 18 AUGUST 2022

17:00 – 19:00hrs

Registration & Welcome Function
Exhibitor Area, Pounamu Room, Heritage Hotel, Queenstown

Browns Ski Shop Fitting Service
Icon Foyer, Heritage Hotel, Queenstown

FRIDAY, 19 AUGUST 2022

16:30 – 21:00hrs approx.

AQUA BBQ Function
Coronet Peak Base Building, Queenstown

16:30hrs	Bus to Coronet Peak departs (for non-skiers)	Main Entrance, Heritage (17.30 Bus for POCUS Workshop Attendees)
16:30hrs	Function area opens	Coronet Peak Café
18:00hrs	Function commences	Coronet Peak Café
20.30hrs	First bus to Heritage departs	Coronet Peak Car Park
21:10hrs	Bus to the Heritage departs (NB: at the conclusion of night-skiing)	Coronet Peak Car Park

SATURDAY, 20 AUGUST 2022

17:30 – 21:30hrs (you need to be at Skyline Gondola no later than 17:45hrs)

AQUA Conference Dinner (pre-purchase)
Skyline Restaurant – Includes Gondola
Ride and a Glass of Bubbles
Buses from Heritage Hotel to Skyline depart 17:30hrs

16:10hrs	Bus to the Heritage departs (arrives back at the Heritage ~16:55hrs)	Coronet Peak Car Park
17:30hrs	Conference Dinner bus departs from Heritage	Main Entrance, Heritage
18:00hrs	Gondola rides to Skyline restaurant	
18:45hrs	Guests seated	
19:00hrs	Dinner Served	
21:30hrs	Buses depart Skyline restaurant and return to Heritage	

Scientific Programme

Friday, 19th August 2022

0645	Breakfast Buffet	Pounamu Room, Exhibitor Area

Session 1 — **Icon Conference Room**

07:55	Welcome, introduction and karakia	Dr Sheila Hart & Dr Mataroria Lyndon
08:00	Ultrasound for everyone – why?	Assoc Prof David Canty
08:30	Acute pain update	Dr Conrad Englebrecht
09:00	Blood and transfusion medicine update	Dr Katia Hayes
09:30	Maori health and equity: The Maori Health Authority and lessons from COVID-19	Dr Mataroria Lyndon
1000 - 1030	Morning Break	Pounamu Room, Exhibitor Area

Session 2 — **Icon Conference Room**

10:30	Anaphylaxis update	Dr Karen Pedersen
11:00	ICU update	Dr Kerry Benson-Cooper
11:30	Anaesthesia and the environment: What's next?	Dr Rob Burrell
1200	Close – Lunch packs and fresh fruit available for pick-up	Mackenzies Restaurant
1230	Bus to Coronet Peak departs (skiers)	Main Entrance, Heritage

AQUA Workshops — **Icon Conference Room**

1300 – 1500	POCUS Workshop [A1] 120 mins	Assoc Prof David Canty
1500 – 1520	Afternoon Break	Icon Foyer
1530 – 1730	POCUS Workshop [A2] 120 mins	Assoc Prof David Canty

Saturday, 20th August 2022

0645	Breakfast Buffet	Pounamu Room, Exhibitor Area

Session 3 — **Icon Conference Room**

08:00	Ultrasound for everyone – how?	Assoc Prof David Canty
08:30	Research in anaesthesia update	Prof Timothy Short
09:00	Paediatric anaesthesia update	Dr Elsa Taylor
09:30	Cardiology update	Dr Fiona Stewart
1000 - 1030	Morning Break	Pounamu Room, Exhibitor Area

Session 4 — **Icon Conference Room**

10:30	A Covid update: everyone's over Covid but Covid's not over us	Prof Rod Jackson
11:10	Anaesthesia in developing countries	Dr Brigid Brown
11:50	Q+A	
1200 – 1230	Close – Lunch packs and fresh fruit available for pick-up	Mackenzies Restaurant
1230	Bus to Coronet Peak departs (skiers)	Main Entrance, Heritage

AQUA Workshops — **Icon Conference Room**

1300 – 1430	Anaphylaxis Workshop [A1] 90 mins	Dr Karen Pedersen
1430 – 1440	Afternoon Break	Icon Foyer
1440 – 1610	Anaphylaxis Workshop [A2] 90 mins	Dr Karen Pedersen

Ultrasound for everyone – Why?

Assoc Prof David Canty

Associate Professor of Anaesthesia, Monash University, Melbourne

Anaesthetists are expected to be the hospital expert in the rapid assessment of the severity of disease so they can provide the safest possible perioperative anaesthetic, analgesia and medical care plan. They are also expected to be the expert in percutaneous insertion of needles for invasive haemodynamic monitoring and regional analgesia and know how to perform emergency needle-guided relief of airway obstruction, tension pneumothorax and effusions compressing the lungs and/or heart. The pressures on anaesthetists continue to increase with an ageing population and an associated increase in severity of illness, proportion of emergency procedures with an associated limit in time for preoperative assessment.

Traditional (before ultrasound) training relies on performing a clinical history, physical examination, interpretation of available test results and sometimes requiring more preoperative tests prior to proceeding with anaesthesia and surgery. Despite the considerable training that anaesthetists undergo, there often remains uncertainty in the accuracy of clinical assessment and needle placement, that may result in sub-optimal patient care and safety.

Point of care ultrasound (POCUS) enables rapid bed-side visual guidance of both clinical assessment and needle placement in real-time, improving both diagnostic and procedural accuracy. The use of ultrasound has evolved from discrete office-based procedures in cardiology and radiology to an extension of the hand, replacing the stethoscope, enabling ‘ultrasound assisted examination’ and ‘ultrasound assisted procedures’. Some common uses of POCUS for anaesthesia include fasting state, detection, quantification or exclusion of common cardiac and respiratory diseases, haemodynamic monitoring (TOE), deep venous thrombosis and raised intracranial pressure. POCUS has re-ignited regional anaesthesia. The resulting explosion of the use of POCUS in anaesthesia and critical care has led to an increasing requirement in specialty training, spreading to other medical and surgical specialties, medical students, paramedics, allied health and ACLS algorithms.

The costs of POCUS include equipment and training. Equipment costs are reducing, with hand-held devices available for under $AUD5,000.

Training costs are much more significant and should be guided by evidence base for the ever-increasing indications for POCUS. Although research answers lag behind clinical use, the evidence will be the main focus on this presentation.

Acute Pain Update

Dr Conrad Engelbrecht

Specialist Anaesthetist and Pain Specialist, Waikato Hospital

Prior to Covid-19, the World Health Organisation published the 'top 10' leading causes of death in upper- and middle-class income countries and globally in 2019.[1] Opioid related deaths are not on the list. There is however wide acceptance that the USA have an opioid epidemic associated with unnecessary death and 2020 saw a new record of 93,000 deaths because of opioid drug overdose that cost Americans about 3.5 million years of life.[2] In New Zealand we have witnessed a steady increase in opioid use from 14.4 per 1000 people in 2011 to 16.6 per 1000 in 2016.[3]
Coroner inquest reports have recorded 325 opioid related deaths over a 5-year period between 2008 and 2012[4] and Ministry of Health data recorded an average of 37 deaths per year between 2004 and 2011 with the cause of death recorded as 'opioid poisoning'.[5]

Of course 'death' is not the only opioid related harm. A New Zealand study published in 2017 examined medication harm in hospitals and found that opioids (including tramadol) and anticoagulants/antiplatelet agents accounted for 40% of all harm. They were also implicated in the most severe harm; defined as bleeding, hypotension and delirium, confusion and over-sedation.[6]

In the face of growing concern over opioid stewardship, the Australian and New Zealand College of Anaesthetists (ANZCA) has updated and amalgamated two separate college statements on slow-release opioids and identifying and preventing opioid induced ventilatory impairment (OIVI).
PS41 - Position Statement on Acute Pain Management, was developed with the stated purpose to 'advance the standards of care related to the management of acute pain' and to 'develop a framework for the provision of high quality management of acute pain'.

The framework includes provisions for pain education, assessment of analgesic efficacy and adverse events, recommendations for pharmacological therapies, delivery of acute pain services and quality assurance.

Education recommendations are directed to undergraduate medical students, ANZCA and FPM trainees and 'other medical staff' and nurses; acknowledging that anaesthetists play a key role in the education process. There is also acknowledgement of the importance of patient and carer education with explicit emphasis on setting expectations of having well managed pain in the rehabilitation process rather than having 'no pain'.

Assessment of efficacy considers both pain intensity scores and functional assessment.

Table 1: Functional Activity Scale*	
A	No limitation: the patient is able to undertake the activity** without limitation due to pain
B	Mild limitation: the patient is able to undertake the activity but experiences moderate to severe pain
C	Severe limitation: the patient is unable to complete the activity due to pain

* Adapted from Scott DA & McDonald WM (2008) Assessment, Measurement and History. In: Textbook of *Clinical Pain Management: Acute Pain* 2e. Macintyre PE, Rowbotham D and Walker S (eds). London, Hodder Arnold.

** Activity assessed is relevant activity related to the cause of the 'new' acute pain –

e.g., ability to take deep breaths and cough after abdominal surgery or injury, or to flex knee after knee surgery

Scott & McDonald, 2008; Schug et al, 2020

Provision is also made for assessment of anxiety, mood and past experience with a recommendation that these factors should inform non-pharmacological management and that additional opioids to manage these should be avoided.

A large section in the appendix is devoted to opioid induced ventilatory impairment (OIVI) as the most dangerous adverse effect and emphasis is placed on sedation monitoring as an early warning system to identify over-sedation and raise alarm to take appropriate action. The sedation score table below aims to improve on the traditional AVPU – scoring system (A = alert; V = responds to voice; P = responds to pain, and U = unresponsive) that is not sensitive enough for early detecting of OIVI.

Macintyre & Schug, 2021

Table 2: Sedation Scores
0 = wide awake 1 = easy to rouse 2 = easy to rouse but unable to remain awake 3 = difficult to rouse
1. A score of 2 is taken to indicate early OIVI and therefore the aim should be to titrate an opioid so that a patient's sedation score is always less than 2. 2. Note that a sedation score (e.g. 'sedation score less than 2') may be specified in the 'Max Dose/24 hrs' in the PRN section of the ACSQHC *National Inpatient Medication Chart* (NIMC) to indicate the maximum amount to be administered in 24 hrs when prescribing opioids in (Australian Commission on Safety and Quality in Health Care, 2019).

Overall, PS41 provide a good framework and the language has softened from the original position statement of 2018 with an acknowledgement that it not possible to accurately conclude whether the risk of OIVI is higher or lower in specific patient populations. There is an acknowledgement that long acting opioids may have a place in acute pain management where there is a demonstrated need, close monitoring and a clear cessation plan in place.[7]

Analgesic (and opioid) stewardship spans the domains of pre-operative, intra-operative and post-operative care.

Opioid free anaesthesia (OFA), in the context of the current opioid epidemic, has been promoted as an intra-operative strategy that could have a meaningful influence on the problem.[8] However, despite a surge in research on opioid free anaesthesia, it is still not clear if OFA is any better or safer than an opioid permissive balanced anaesthetic. There are many OFA 'recipes' in use, but apart from a reduction in nausea and vomiting, the benefit remains unclear.[9] A multicentre, double-blind, randomised, controlled clinical trial comparing opioid free versus opioid anaesthesia on postoperative opioid-related adverse events after major or intermediate non-cardiac surgery (POFA trial study protocol) is hoping to clarify the role of OFA.[10]

There are encouraging evidence emerging of effective analgesic modalities that is opioid *sparing* rather than opioid *free*. And interesting strategy out of Auckland, published in January 2021, showed a significant reduction in opioid consumption when intraperitoneal lignocaine was used compared to intravenous lignocaine for

laparoscopic colectomy, showing a greater than 50% reduction in opioid use in the first 3 post operative days as well as reduced opioid use for the total length of stay.[11]

Studies have suggested that over prescribing of opioids was not only a common problem, but likely a significant contributor to opioid availability in the community.[12-15] It is estimated that 50% of adults who misuse opioids obtain them from family and friends.[9] Arguably, it is in the post-operative domain of analgesic stewardship where the most gains are to be made to minimise harm.

In 2015, I presented on Methadone and its perioperative utility. Since that presentation, the landscape for the use of long-acting opioids within the first 24h after surgery, has changed and its use is no longer recommended by ANZCA.[9,16] The position that methadone is considered a long acting opioid and should be avoided in acute pain management, seems at odds with evidence to suggest that methadone is no more unsafe than any other conventional short acting opioid.[17] It is also useful as a rescue analgesic where short acting opioids have failed.[18] A systematic review and meta-analysis published in Pain demonstrated that methadone had an overall opioid sparing effect, introducing the concept of opioid sparing opioids.[19]

A surge in accidental deaths involving fentanyl caused regulators to restrict the indications for the use of fentanyl patches, which will likely pave the way for future changes to opioid regulation; including box warnings, smaller pack sizes and changes to the wording in packet inserts of opioids.[20]

The use of non-steroidal anti-inflammatory drugs (NSAIDs) are a useful strategy to minimise the use of opioids and there are a number of new and strengthened recommendations for their use:[9]

- Celecoxib given as a single pre-operative dose is effective at reducing opioid usage, pain scores at 24 hours and postoperative nausea and vomiting. (New Recommendation, Level I)
- The COX-2 inhibitors do not impair platelet function and are not associated with increased perioperative blood loss. (Strengthened Recommendation, Level I)
- In patients with normal renal function, parecoxib perioperatively does not increase renal failure. (New Recommendation, Level I)
- NSAIDs hasten bowel recovery after colorectal surgery. (New Recommendation, Level I)
- With regard to renal function, celecoxib and naproxen are safer than ibuprofen with long-term use. (New Recommendation, Level II)

There is continued debate on the effect of opioids on cancer and the literature remains conflicting. More recent studies and meta-analysis has not been able to provide conclusive evidence or recommendations beyond those in existence.[21,22]

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Blood and transfusion medicine update

Dr Katia Hayes

Cardiothoracic Anaesthetist, Auckland City Hospital, Chair of Transfusion Committee

National Massive Haemorrhage Pathway (MHP) Redesign

A group of blood and transfusion representatives from regional and tertiary hospitals throughout New Zealand have created a new national MHP. The aim of the project is to simplify and standardise all three MHP's for all healthcare workers no matter where in New Zealand they work. The aim is to also improve communication between blood bank and the location of the transfusion and reduce wastage of blood products.

The MHP incorporates all three types of massive transfusions that can be activated:

a) Standard MHP
b) Code crimson / Trauma MHP
c) Obstetric MHP

The major changes within this project include:

1. **The introduction of a "Stat Pack" for all three pathways**. This gives clinicians immediate access to blood products with the opportunity to transfuse, then stop and reassess the patient. If there is ongoing bleeding and signs of shock, there can then be formal activation of the MHP. However, if the patient has stabilised or bleeding has ceased, there has been no further thawing of blood products and therefore no wastage.

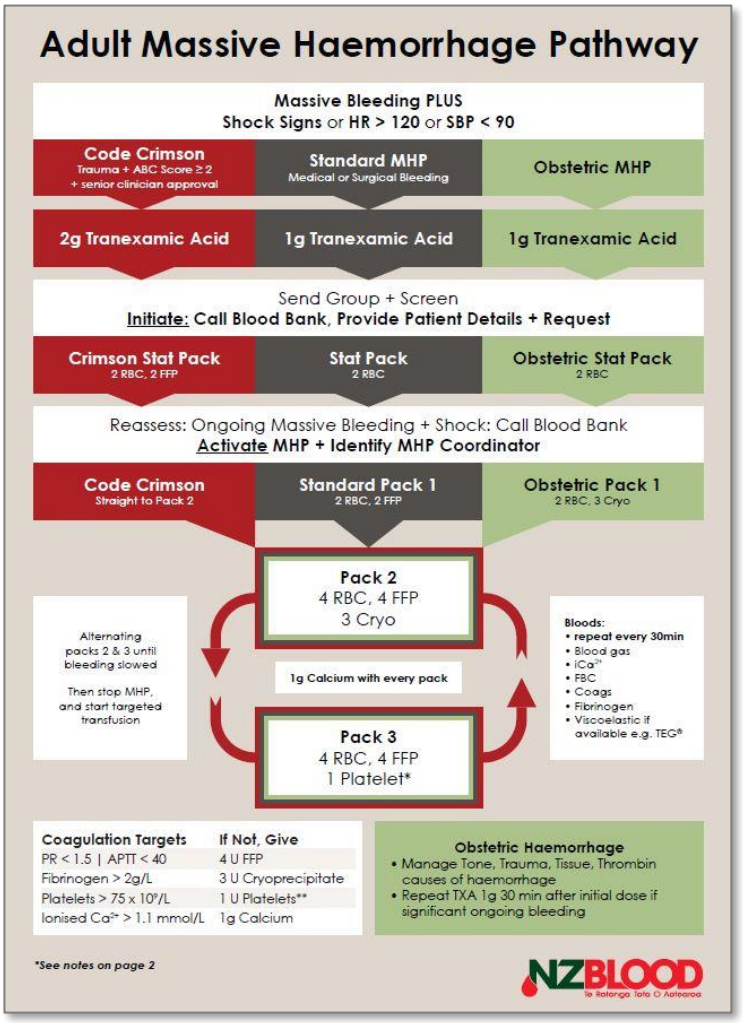
   From international statistics we know that 65% of major trauma does not require more than one unit of RBC's (Holcomb 2015). These statistics are similar amongst other New Zealand hospitals, and that is why we have instituted these changes. However, if the treating clinician believes this is a major haemorrhage that requires immediate activation of the MHP, this can be done, the stat pack will be issued and thawing of box one will be immediate.

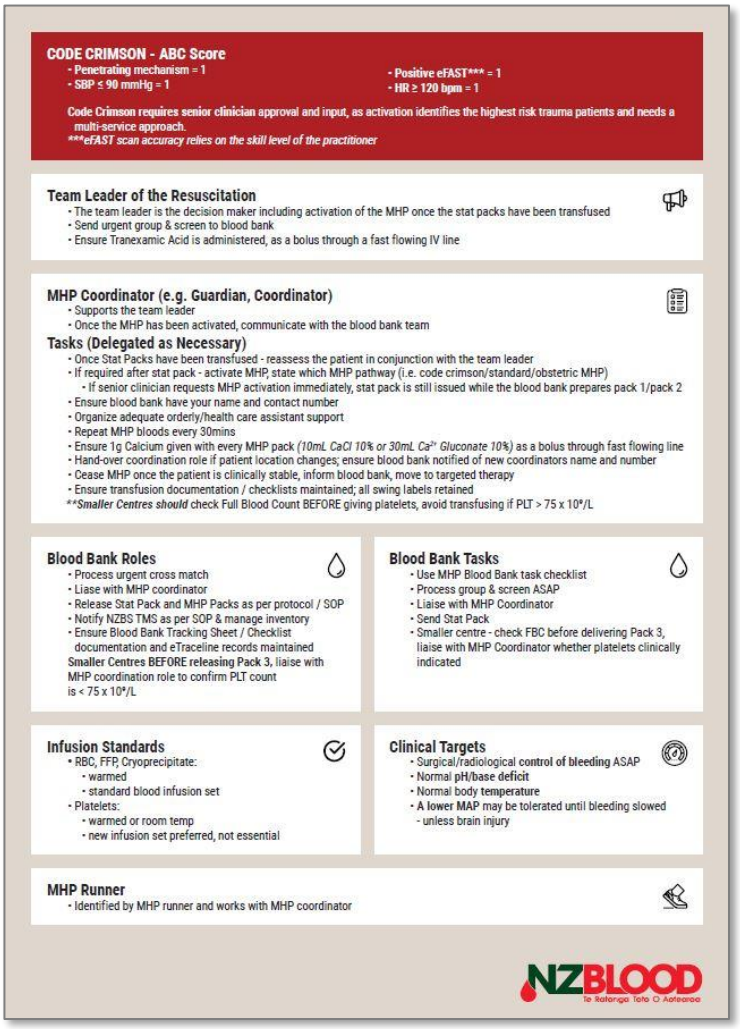
2. **The introduction of a MHP/Transfusion Co-ordinator**. This is a separate role to the team leader, this person is the liaison between the point of the resuscitation and blood bank. Their list of tasks are on the back page of the MHP pathway. Most importantly they are there to improve communication with blood bank and update them when formal activation of the pathway is required, location change of the patient, ceasing the MHP and moving to targeted transfusion.

3. **Simplification of packs 1/2/3**, where packs 2/3 become the alternating products until the MHP is stopped and commencement of targeted transfusion.

4. **Stat dose of 2g tranexamic acid** in code crimson/trauma.

Successful trauma management is not just about the detail of blood product ratios of a MTP but is rather a co-ordinated approach to rapid assessment and definitive damage control surgery. While this is occurring there should be resuscitation with blood products that represents the reconstitution of whole blood with minimal crystalloid administration.


Adult Massive Haemorrhage Pathway
Massive Bleeding PLUS
Shock Signs or HR > 120 or SBP < 90
Code Crimson
Trauma + ABC Score ≥ 2
+ senior clinician approval
Standard MHP
Medical or Surgical Bleeding
Obstetric MHP
2g Tranexamic Acid
1g Tranexamic Acid
1g Tranexamic Acid
Send Group + Screen
Initiate: Call Blood Bank, Provide Patient Details + Request
Crimson Stat Pack
2 RBC, 2 FFP
Stat Pack
2 RBC
Obstetric Stat Pack
2 RBC
Reassess: Ongoing Massive Bleeding + Shock: Call Blood Bank
Activate MHP + Identify MHP Coordinator
Code Crimson
Straight to Pack 2
Standard Pack 1
2 RBC, 2 FFP
Obstetric Pack 1
2 RBC, 3 Cryo
Pack 2
4 RBC, 4 FFP
3 Cryo
Alternating packs 2 & 3 until bleeding slowed
Then stop MHP, and start targeted transfusion
1g Calcium with every pack
Pack 3
4 RBC, 4 FFP
1 Platelet*
Bloods:
• repeat every 30min
• Blood gas
• iCa2+
• FBC
• Coags
• Fibrinogen
• Viscoelastic if available e.g. TEG®
Coagulation Targets
If Not, Give
PR < 1.5 | APTT < 40
4 U FFP
Fibrinogen > 2g/L
3 U Cryoprecipitate
Platelets > 75 x 10⁹/L
1 U Platelets**
Ionised Ca2+ > 1.1 mmol/L
1g Calcium
Obstetric Haemorrhage
• Manage Tone, Trauma, Tissue, Thrombin causes of haemorrhage
• Repeat TXA 1g 30 min after initial dose if significant ongoing bleeding
*See notes on page 2
NZBLOOD



CODE CRIMSON - ABC Score

- Penetrating mechanism = 1
- SBP ≤ 90 mmHg = 1
- Positive eFAST*** = 1
- HR ≥ 120 bpm = 1

Code Crimson requires senior clinician approval and input, as activation identifies the highest risk trauma patients and needs a multi-service approach.
***eFAST scan accuracy relies on the skill level of the practitioner*

Team Leader of the Resuscitation

- The team leader is the decision maker including activation of the MHP once the stat packs have been transfused
- Send urgent group & screen to blood bank
- Ensure Tranexamic Acid is administered, as a bolus through a fast flowing IV line

MHP Coordinator (e.g. Guardian, Coordinator)

- Supports the team leader
- Once the MHP has been activated, communicate with the blood bank team

Tasks (Delegated as Necessary)

- Once Stat Packs have been transfused - reassess the patient in conjunction with the team leader
- If required after stat pack - activate MHP, state which MHP pathway (i.e. code crimson/standard/obstetric MHP)
  - If senior clinician requests MHP activation immediately, stat pack is still issued while the blood bank prepares pack 1/pack 2
- Ensure blood bank have your name and contact number
- Organize adequate orderly/health care assistant support
- Repeat MHP bloods every 30mins
- Ensure 1g Calcium given with every MHP pack *(10mL CaCl 10% or 30mL Ca^{2+} Gluconate 10%)* as a bolus through fast flowing line
- Hand-over coordination role if patient location changes; ensure blood bank notified of new coordinators name and number
- Cease MHP once the patient is clinically stable, inform blood bank, move to targeted therapy
- Ensure transfusion documentation / checklists maintained; all swing labels retained

***Smaller Centres should* check Full Blood Count BEFORE giving platelets, avoid transfusing if PLT > 75 x 10⁹/L

Blood Bank Roles

- Process urgent cross match
- Liase with MHP coordinator
- Release Stat Pack and MHP Packs as per protocol / SOP
- Notify NZBS TMS as per SOP & manage inventory
- Ensure Blood Bank Tracking Sheet / Checklist documentation and eTraceline records maintained

Smaller Centres BEFORE releasing Pack 3, liaise with MHP coordination role to confirm PLT count is < 75 x 10⁹/L

Blood Bank Tasks

- Use MHP Blood Bank task checklist
- Process group & screen ASAP
- Liaise with MHP Coordinator
- Send Stat Pack
- Smaller centre - check FBC before delivering Pack 3, liaise with MHP Coordinator whether platelets clinically indicated

Infusion Standards

- RBC, FFP, Cryoprecipitate:
  - warmed
  - standard blood infusion set
- Platelets:
  - warmed or room temp
  - new infusion set preferred, not essential

Clinical Targets

- Surgical/radiological **control of bleeding** ASAP
- Normal **pH/base deficit**
- Normal body **temperature**
- **A lower MAP** may be tolerated until bleeding slowed - unless brain injury

MHP Runner

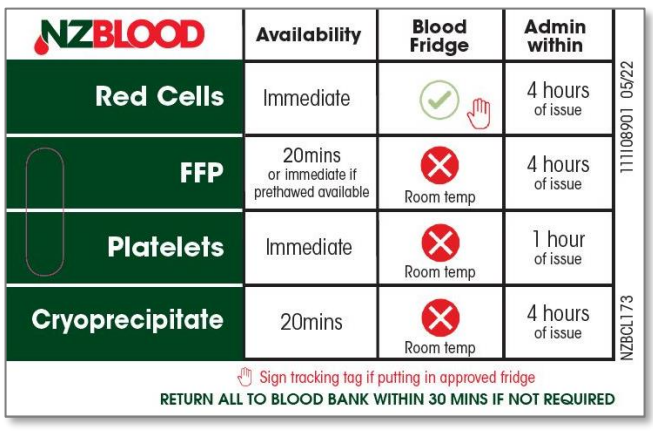
- Identified by MHP runner and works with MHP coordinator

NZBLOOD Te Ratonga Toto O Aotearoa

Blood Handling Rules Lanyard

It is impossible to remember all the rules around the safe handling of blood products, when you must return them by in order to be reissued and not wasted. Therefore, we have designed a simple lanyard as a reference tool for all healthcare workers nationwide. These are based on New Zealand Blood Service (NZBS) rules, (which most non-NZBS blood banks also follow).

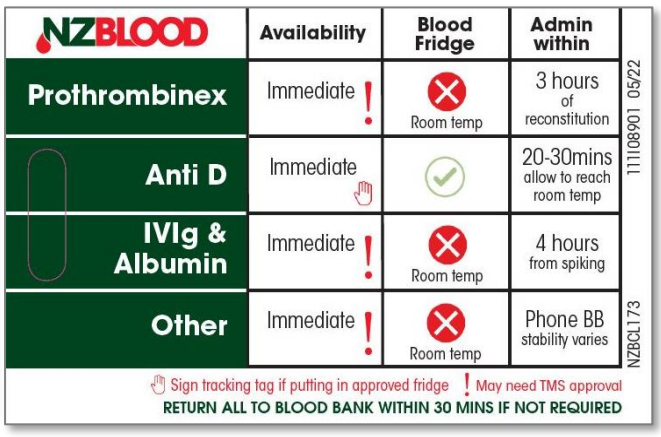
We hope to one day have a solution to the manual swing tag sign in/out on the unit of RBC's when they enter/exit a blood fridge, but at this stage, it's still a manual task. Without evidence of the cold chain on the swing tag, the RBC will be discarded.



NZBLOOD	Availability	Blood Fridge	Admin within
Red Cells	Immediate	✓	4 hours of issue
FFP	20mins or immediate if prethawed available	✗ Room temp	4 hours of issue
Platelets	Immediate	✗ Room temp	1 hour of issue
Cryoprecipitate	20mins	✗ Room temp	4 hours of issue

111108901 05/22 NZBCL173

Sign tracking tag if putting in approved fridge
RETURN ALL TO BLOOD BANK WITHIN 30 MINS IF NOT REQUIRED



NZBLOOD	Availability	Blood Fridge	Admin within
Prothrombinex	Immediate !	✗ Room temp	3 hours of reconstitution
Anti D	Immediate	✓	20-30mins allow to reach room temp
IVIg & Albumin	Immediate !	✗ Room temp	4 hours from spiking
Other	Immediate !	✗ Room temp	Phone BB stability varies

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Sign tracking tag if putting in approved fridge ! May need TMS approval
RETURN ALL TO BLOOD BANK WITHIN 30 MINS IF NOT REQUIRED

Top tips for saving blood products:

- **RBC's** – Ensure the "swing tag" is signed in/out of the blood fridge when storing them in your operating room environment.
- **RBC's** – Ensure they are never out of the fridge for more than 30 minutes.
- **FFP** – You can "thaw and hold" FFP in your blood bank in situations where you can't predict if FFP will be required, and if you do need it, it is time critical. This is especially helpful in cardiac surgery, liver surgery and trauma when moving on to targeted transfusions. If FFP is not needed, then it can stay in blood bank and be moved to "extended life plasma" (ELP), where it has a five day fridge life and can be reissued to another patient.
- **Cryoprecipitate** - Only thaw cryoprecipitate if it's going to be needed. If you thaw it and then don't need it, it only has four hours to be reissued to another patient. The cryoprecipitate would most likely be wasted since reissuing is unlikely.

Prices 2022

Below are the costs of each unit of blood product supplied from NZBS to our hospitals. This does not include consumables, nursing or administration time.

Red cells	$337.10
FFP	$247.28
Prothrombinex (500IU)	$346.39
Cryoprecipitate	$464.28
Platelets	$948.48
Riastap (fibrinogen concentrate)	$852.49

Future Blood Product Changes

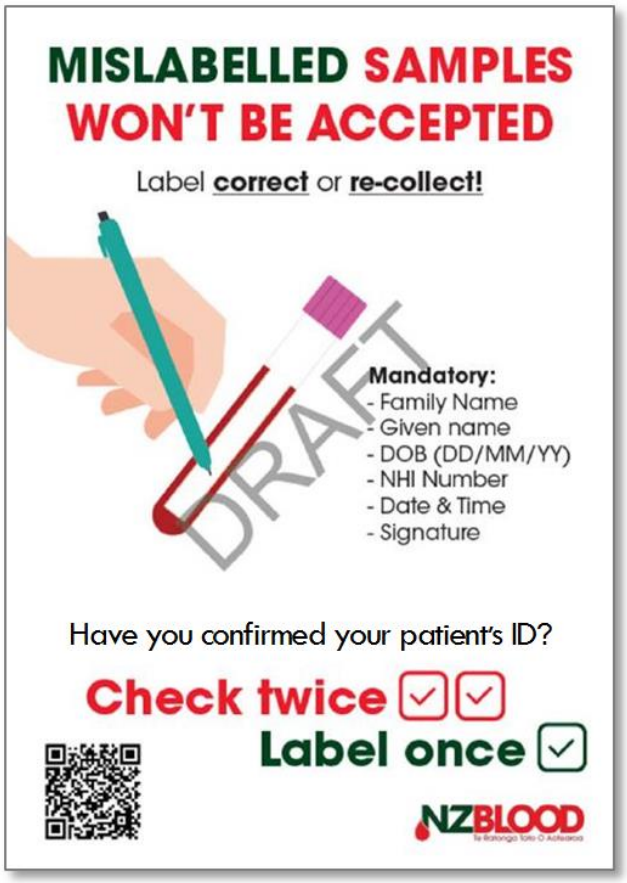
Prothrombin complex concentrates (PCC's) e.g. Prothrombinex.

With the upgrade of CSL Behring plant in Melbourne, we will have Beriplex NZ, a four factor PCC containing factors II, VII, IX, X and the important balanced anticoagulants protein S and C. This will bring us into alignment with the rest of the world with four factor PCC. This will enable us to apply international data and research on PCC use in areas such as cardiac surgery, liver transplant and massive bleeding. We expect Beriplex NZ to arrive end of 2024.

Albumin

Albumin will be changing from Albumex 4% to Alburex NZ 5%, with Albumex 20% staying at the current concentration but with a name change to Alburex NZ 20%.

Group and Screen Labelling Errors



As anaesthetists, occasionally we have to do a group and screen on our patient. We fill out the request form, awkwardly handwrite on the tube, send the sample off in the Lamson tube, then await the phone call from blood bank saying you've done it wrong, the sample is rejected and you have to do it all over again.

Unfortunately things are about to get harder. From September 2022 blood banks around New Zealand will no longer accept minor and moderate errors. Yes, most of us have been getting away with minor and moderate errors up until now. The **mandatory** information that must be on the pink group and screen tube is:

- Family name
- First name
- DOB (DD/MM/YY)
- NHI number
- Date and time
- Initial

This requirement is to reduce the frequency of wrong blood in tube events (WBIT) and ensure the patient and their blood group has been correctly identified. A WBIT event can lead to the wrong blood group being transfused to the patient and death; we have had one of these in a large city in last few years.

A working group is looking for a better solution to the arduous and awkward process of handwriting group and screens tubes and forms, with the introduction of electronic bedside labelling, much like when you have a blood test done at Labtests. This will require money and IT support, hopefully something that will be supported with Health NZ.

Cryopreserved platelets (CPS)

Platelet transfusion is a life-saving component in the treatment of major bleeding in such scenarios as trauma, major surgery, obstetric emergencies and acute medical conditions. The main issue with our current platelets formulation is their short shelf-life of only seven days. This limits the ability to keep an adequate supply at medium and small hospitals. In addition, almost 30% of platelets are wasted each year because they expire before administration. This not only results in significant financial loss, in excess of $5million per year (each bag costs $948), but it's also a discourtesy to those who donate platelets.

Unlike red blood cells, platelets cannot be refrigerated as this significantly impairs their function, and room temperature storage (RTS) for > 7 days is limited by the risk of infection.

Unlike refrigeration, and somewhat surprisingly, cryopreservation of platelets at -80°C increases the shelf life to two years. If cryopreserved platelets are as safe and effective as liquid-stored platelets it would allow smaller hospitals to easily provide platelet transfusions, and would reduce platelet wastage, and possibly produce better patient outcomes through more effective haemostasis.

There are two clinical trials which are relevant obligatory steps which need to be completed before cryopreserved platelets will be ready for use in New Zealand.

CLIP-I (NZ) was a pilot study conducted by Auckland City Hospital, Cardiovascular ICU Research and the NZBS. This pilot assessed production and distribution logistics, feasibility and safety aspects of CPS. In addition, the results of the trial were used by NZBS to support the successful product registration of CPS with MEDSAFE. Over 12 months, 91 patients were enrolled and 23 of these received platelets (25% of enrolled patients) and were randomised to either RTS platelets or CPS. There were no differences in outcomes between the groups. CLIP-1 NZ also demonstrated that NZBS was able to manufacture and distribute CPS and that these platelets were safe for patients. CLIP-I (NZ) has now been published.

CLIP-II (NZ) is now running in all five cardiac surgery centres in New Zealand. It is multicentre, blinded, randomised controlled, non-inferiority trial of CPS vs. conventional RTS platelets for the management of post-operative bleeding in patients undergoing cardiac surgery. We will need to recruit 800-900 patients in order to enroll 230 patients (recruitment rate around 25%) in this study.

If this research demonstrates that CPS are not inferior to traditional platelets for the control of major bleeding occurring during cardiac surgery, then their use will be extended to other situations where urgent platelet transfusion is indicated, and they will be made available in hospitals that do not currently keep them on site.

The research impact includes:

1. Reduction in inequity. Patients presenting to smaller hospitals will have access to platelets in a timely manner so that the latest MTP's can be followed which have been shown to improve outcomes in diverse clinical scenarios including trauma, major surgery and obstetric emergencies.
2. Significant cost savings.
3. Less wastage of donated platelets.

Four Factor PCC's for New Zealand and Australia AND the use of PCC's in non-warfarin contexts

Australia and New Zealand are the only countries to exclusively have the three factor prothrombin complex concentrate (PCC) Prothrombinex. Prothrombinex contains factors II, IX, X with variable smaller amounts of VII, and heparin 192 iu/vial. Four factor PCC's contains factors II, VII, IX, X and protein S and C. This product will be introduced into New Zealand towards the end of 2024, replacing our current Prothrombinex.

As we all know PCC's are routinely used for reversal of warfarin, however now there is growing evidence for PCC use in trauma and cardiac surgery.

A recent systematic review of the use of PCC's for the treatment of bleeding in trauma patients, showed that PCC's could be a beneficial adjunct during an MTP in addition to FFP. In trauma, PCC's combined with FFP showed reduced mortality when compared to FFP alone. The dose range for this was between 10-50 iu/kg, and there was no difference in mortality based on PCC dose. PCC's also showed a reduction in RBC transfusions when compared to transfusions with no PCC's. There was no difference in thromboembolic events between the two groups (van den Brink 2020;18). A standard 20 iu/kg dose in a 70kg patient costs about $1000.

A Cochrane review will be published this year on PCC use in cardiac surgery. Again, this shows a reduction in units of RBC transfusion, reduction in the incidence of RBC transfusion with no increased incidence of thrombotic events. We now routinely use PCC's in high-risk cardiac surgery who cannot tolerate the volume associated with FFP in cardiac surgery at Auckland City Hospital (Hayes 2020).

Cytosorb – For the emergency removal of Ticagrelor and Rivaroxiban

With no reversal available for ticagrelor and rivaroxaban, this poses a challenge for clinicians treating a patient who is taking one of these drugs who also has life-threatening bleeding such as upper GI bleeding, intracranial bleeding, ruptured abdominal aneurysm or is requiring emergency cardiac surgery.

Rivaroxaban is not dialysable as it is highly protein bound (95%), and can be expected to have decreased by more than 90% but only after four half-lives, i.e. approximately 28 hours (range 20 - 36 hours) in a patient with normal renal function. This is too long to wait in a life threatening bleeding context. Andexanet Alpha (in the USA) is a specific reversal agent for this drug but is not available in Australasia, costs over $60,000 for a bolus and small infusion dose, and there are safety concerns regarding its prothrombotic effect. Prothrombinex will only partially reverse the effects of rivaroxaban.

Ticagrelor is a reversible inhibitor of ADP on platelets, has no reversal agent available,

and if any platelets are transfused to a patient on this drug in a bleeding context these platelets will in turn become inhibited.

A novel way of removing these drugs is using Cytosorb. This 300 ml cartridge is filled with porous polymer beads which adsorbs drugs with a size less than 55 kD. This requires a vascath, a dialysing circuit allowing a blood flow of around 150-250 ml/min and a pump to circulate the blood. The approximate cost is $800-$1000, which is similar to a bag of platelets.

So far this has successfully been used in cardiac surgery (where it is used while on cardiopulmonary bypass) both in Auckland and Wellington with approximately 20 patients at each site. This provides an option for those extreme cases of life-threatening bleeding caused by these two drugs and which is not controlled by other drug, blood, interventional or surgical means.

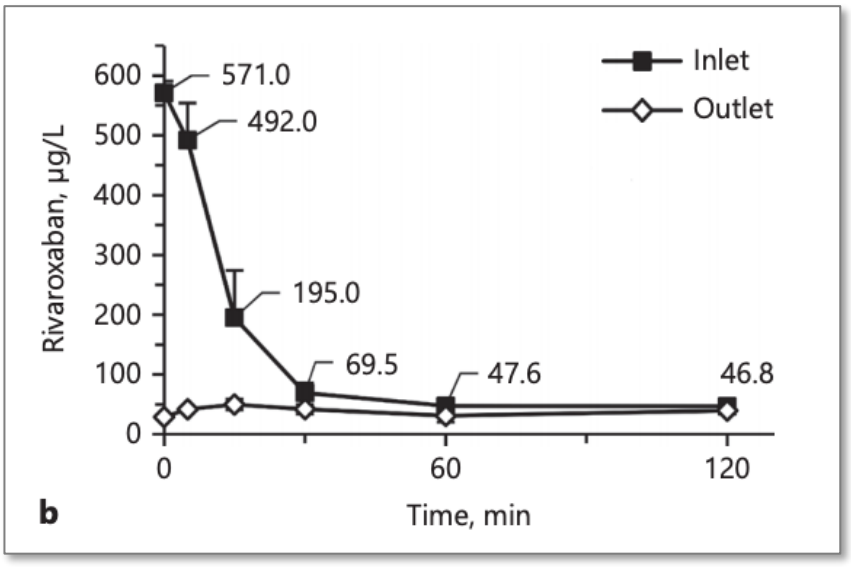


Figure 1 Invitro recirculation model showing inlet/outlet rivaroxaban plasma concentrations

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Maori health and Equity: The Maori Health Authority and lessons from COVID-19

Dr Mataroria Lyndon

Equity Lead at Mahitahi Hauora PHO, Clinical Director at Tend Health, Senior Lecturer at University of Auckland (Ngāti Hine, Ngāti Whatua, Waikato)

Summary: There are persistent inequities for Māori in healthcare access, healthcare quality, and overall health outcomes compared with non-Māori New Zealanders. Māori are less likely to access high quality healthcare, suffer a higher prevalence of long-term conditions, and have higher COVID-19 case rates, hospitalisations, mortality, and inequitable COVID-19 vaccination coverage.

This presentation will highlight lessons learnt and innovations sparked by the pandemic that can contribute to health equity through partnerships with communities, digital and outreach services, and Māori leadership. It will also highlight the health system reforms taking place within Aotearoa. At the centre of the changes is the establishment of two new organisations – Te Whatu Ora/Health New Zealand which will see our 20 District Health Boards become one organisation, and the Te Aka Whai Ora/Māori Health Authority which will provide new leadership for hauora Māori (Māori health).

Anaphylaxis update

Dr Karen Pederson
Specialist Anaesthetist, Auckland Anaesthetic Allergy Clinic, Auckland City Hospital

There have been a number of developments in the field of perioperative anaphylaxis over the last few years. I am going to focus on 3 main areas: perioperative anaphylaxis management guidelines, cefazolin anaphylaxis and sugammadex anaphylaxis.

ANZCA/ANZAAG Perioperative anaphylaxis management guidelines

These guidelines and management cards were originally developed by ANZAAG and endorsed by ANZCA in 2013. The first revision in 2016 was co badged by ANZAAG and ANZCA. The second revision was completed this year and is now out as a pilot.

The key changes in the 2022 guideline are:

- Cardiac compressions should be initiated at a systolic blood pressure of less than 50mmHg in the anaesthetised patient.
- A graded approach to volume replacement with an initial crystalloid fluid bolus of 500mL in a moderate (Grade 2) and 1000mL in a life threatening (Grade 3) reaction to be repeated as required and titrated to clinical response. In the case of a cardiac arrest (Grade 4) reaction the recommendation remains for an initial bolus of 2000mL.
- A more graded approach to IV adrenaline bolus dosing with lower starting doses for each grade of reaction and guidance on how to escalate doses if there is no response.
- Manual left uterine displacement (LUD) should be applied during the management of hypotension or cardiac arrest due to anaphylaxis in the pregnant patient to minimise aortocaval compression (in preference to left lateral tilt).
- Oesophageal intubation has been added to the differential diagnosis list for refractory bronchospasm and has been included on the immediate management card
- Some changes have been made to the layout and colour scheme of the cards

Cefazolin anaphylaxis

Cefazolin is one of the 3 main causes of perioperative anaphylactic reactions in New Zealand and Australia (along with neuromuscular blocking drugs and chlorhexidine). Historically it has been thought that there was a significant risk (up to 10%) of cross sensitivity between penicillins and cephalosporins due to the shared beta lactam ring and the advice given to patients who had an anaphylactic reaction to any of these drugs was to avoid all beta lactam antibiotics. In the context of surgical antimicrobial prophylaxis vancomycin and clindamycin use was (and still often is) recommended in these patients.

Over time it has become evident that the patterns of cross sensitivity between penicillins and cephalosporins and between different cephalosporins are variable and that many patients who are allergic to one drug in the group are able to tolerate others. One of the strong predictors of cross sensitivity is the presence of common side chains. Cefazolin has a unique R1 side chain. This means that **patients with a history of IgE mediated immediate hypersensitivity reactions to cefazolin are at low risk of reacting to penicillins or other cephalosporins and should be given these drugs if required.** The surgical antimicrobial prophylaxis guidelines at ADHB have been changed accordingly. Cefuroxime is now the recommended antibiotic in patients with cefazolin anaphylaxis. Cefazolin is the recommended antibiotic in patients with anaphylaxis to penicillin or another cephalosporin.

The unnecessary restriction of antibiotic usage due to unfounded concerns about cross sensitivity and allergy result in increased healthcare costs, increased morbidity and increased mortality for patients.

It is important to distinguish between **immediate** hypersensitivity reactions/IgE mediated reactions/anaphylaxis and **delayed** hypersensitivity reactions. The mechanisms underlying delayed hypersensitivity reactions are poorly understood. Red flags on history include mucosal ulceration (mouth, eye or genitals) and desquamating

skin lesions. **Any patient with a severe cutaneous adverse reaction to penicillin should not be given any beta lactam antibiotics** and should be referred to immunology for further assessment. Alternative antibiotic prophylaxis outside of the class should be used i.e. gentamicin, clindamycin or vancomycin.

Sugammadex anaphylaxis

Sugammadex is a medication which is increasingly being used for reversal of neuromuscular blockade as an alternative to neostigmine. Sugammadex was approved for use in Europe, Australia and New Zealand in 2008. It was approved for use in Japan in 2010. It was not approved by the FDA until 2015 due to concerns about hypersensitivity reactions. Currently over 90% of reversal agent used in Japan is sugammadex. At ADHB neostigmine is still our main reversal agent but our sugammadex usage (based on number of 200mg vials dispensed) has increased tenfold between 2015 and 2021 (354 vials in 2015 to 3610 vials in 2021).

Sugammadex is a modified gamma cyclodextrin which antagonises aminosteroid neuromuscular blockers (rocuronium and vecuronium) by encapsulating the drug molecule in the plasma. Sugammadex has several clinical advantages compared to neostigmine but there are significant concerns regarding cost and potential to cause anaphylaxis.

At ADHB in 2021 the cost of a 200mg vial of sugammadex was $120 (minus an unknown rebate). The cost of a pre-mixed vial of neostigmine and glycopyrrolate was $2.09.

In Japan the estimated incidence of anaphylaxis to sugammadex, based on a number of large retrospective analyses, is between 1:2,500 and 1:5,000. This is similar to the quoted incidence of anaphylaxis to rocuronium and suxamethonium.

There are at least 2 mechanisms of anaphylaxis to sugammadex: (1) IgE mediated immediate hypersensitivity reactions with sensitisation due to previous use or exposure to similar molecules such as cyclodextrins in food additives and cosmetics in the community (2) Non IgE mediated, dose related hypersensitivity reactions.

There continue to be case reports claiming benefits temporally related to the administration of sugammadex in cases of rocuronium anaphylaxis. In all these cases conventional resuscitative therapies had also been administered. In vitro and in vivo human models of anaphylaxis have not been able to demonstrate immunologically mediated attenuation of established anaphylaxis. The observed therapeutic effect of sugammadex on resuscitation may be to increase muscle tone (and therefore, reduce venous capacitance) in circumstances where there is severe distributive shock and inadequate resuscitation. The resumption of spontaneous (negative pressure) ventilation after reversal of neuromuscular blockade may also increase venous return. There are potentially practical difficulties during resuscitation if neuromuscular blockade is reversed. The 2022 ANZCA/ANZAAG perioperative anaphylaxis management guideline does **not recommend the use of sugammadex in resuscitation of suspected anaphylaxis to rocuronium.**

ICU Update

Dr Kerry Benson-Cooper

Intensive Care Medicine Specialist, Auckland City Hospital

Although we are very saturated with things COVID in mid-2022, it is impossible to give an ICU update without mentioning REMAP CAP. My talk will include a brief update of the current research for COVID with an ICU focus. I will then present some of the more recent ICU general research – largely around fluid and resuscitation. I also hope to finally put the Vitamin C question to rest – at high dose anyway!
Lastly I will briefly outline the current trials that are underway (in our part of the world)

Anaesthesia and the Environment: What's next?

Dr Rob Burrell

Specialty Anaesthetist, Middlemore hospital; Chair of NZSA environmental and sustainability network

The environment was once taken for granted. These days we need to treat it as we would treat a patient. With dignity and respect. First, we must do no harm.

Anaesthesia is to be congratulated. As a specialty, the NZ anaesthetic community has embraced the challenge to reduce the carbon footprint of patient care, without any loss of benefit or safety for patients. The use of desflurane, an extremely potent greenhouse gas, has so steeply declined over the past 5 years that we no longer feature in the top 10 carbon intense areas of healthcare in this country.

We have probably learned some new skills along the way. We have learned lessons, educated ourselves, and our colleagues. We have saved money, significantly reduced environmental harm, and created a template for other specialties to follow.

There have been trade-offs and substitutions, and these raise their own questions. We also must examine the landscape of the health system, and examine where we can make changes. We need to bravely mix our metaphors, and ask where are the hotspots, what is the low-hanging fruit, and where is this waka going?

POCUS Critical Care Workshop Pre-reading

Dr David Canty

Associate Professor of Anaesthesia, Monash University, Melbourne

Point of care surface ultrasound can be lifesaving for emergency care of critically unwell patients.

Five commonly used techniques are described below, which will be covered in the workshop.
1. Cricothryoid puncture
2. Cardiac ultrasound
3. Lung ultrasound
4. Gastric ultrasound
5. DVT ultrasound

The two-hour workshop will be conducted as follows:
1 instructor / 5 delegates / 1 live human volunteer model
The instructor will demonstrate the scan– 5 minutes
Then delegates will copy (2-3 minutes)

1. Cricothyroid puncture

Surface ultrasound may be used to identify the correct site for percutaneous subglottic airway access and to guide access in real-time in principle; the technique is similar to ultrasound-guided vascular access. Cricothyroid subglottic tracheal access is usually performed in an emergency, when orotracheal intubation has failed or when it is deemed that orotracheal intubation will fail. Although the standard method for identification of the cricothyroid membrane and trachea for planned and emergency percutaneous subglottic intubation is by palpation, correct identification is generally poor. In one study, the success rate by palpation alone was only 30%. This is particularly so if there is an inflammatory process involving the neck. Using ultrasound, the mean time to accurately identify the membrane by emergency physicians was only 25 seconds. Ultrasound location of the subglottic airway may be particularly useful in patients with obesity or abnormal anatomies such as pretracheal infection or scarring. The site and depth of the cricothyroid membrane should be routinely identified and marked before attempts at intubation are made in patients with a predicted difficult intubation. This would facilitate emergency cricothyroid access if required, such as after failed intubation or inability to oxygenate. Alternatively, a cricothyroid cannula may be safely placed under local anaesthesia prior to oral intubation attempts.

Cricothyroid puncture

Either the longitudinal or transverse ultrasound approach may be used. The cricothyroid membrane appears as a thin but brightly echoic line between the cricoid and thyroid 2 cartilages and their accompanying shadowing. The tracheal rings below the hyoid bone have a characteristic ‘line of beads’ appearance. The procedure can be assisted by either using ultrasound to mark the safest needle entry
site on the skin (static) or to guide the needle into the trachea in real-time (dynamic).

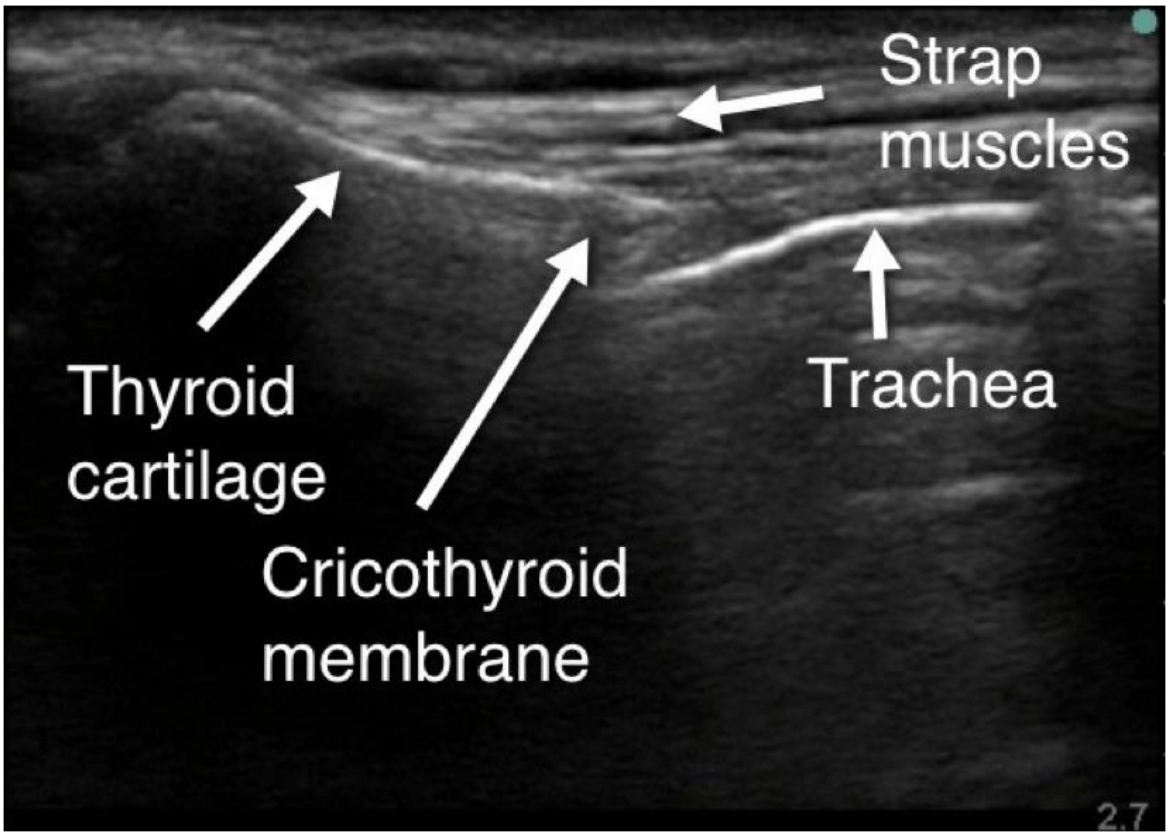


Figure – long axis view of the airway

Static ultrasound technique

• Use a linear transducer for higher frequency and improved resolution.
• Stand at the head of the bed with the ultrasound machine facing you and as close to the patient as possible.
• Orient the probe such that movement of the probe laterally in one direction gives the corresponding change in image (left and right concordance).
• Apply the probe transversely showing a short-axis view of the larynx. The thyroid and cricoid cartilages are very easily palpated.
• Look for the cricoid and thyroid cartilages with an intervening horizontal bright cricothyroid membrane.
• Mark the skin for the subsequent cricothyroid puncture in a conventional manner (static ultrasound).

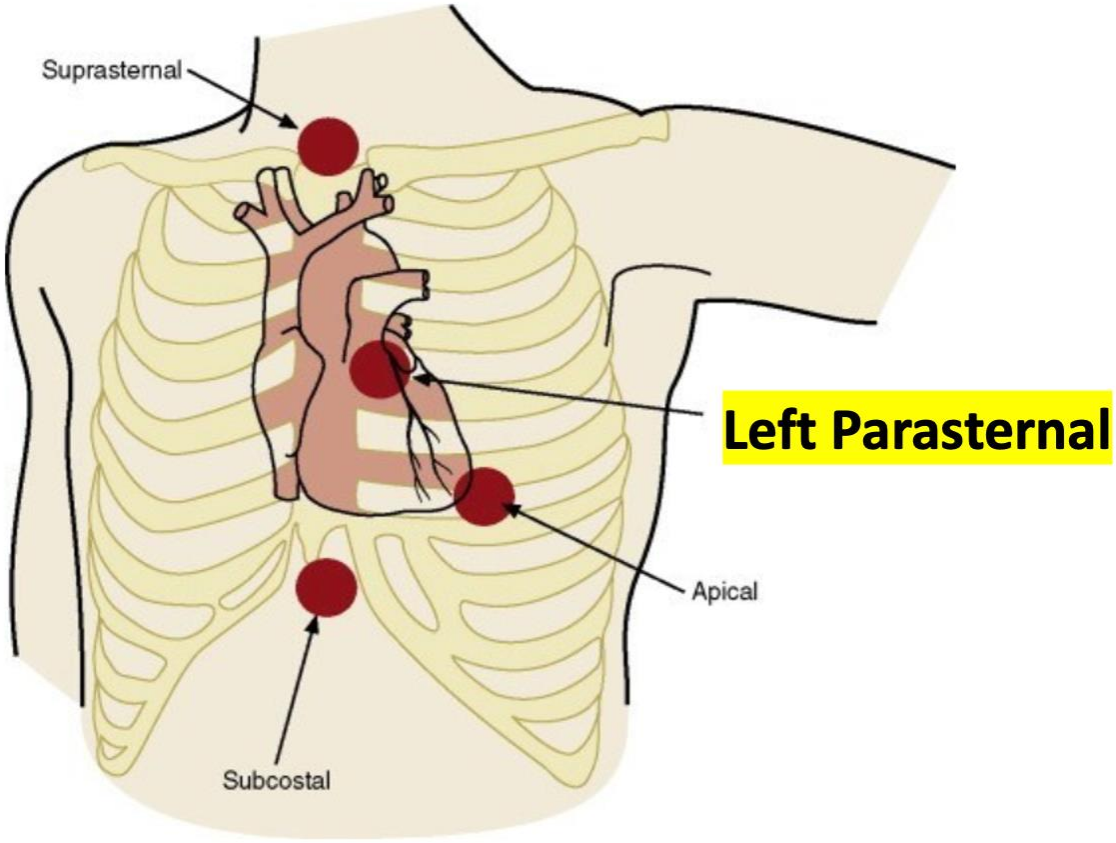
Dynamic ultrasound technique

• Locate the safest needle entry point as above, using sterile technique. Several types of sterile sheaths are available to place the probe.
• Holding the probe in one hand, insert the needle with the other hand at the midpoint of the transducer into the skin. Identify the needle tip on ultrasound and ensure that it is located directly above the target.
• Advance the needle under direct ultrasound guidance, ensuring that the needle tip is visible at all times. Failure to do so risks needle advancement in an undesired direction.
• When the needle tip reaches the airway dispense with the ultrasound equipment and proceed with your normal technique.

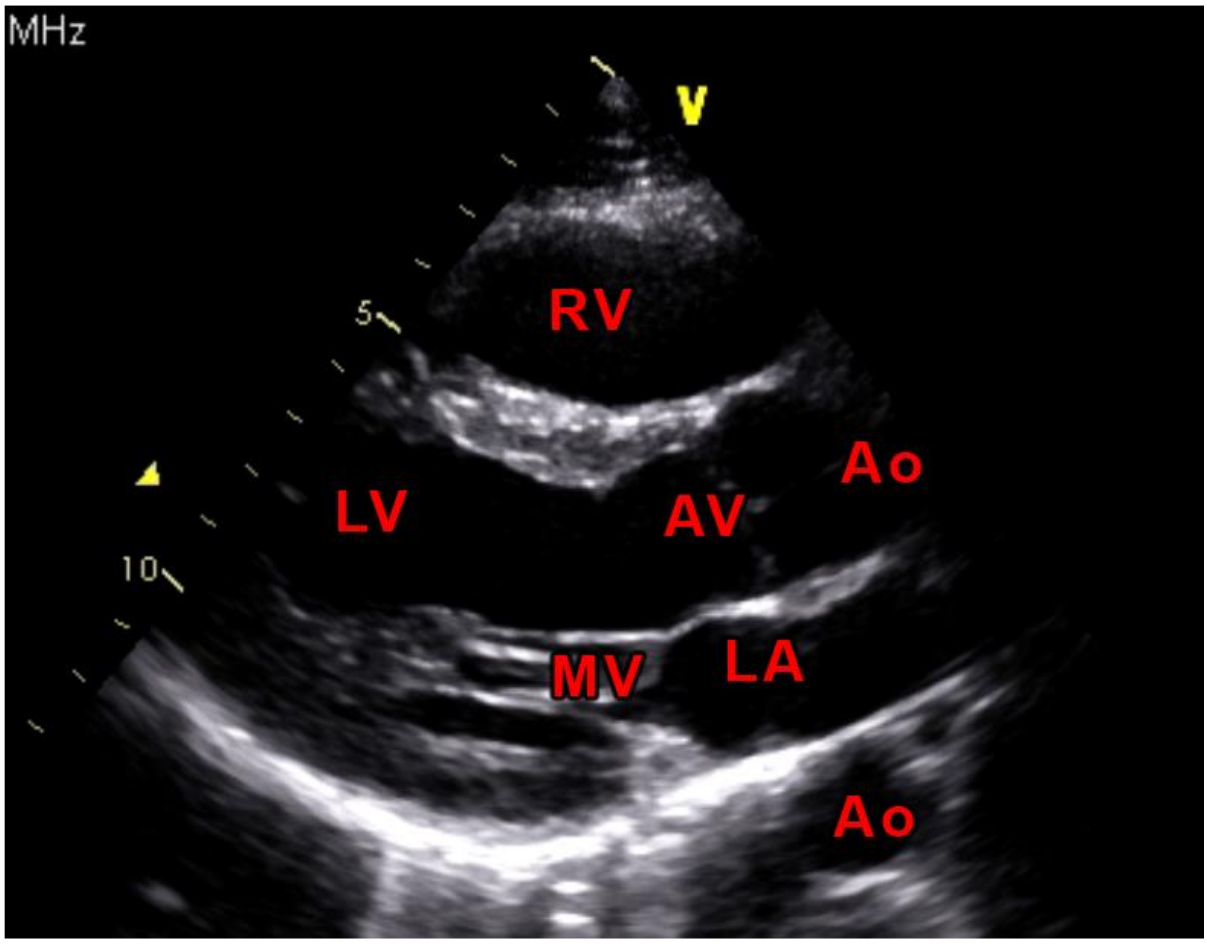
2. Cardiac ultrasound

Clinical examination has been shown to be unreliable in the assessment of shock. Focused cardiac ultrasound (FCU) has been demonstrated to increase the diagnostic accuracy of clinical examination from around 50% to 80%, enabling increased confidence in using FCU to direct acute resuscitation, such as identification of

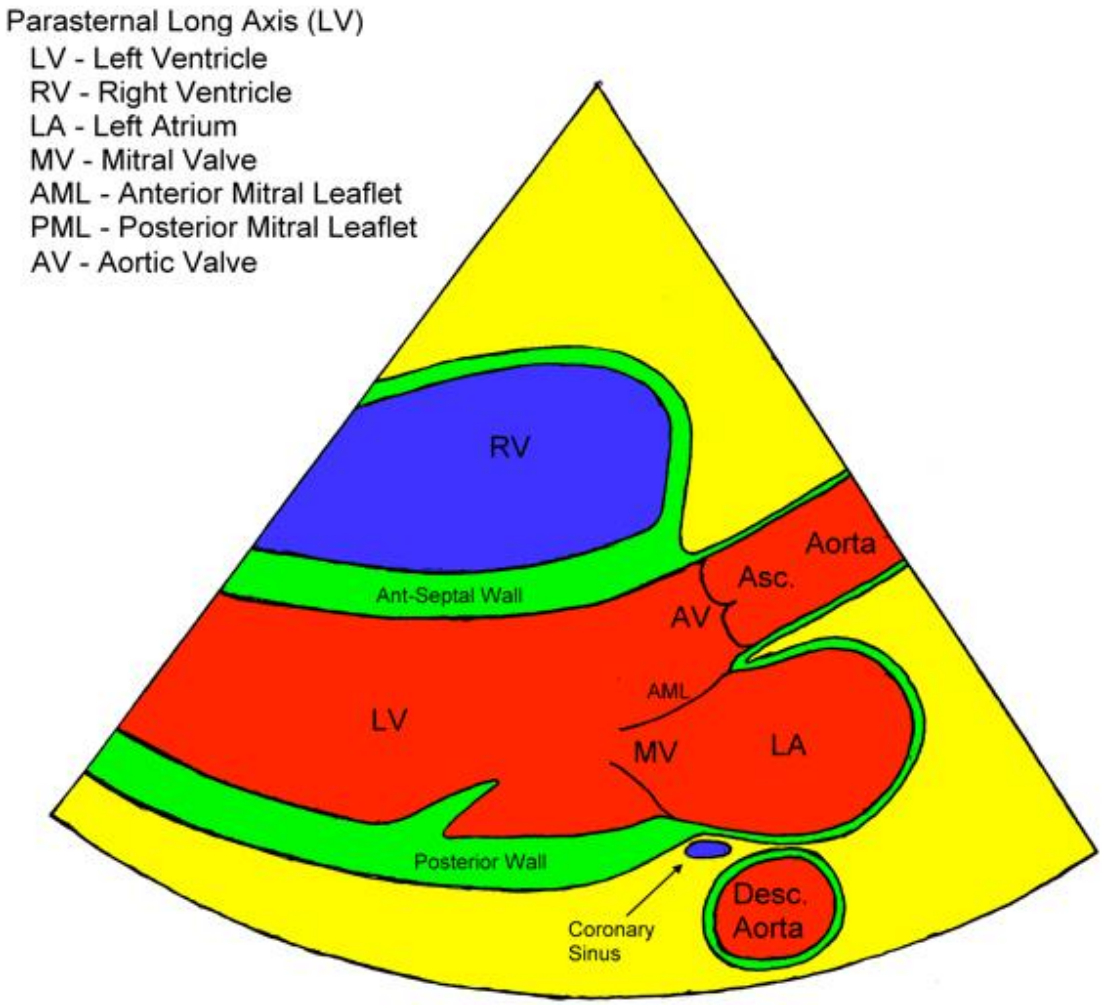
hypvolaemia, vasodilation (e.g. sepsis, anaphylaxis or response to anaesthetic drugs), left and right ventricular dysfunction, aortic stenosis, pulmonary hypertension and cardiac tamponade.
In this workshop, you will learn how to identify LV failure, vasodilation, hypovolaemia and aortic stenosis.
There are three commonly used transthoracic windows (figure below). **The parasternal long axis view** can identify these conditions and will be described here and practised at the workshop.
The left parasternal window is located around the fourth intercostal space just to the left of the sternal edge. The exact location depends on the position of the patient and the position of their heart in the chest. Various pathologies, especially lung disease, may make the exact position and alignment of the probe differ from patient to patient. For example, the window is often seen in the fifth intercostal space in supine patients, and in patients with hyperinflated lungs or unfolded aortas as the heart is pushed down in the chest.



The optimum position of the patient is generally left lateral at an angle of 45° to 90°, although in some people a greater or lesser amount of lateral tilt is required. This window is often the starting point of an examination. Still, it is also the window most likely to fail in the setting of hyper-inflated lungs from positive end-expiratory pressure (PEEP) or airway disease or when there is air in the chest after cardiac surgery. Air in the mediastinum will typically resolve within 12–24 hours post-surgery allowing some degree of imaging after that time.
The PLAX view shows the mitral and aortic valves, the left atrium, left ventricle and proximal ascending aorta. The right ventricle (outflow tract region) is also seen. The walls of the left ventricle in any long axis view are the anteroseptal and the infero-lateral (posterior) walls.
The descending aorta can be seen adjacent (deep) to the left atrium, but this is not a feature of all long axis views.



Parasternal long axis view. LV; left ventricle, RV; right ventricle, AV; aortic valve, Ao; aorta, MV; mitral valve, LA; left atrium.



The PLAX view can be found by making sure that the index marker of the probe is pointed towards the right shoulder (think of the scan plane dissecting the right clavicle). This tends to align the sector scan with the natural angle of the rib interspace and will produce a parasternal long axis window in most people. However, in some patients the alignment of the ribs is very horizontal, leading to a rotation error. In this instance, the probe needs to be rotated in a clockwise fashion until the scan plane dissects the right clavicle. It may appear in some patients that the probe is crossing the rib rather than snugging inside the intercostal space. A long axis view of the left ventricle has both the aortic valve and the mitral valve in view at the same time.

A common error is to angle the probe a little towards the hip and for the tricuspid valve to be in view. The tricuspid valve can be recognised by its position at the entrance to the chamber under the probe. If the tricuspid valve is in view, it is necessary to angulate a little up towards the head to visualise the left ventricle. Once the mitral valve and left ventricle are in view, a combination of a little angulation and a little rotation is necessary to open up both the left ventricle and the left ventricular outflow tract. Ideally the left ventricle should be reasonably horizontal on the screen. If it is angled with the mitral valve in the bottom right of the screen and the apex towards 10 o'clock, moving up a rib space will make the left ventricle more horizontal. However, in many patients, because of lung obscuration, it is not possible to image from a rib space high enough to get the left ventricle horizontal and a compromise needs to be accepted.

The initial examination should be done with the depth setting near maximum to observe any more distant structures, particularly effusions, before reducing the depth to a more standardised distance (e.g., 14–16 cm). The consistent use of a standardised depth will allow for easier recognition of enlarged structures. By angling the transducer towards the right hip, the right atrium and ventricle can be seen. If angled towards the head (go past the aorta), the pulmonary valve can be seen in long axis.

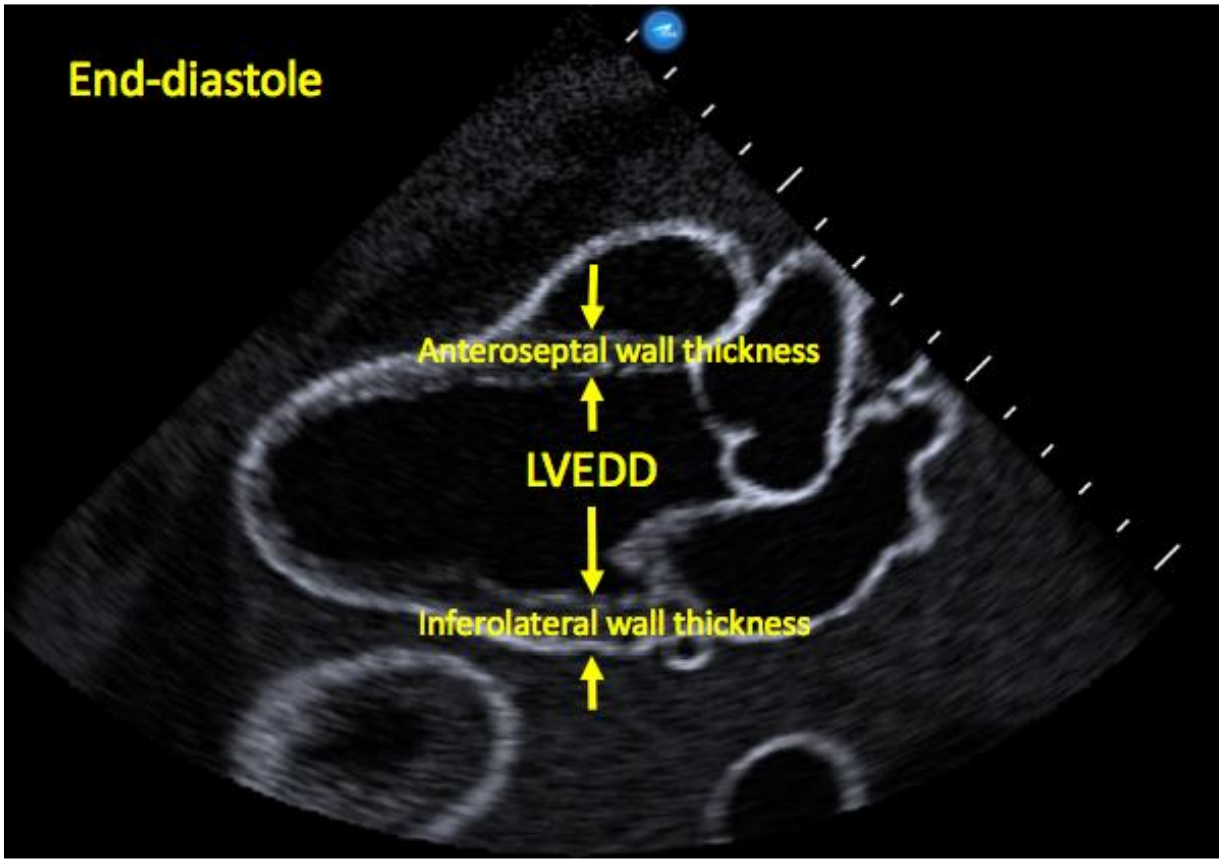
In the absence of certain congenital heart lesions, when viewing the heart through the (left) parasternal window, the chamber next to the probe is always the right ventricle irrespective of the exact view. The right ventricle is

the more anterior of the two ventricles. Accordingly, if when attempting to get the parasternal long axis view of the left ventricle, there is a valve visible on the screen and it is connected to the chamber immediately under the probe, you know that it is either the tricuspid valve or the pulmonary valve (much more likely to be the tricuspid valve).

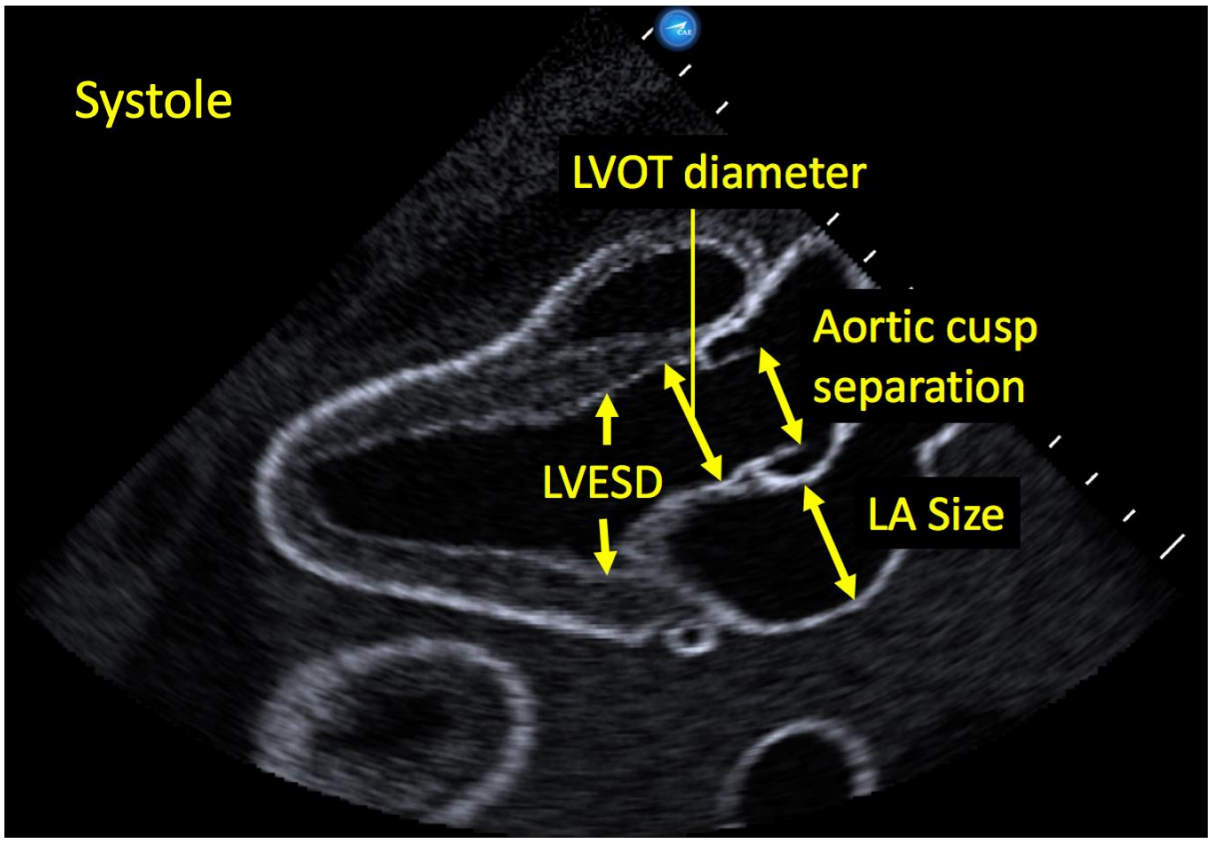
If the valve is opening into the chamber, it is the tricuspid valve, you have the right ventricular inflow view, and you know you have angled the probe too much towards the hips. Therefore, you need to angle the probe up a little towards the head. If the valve is opening away from the probe, it is the pulmonary valve and you have angled too much towards the head.

Assessment of pathology

Both volume assessment and LV and RV function are assessed quickly by measuring the LV chamber dimensions at end diastole and mid systole.



LVEDD = Left Ventricular End Diastolic Dimension
Hypovolaemia: LVEDD < 2.8 cm
Hypervolaemia: LVEDD > 6.6 cm



LVESD = Left Ventricular End Systolic Dimension

LV Fractional shortening (FS) = LVEDD – LVESD / LVEDD x 100 (%)
Normal range: 28 – 44%
LV failure: FS < 28%
Vasodilation: FS > 44%

Aortic stenosis (AS)

Findings associated with aortic stenosis include:
• Left ventricular hypertrophy (a wall thickness greater than 1.2 cm) is almost universally found in association with significant aortic stenosis.
• Aortic regurgitation is common as part of the valve degeneration.
• Post-stenotic dilatation of the aortic root is common with severe stenosis.
• Coarctation is associated with a bicuspid aortic valve.
• Aortic atheroma and mitral annular calcification are commonly seen with calcific disease.

TTE can easily identify aortic stenosis. The central feature of severe aortic stenosis is a failure of the leaflets to open during systole, which is identified using the PLAX view to observe the maximum aortic valve cusp separation (figure above).

There are three main types of aortic stenosis with roughly equal incidence: bicuspid valve stenosis, degenerative (calcific) aortic stenosis and rheumatic aortic stenosis.

A calcific valve appears as a trileaflet valve with progressive deposits of calcium in the leaflets. Rheumatic calcification occurs from the edges of the valve inwards, leading to a small, central opening

While features of the different types of stenosis are distinctive in early disease, by the time stenosis becomes severe, calcification is marked and the underlying aetiology very hard to determine. For the purposes FCU, the identification of the cause of the aortic stenosis is not relevant. The presence of a restricted and heavily calcified aortic valve indicates a significant haemodynamic change from normal and this is more important in the critical care or emergency environment.

Any stenosis that impedes valve opening enough to be moderate or severe will result in a positive examination, and the consequences of all three types of aortic stenosis are essentially identical for a given level of valve restriction.

Colour flow Doppler (CFD)

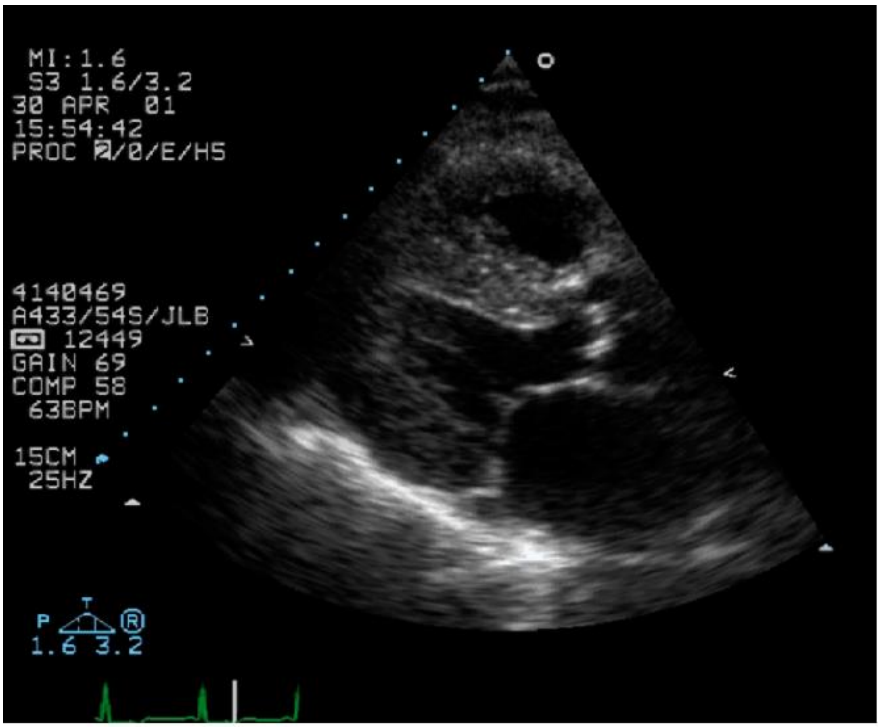
Colour flow Doppler is more useful for assessing aortic regurgitation, but any significant narrowing of the aortic valve will be associated with turbulence distal to the valve. This will be readily seen in a long axis window.

FCU criteria

These criteria are based solely on the 2D appearance of the valve. A positive scan is simply a valve that has a restricted opening similar to the reference views provided:

- An opening less than 15 mm in the parasternal long axis view
- Heavy calcification with an inability to see the valve opening

If the opening is clearly more than 15 mm then the FCU is negative for AS. If the opening is less than 15 mm or you cannot see the opening clearly, the FCU study is positive. An opening of at least 15 mm means that any aortic stenosis will be only mild.



In this image the aortic valve is calcified and not opening representing aortic stenosis

3. Lung Ultrasound

Ultrasound can be used to rapidly diagnose (and exclude) pneumothorax, consolidation, effusion, pulmonary oedema. Identification of pulmonary embolus is possible but to achieve a level of confidence to treat, usually requires a positive ultrasound for DVT and right heart strain on TTE.

In this workshop, you will learn how to diagnose pneumothorax and pleural effusion and consolidation.

Pneumothorax

Tension pneumothorax can be life threatening, and a pneumothorax may be life threatening if there is insufficient respiratory reserve and may develop into a tension pneumothorax.

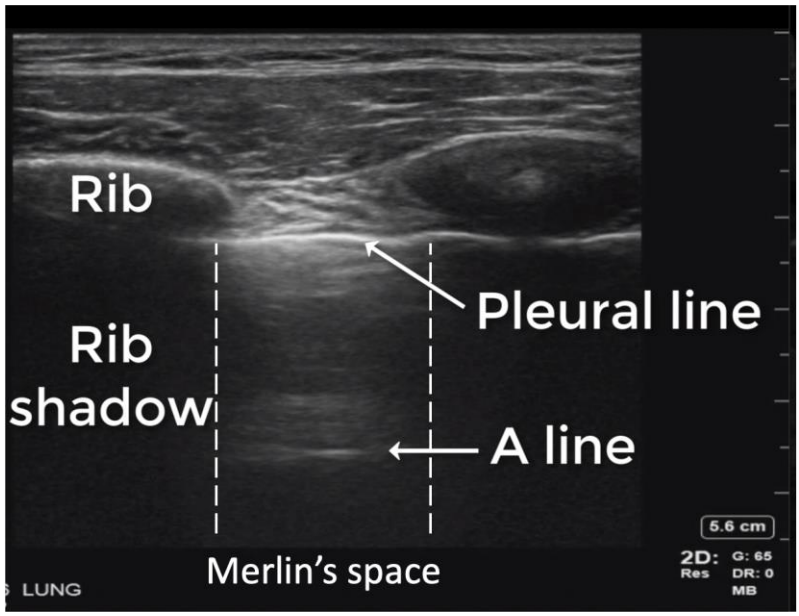
Probe

The curvilinear probe provides the best resolution and the largest foot-print (covers more intercostal spaces) than a phased-array transthoracic probe. A linear (vascular) probe has similar resolution to a curvilinear probe. However, a cardiac probe may be more convenient as it allows you to perform a cardiac and lung examination without the hassle of changing probes.

Patient position

In a supine patient, the air in a pneumothorax usually is best seen anterior, somewhere between (usually in the middle) the costal margin and the clavicle adjacent to the sternal edge.

Place the probe in a vertical orientation in this region, with the probe perpendicular to the chest wall. Look for the ribs (cast black shadows) and these will guide you to the pleural line, a bright white horizontal line just beneath the ribs and intercostal muscles. Adjust the depth so that the pleural line is in the middle of the screen.



During respiration, the two layers of pleura slide past one another resulting in subtle movement on the ultrasound display at the pleural line. This is termed the lung sliding sign and has been described as the appearance of 'crawling ants'.

The image deep to the pleural line in a normally aerated lung is all artefact and not an image of the lung parenchyma. In the normally aerated lung, the rest of the artefact appears as a grey speckled shadow and changes appearance during respiration similar to television 'white noise'. This is called Merlin's space. Lung sliding results in this grey pixelated appearance to speckle.

As the pleural line is highly reflective, it is usually duplicated below as reverberation artefacts, which are referred to as A-lines. These are caused by the ultrasound reverberating multiple times between the pleural line and the transducer face. The lines are equally spaced, at approximately the same distance between the skin and pleural

line. Small degrees of probe manipulation (angling and heel-toe) so the ultrasound beam hits the pleura at right angles will enhance the appearance of A-lines. A normal appearance may include the occasional short vertical line seen to extend inferiorly from the pleural line, which moves and disappears with respiration. These are short comet-tail artefacts and are called Z-lines.

For lung ultrasound appearance to be regarded as normal, both A-lines and pleural lung sliding need to be present.

**Pneumothorax is suggested by the inability to see lung sliding. This is observed in two ways:
• The pleural line appears static and there is no movement
• The Merlin's space appears static and there is no movement

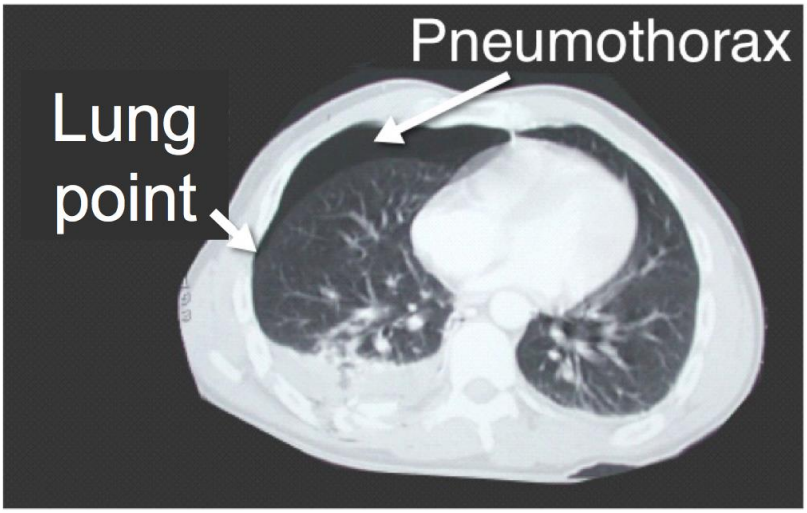
It is important to keep the probe still as each location is analysed as movements of the probe may be misinterpreted as lung sliding.

Identification of lung sliding excludes the presence of pneumothorax in the scanned region with a sensitivity close to 100%, depending mostly on operator experience.

Unfortunately, lack of lung sliding may be caused by other pleural or parenchymal pathology that prevents movement of the pleura and hence lung ultrasound is better at ruling pneumothorax out rather than ruling it in.

Conditions that also cause apparent lack of lung sliding include
• pleural adhesions/fibrosis/pleurodesis
• bullous disease
• severe atelectasis or consolidation,
• either bilateral or unilateral (such as bronchial positioning of a cuffed endotracheal tube) hypoventilation. For example, severe asthma/chronic obstructive pulmonary disease (COPD) or sputum obstruction can cause decreased or apparently absent lung sliding through global decreased ventilation.

**The method used to confirm pneumothorax (approaches 100% specificity depending on operator experience) is the identification of a lung point. The lung point is the point where the pleural air (that is separating the pleural layers) ends and the pleural layers become apposed. The lung point is the border (limit) of the pneumothorax air bubble. If the probe can be positioned over this lung point (edge) then the lung point can usually be seen to be moving with respiration.



Observe the following video of a lung point and pneumothorax:

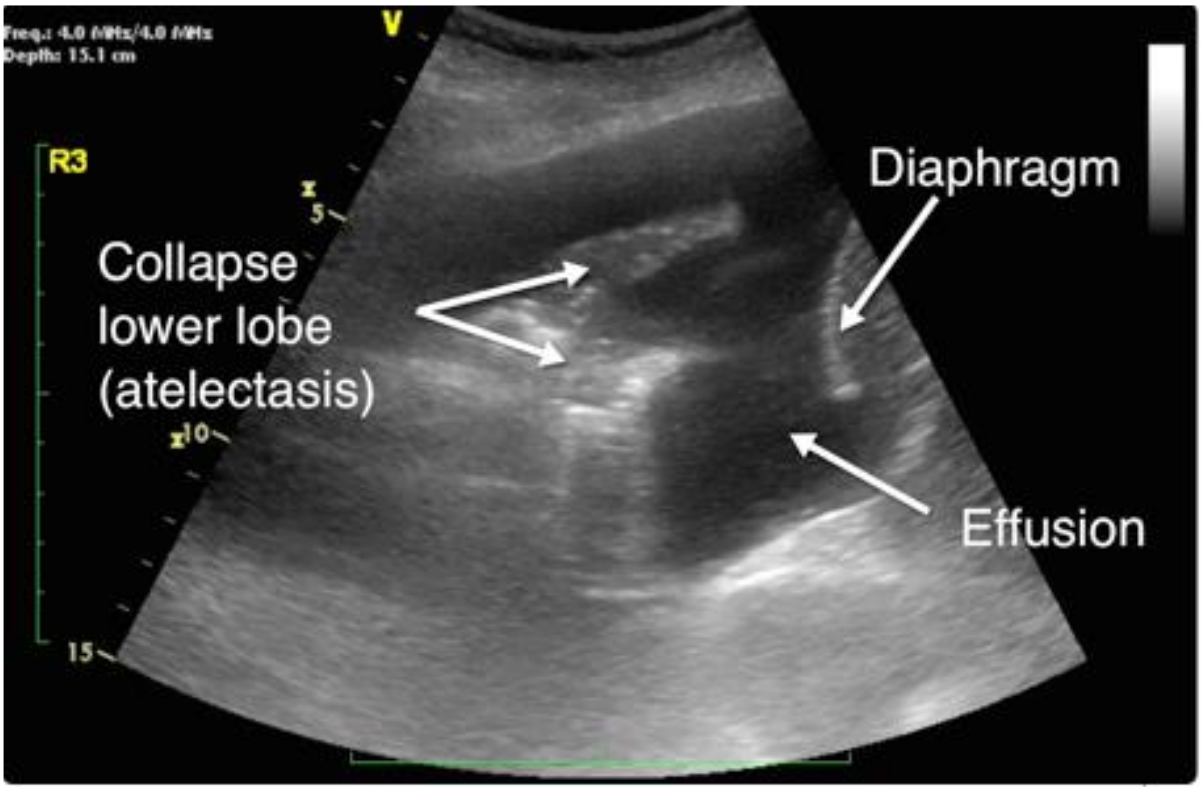
https://youtu.be/7IZlR6aV8Io

The lung point may not be found with a very large pneumothorax, especially when the patient is supine, as the collapsed lung may only contact the pleura at an extremely posterior location.

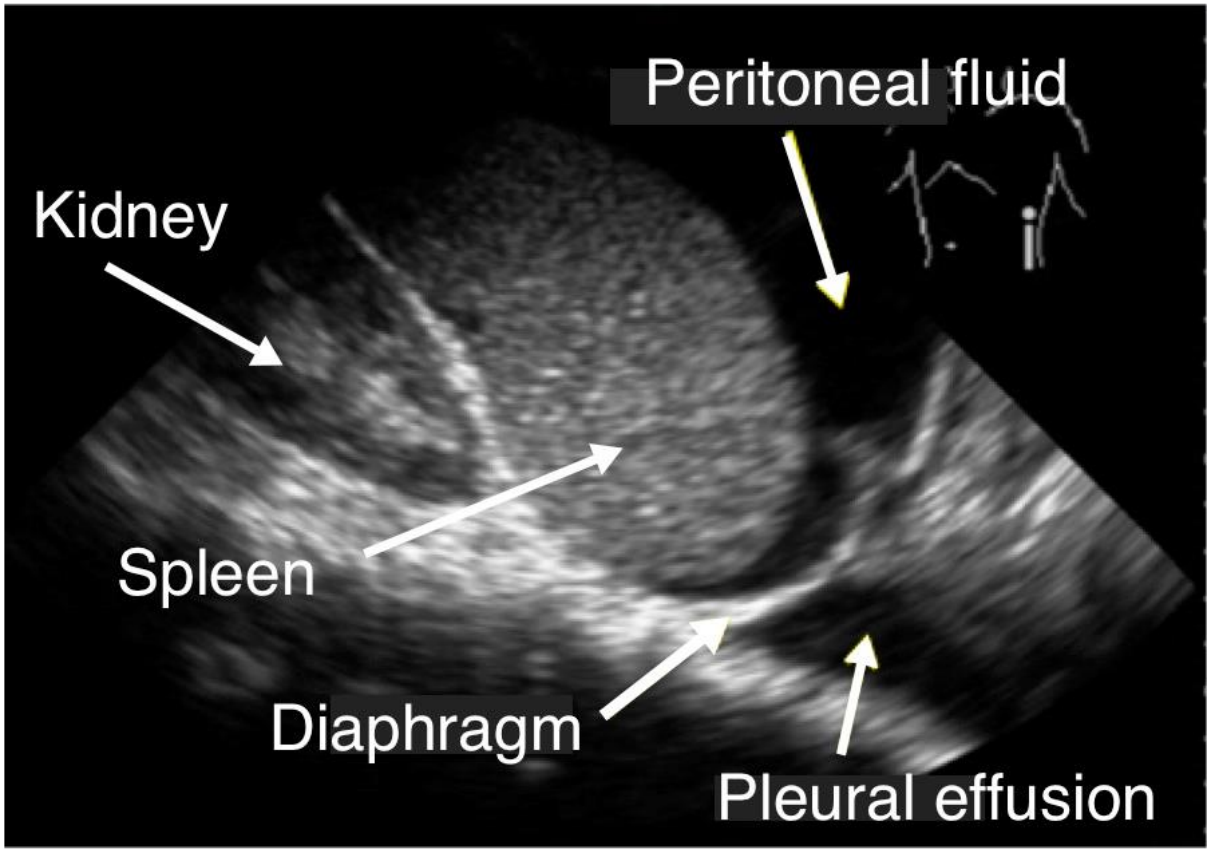
Pleural effusion/consolidation

Pleural effusion

The typical sonographic appearance of pleural effusion is an anechoic (black) area between the parietal and visceral pleura, which usually changes size with respiratory movements. Because fluid is an effective transmitter of ultrasound, a pleural effusion can easily be detected with ultrasound, and the underlying lung pathology such as atelectasis and consolidation directly visualised. The heart and aorta may also be visualised through an effusion. Lung ultrasound is more accurate than supine chest X-ray and is as accurate as computed tomography for detecting effusion, LUS is more accurate than chest X-ray in distinguishing between effusion and consolidation and is also able to detect much smaller effusions. Pleural effusions are commonly seen in patients with cardiac failure, malignancy
and after cardiac or thoracic surgery.



Pleural effusion. A pleural effusion is seen here as a large hypo-echoic area beneath the chest wall



Peritoneal fluid The key landmarks are the diaphragm, kidney and spleen. Peritoneal fluid is seen here between the spleen and diaphragm.

Consolidation

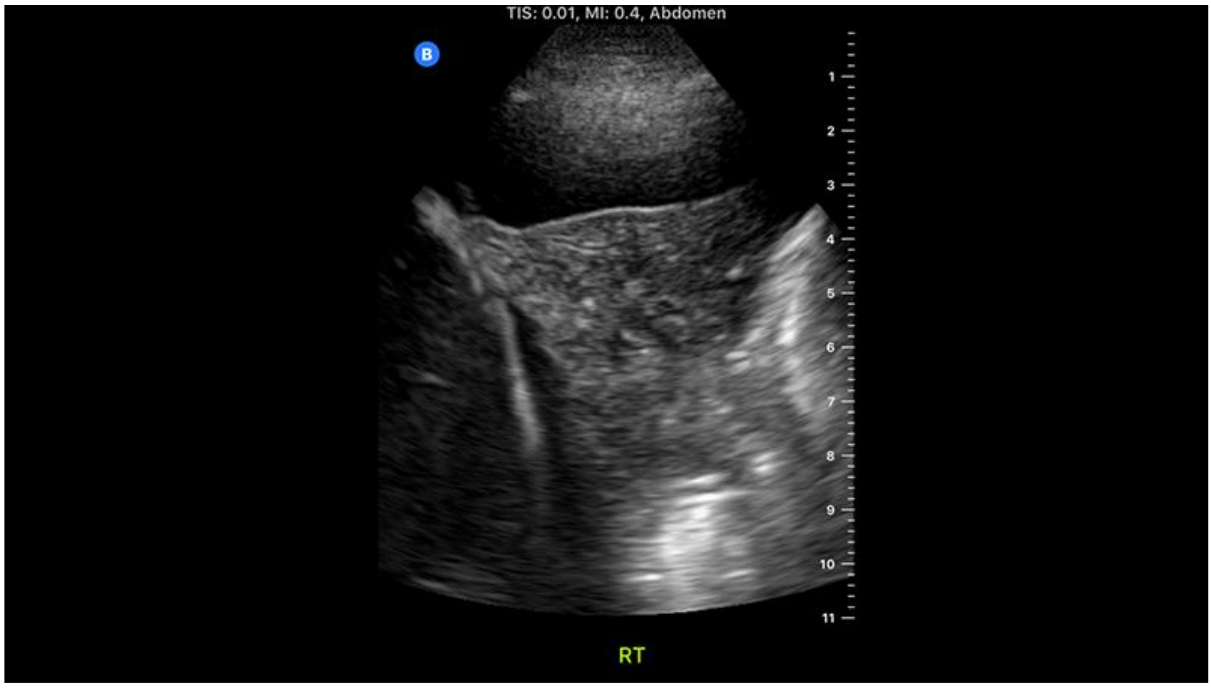
Lung consolidation is easily seen with ultrasound because the lung alveolar air spaces have become filled with fluid, which allows the transmission of ultrasound. Consolidation appears on ultrasound as grey and 'tissue-like', similar to liver tissue (hepatisation), as the homogenous patches of lung are separated by structures which resemble blood vessels. However, unlike liver, consolidated lung commonly still contains cartilage-walled and airfilled bronchi, seen as hyperechoic dots and branching streaks.

Consolidation can have a variety of causes including infection, cancer, contusion and pulmonary embolism. Differentiation of these pathologies with ultrasound may be aided by the quality of the deep margins of consolidation, and the presence of air, fluid and vascular patterns within the consolidation. Lung ultrasound is better than chest X-ray in diagnosis and distinguishing different causes of consolidation in mechanically ventilated patients and in patients presenting with pleuritic pain. It is superior to chest X-ray in diagnosing pneumonia in a variety of clinical settings.

Consolidation may show sharp edges adjacent to the normal lung ultrasound pattern (A lines with pleural sliding) with lobar involvement. More commonly, there is a transition zone of interstitial oedema (B-lines) between the consolidated area and adjacent normal lung, beside or deep to the consolidated area. This has been termed the 'shred' sign.

A low-frequency probe with a large footprint such as a curvilinear or phased array probe is usually required to sufficiently image the full extent of a pleural effusion. Effusions are usually not loculated and will collect in the dependent zone of the chest and will therefore mainly be detected in the lower/dependent areas, whether the patient is supine or upright.
It is important to routinely identify the diaphragm to avoid confusion of pleural fluid with peritoneal fluid. Failure to do this may result in intraperitoneal placement of the drain or needle. Very rarely, there may be confusion

between a vascular structure and free fluid, and the use of colour flow or pulsed wave Doppler may identify the vessel.



Lower lobe lung consolidation with adjacent effusion and diaphragm

4. Gastric Ultrasound

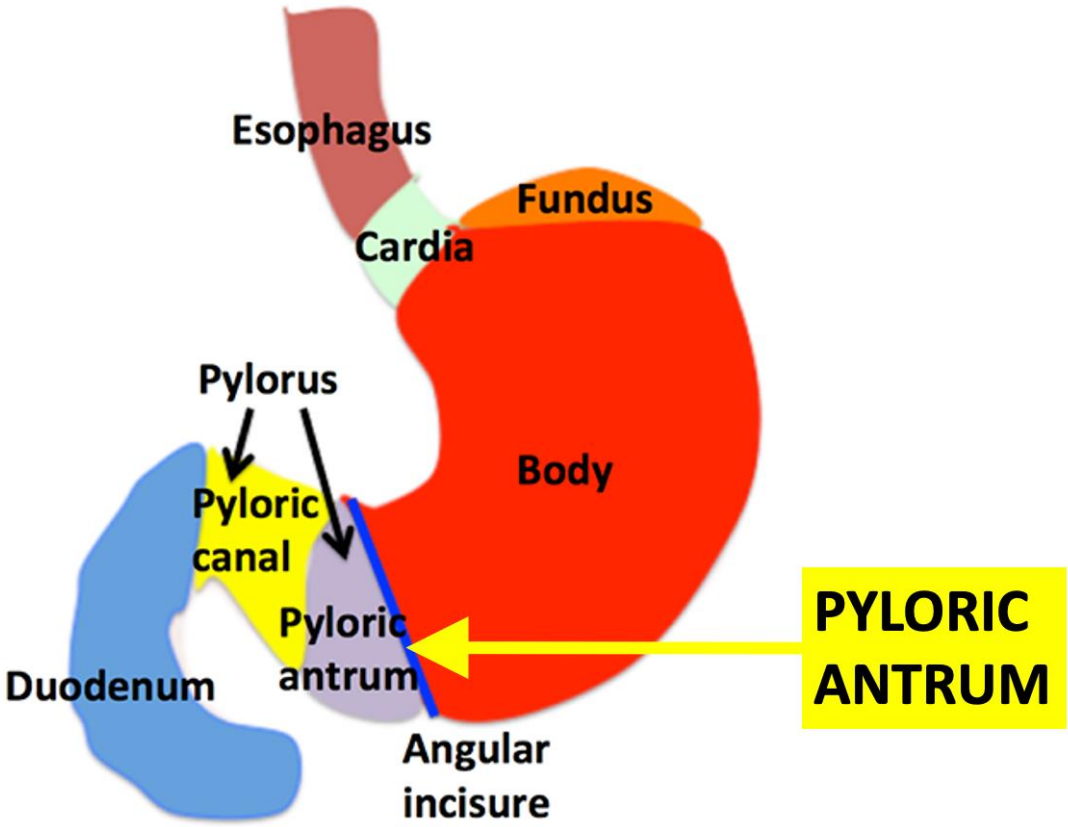
Pulmonary aspiration of gastric contents is a rare but potentially lethal and preventable complication of acute reduction in conscious state, such as from critical illness or induction of anaesthesia.

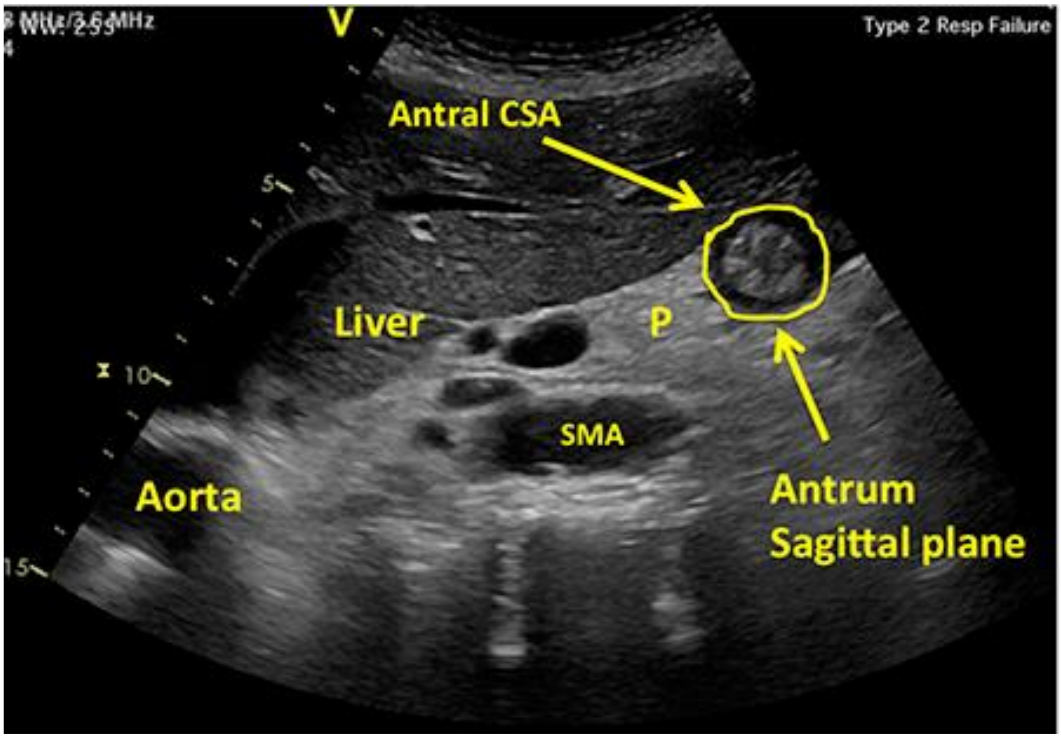
Gastric ultrasound may be used in real-time to assess whether the stomach is empty or contains fluid or solid matter. This may be useful of performed prior to airway intervention or anaesthesia. If a stomach is identified to be 'dangerous', that is containing a significant volume of fluid or solids, this warns the physician of this risk and provides an opportunity to empty the stomach prior to airway manipulation.

Sono-anatomy

For gastric ultrasound assessment, the pyloric antrum is the best-visualised and reproducible region of the stomach. It is the portion of the stomach where solids sit and are processed into particles of less than 1mm in size. For this reason, the antrum is the prime target of gastric ultrasound assessment of contents.

The probe is positioned to obtain a cross-sectional (short axis) view of the antrum, so this will appear as a circular structure.





Probe selection

A curvilinear abdominal probe (2-5MHz) probe provides optimal image acquisition with good depth penetration and resolution enabling identification of the key landmarks and assessment of stomach contents. A phased array

(transthoracic echo probe) may surface in the absence of a curvilinear probe, and paediatric cases can be assessed using a linear probe.

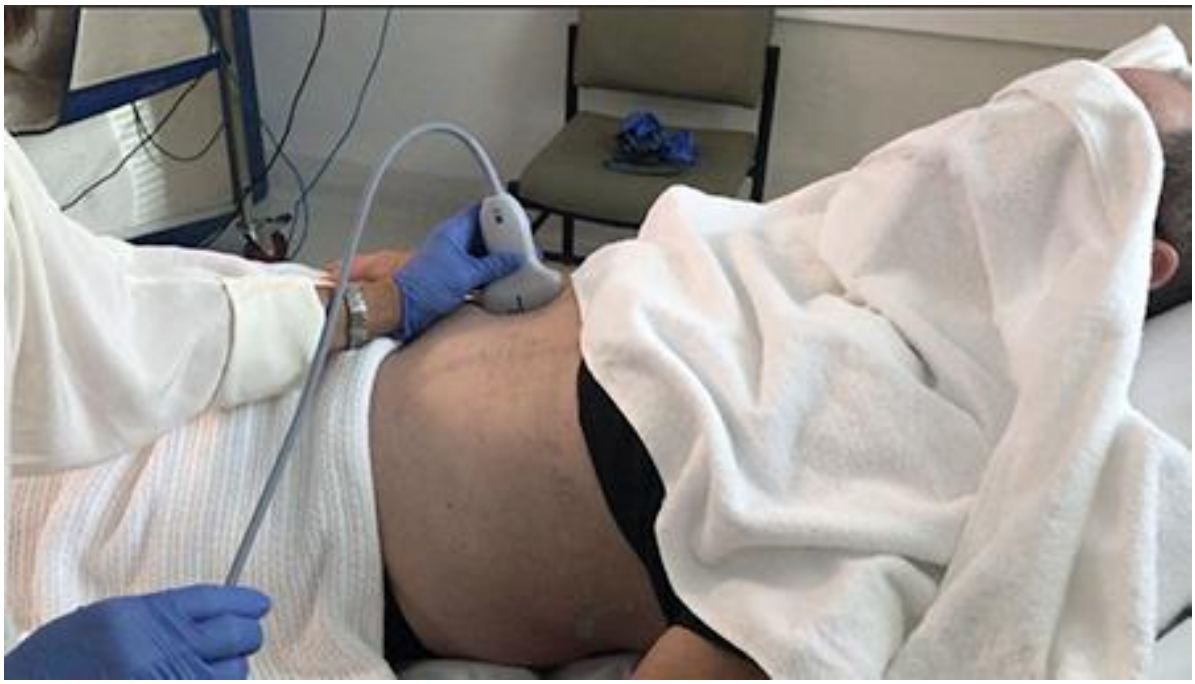
Patient position

The right lateral decubitus position should be used whenever possible as the gastric contents fall into the pyloric antrum and air is displaced into the upper stomach or oesophagus. This improves reliability and image quality. Where this position is contraindicated or impractical, he supine or recumbent position may be used (limited to 30 degrees).

Images may be improved by recording them at end-inspiration when the stomach is displaced inferiorly (and towards the probe).

Scanning technique

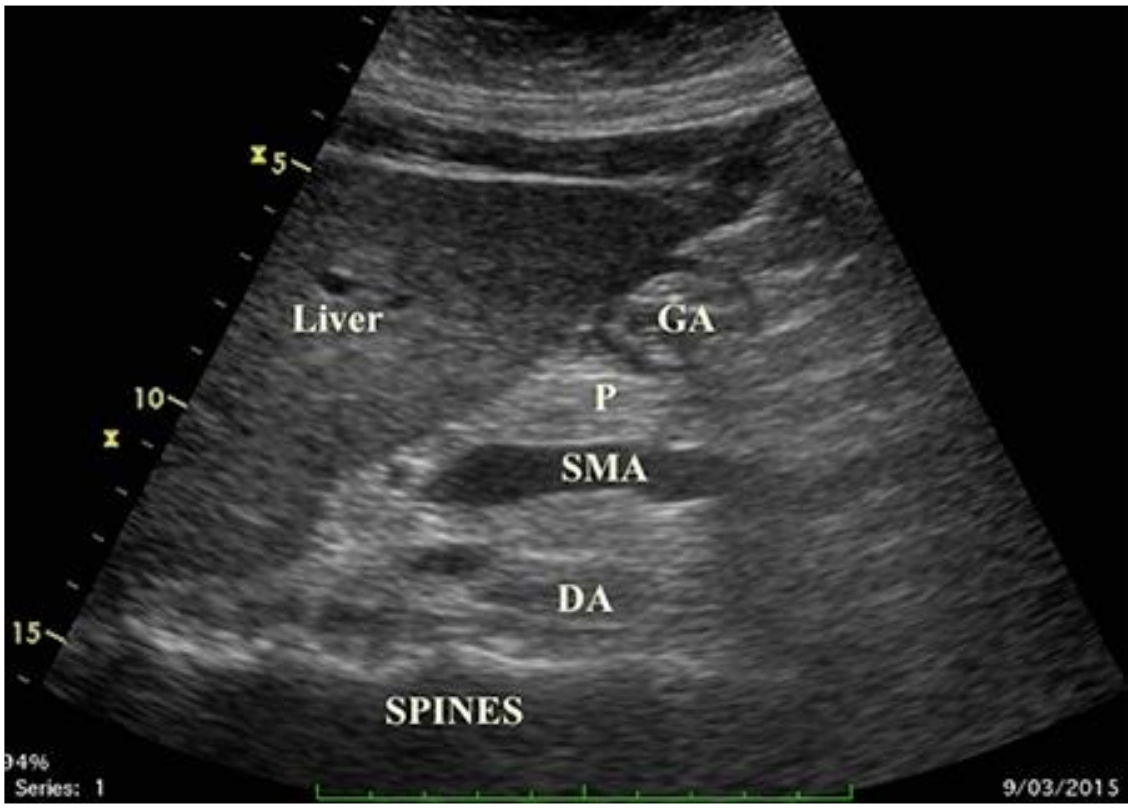
The probe is initially placed in the right epigastrium oriented in a para-sagittal plane (vertical), with the orientation marker positioned such that the head (superior) is to the right and the feet (inferior) is to the left.



Initial probe placement - epigastric, parasagittal plane to obtain the short axis view of the antrum.

First find the liver (figure below) by translating the probe to the left and right, maintaining a perpendicular and superoinfero/vertical/saggital alignment of the probe. The lower lobe of the liver should appear as a ‘tongue’. Beneath this tongue of liver will be gastric antrum, large vascular structures and the spine.

The objective is to obtain the short axis view of the gastric antrum.

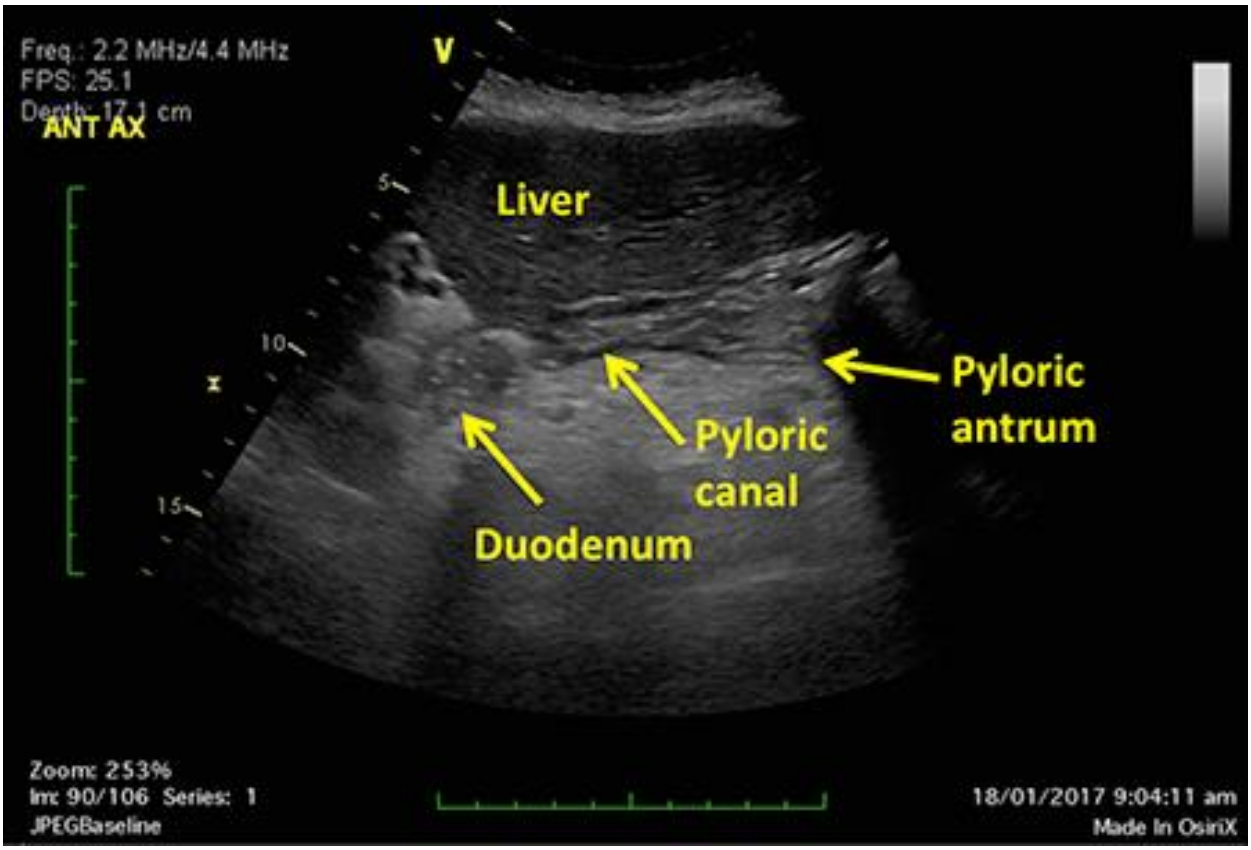


Short axis view of the antrum.

Adjust the depth setting such that the vascular structures below can be seen. This includes the abdominal aorta and inferior vena cava (IVC).

The aorta may be identified by its pulsatile nature, while the IVC may collapse on deep inspiration. To provide a consistent plane of assessment in gastric ultrasound the probe beam should be adjusted to visualise the leg lobe of the liver proximally and the superior mesenteric artery as the deep anchor.

Further confirmation of structures can be performed by rotating the probe into an axial plane to visualise the antrum, antro-pyloric junction and duodenum (third figure below). The pyloric canal may be distinguished from the pyloric antrum due to its thicker muscular layer.

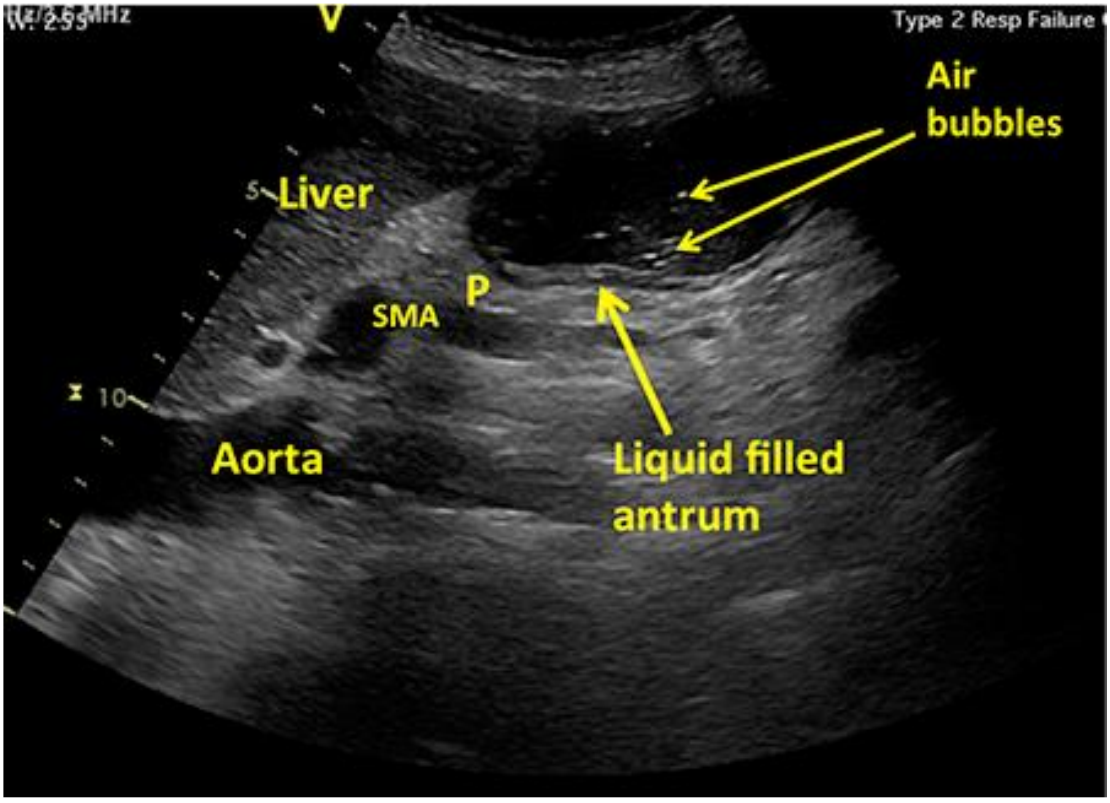


Ultrasound image of gastric antrum-axial plane.

Fluid in the Stomach

Clear fluid in the antrum appears distended, containing a hypoechoic (dark) or anechoic (black) lumen. The gastric wall appears distended and the walls have a thinner appearance by comparison to the contracted empty state.

Initially ingested gas bubbles give an initial ‘starry night’ appearance due to gas bubbles trapped within fluid. Over time bubbles coalesce forming larger hypoechoic regions that cast an acoustic shadow. This may have a similar appearance to nasogastric tubes – which appear as small hypoechoic area in the short axis, and two parallel thin white lines in the long axis (figure below).



How to Estimate the Volume of Gastric Contents

Estimation of the volume of gastric contents may be useful to help warn the clinician of the risk of pulmonary aspiration of gastric contents during airway manipulation under anaesthesia or sedation.

In the fasting state the gastric volume is usually small, containing only up to 1.6mL/kg. For an adult a fasting volume is typically 75 to 150mL. In a non-fasted state, the stomach can hold several litres of fluid and if this is aspirated it can quickly lead to severe respiratory failure and cardiac arrest.

The gastric volume can be estimated using either the cross-sectional area or using 2 linear dimensions made perpendicularly to each other using equations devised by Perlas et al.

Cross sectional area (planimetry):
GV (ml) = 27.0 + (14.6 x CSA (cm^2)) − 1.28 x age (yr)

Cranio-caudal and antero-posterior diameter:
SA= (anteroposterior diameter x craniocaudal diameter x π)/4

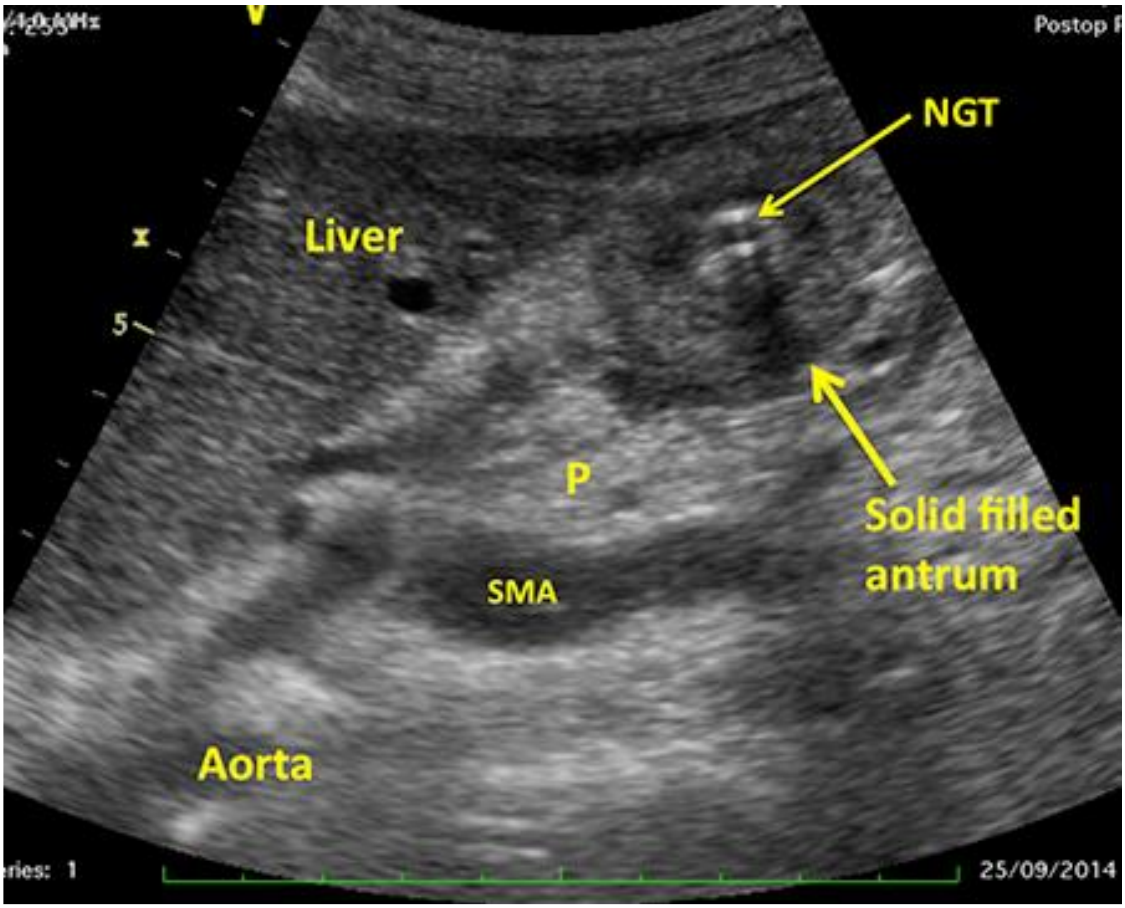
This formula is highly accurate with a mean difference of only 6ml between the predicted and measured volumes. However, it is applicable only to adult, non-pregnant subjects with body mass index up to 40 kg/m^2. It predicts volumes of up to 500 ml.

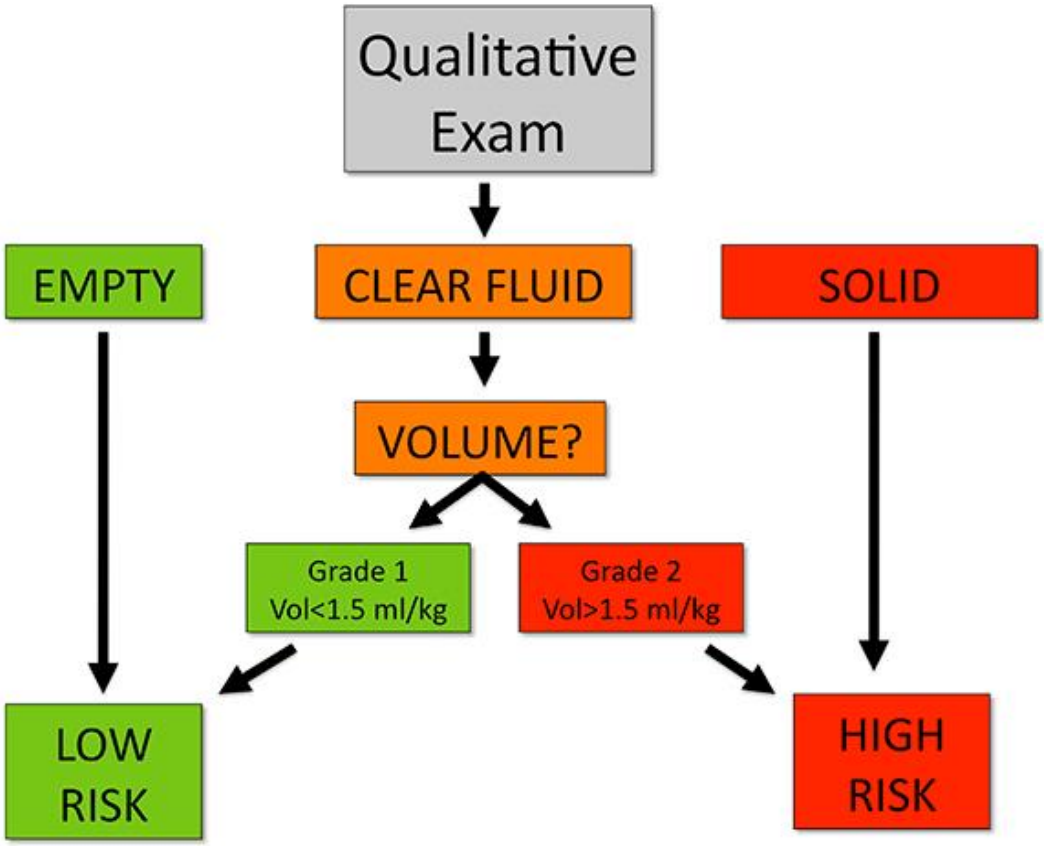
Alternatively, a table has been devised that can be used to estimate volume using the CSA without requiring a calculation using the Perlas formula.

Food in the Stomach

After initial ingestion a food bolus consists of masticated food, fluid and air and hence usually appear quite complicated on ultrasound. The key is to identify the antral wall surrounding the matter. It is especially important here to locate the familiar anatomical landmarks (liver, IVC and aorta) to be confident of identifying the antrum. The presence of air bubbles can produce hypoechoic regions that cast an acoustic shadow. Ring down arrtifacts can be seen that blur the posterior wall of the antrum. It can be difficult to determine the size of the stomach.

With ongoing digestion in the stomach and dissipation of the air bubbles, ingested food takes on a ‘frosted glass’ appearance, and as the artefacts disappear, making the antrum easier to appreciate (figures below).





Ultrasound of Other Stomach Regions

Ultrasound assessment of the gastric body and fundus may be useful for other indications (such as confirmation of gastric tube placement), however they are not reliable for assessment of gastric volume and contents.

5. DVT Ultrasound

Venous thromboembolism, which comprises deep venous thrombosis (DVT) and pulmonary embolus (PE), is the third most common vascular disorder in Caucasian populations. In Australia, DVT alone (without concomitant PE) affects 52 persons per 100 000 annually. It has been suggested that many cases of DVT are not diagnosed.

When there is clinical suspicion of a pulmonary embolus, identification of a lower limb DVT increases the confidence of this important diagnosis. The confidence of this important diagnosis can be further increased by identification of RV strain (dilation of the RV chamber on FCU).

Ultrasound has become the first imaging choice in the investigation of DVT. The examination is in most cases readily accessible, inexpensive and portable and can be performed in a short time. It does however depend upon operator expertise and can be limited by patient factors.

The inability to completely compress the vein with the ultrasound probe has an equivalent accuracy (false positive and negative predictive value) to formal venous "duplex" ultrasound, which is visualisation of a thrombus within the vein lumen (on 2D imaging) with reduced or absent blood flow in the vein using colour flow and spectral Doppler.

Watch the two videos below.

The first video shows complete compression of the vein, indicating the absence of a DVT.
https://www.youtube.com/watch?v=F34VMzz21XE

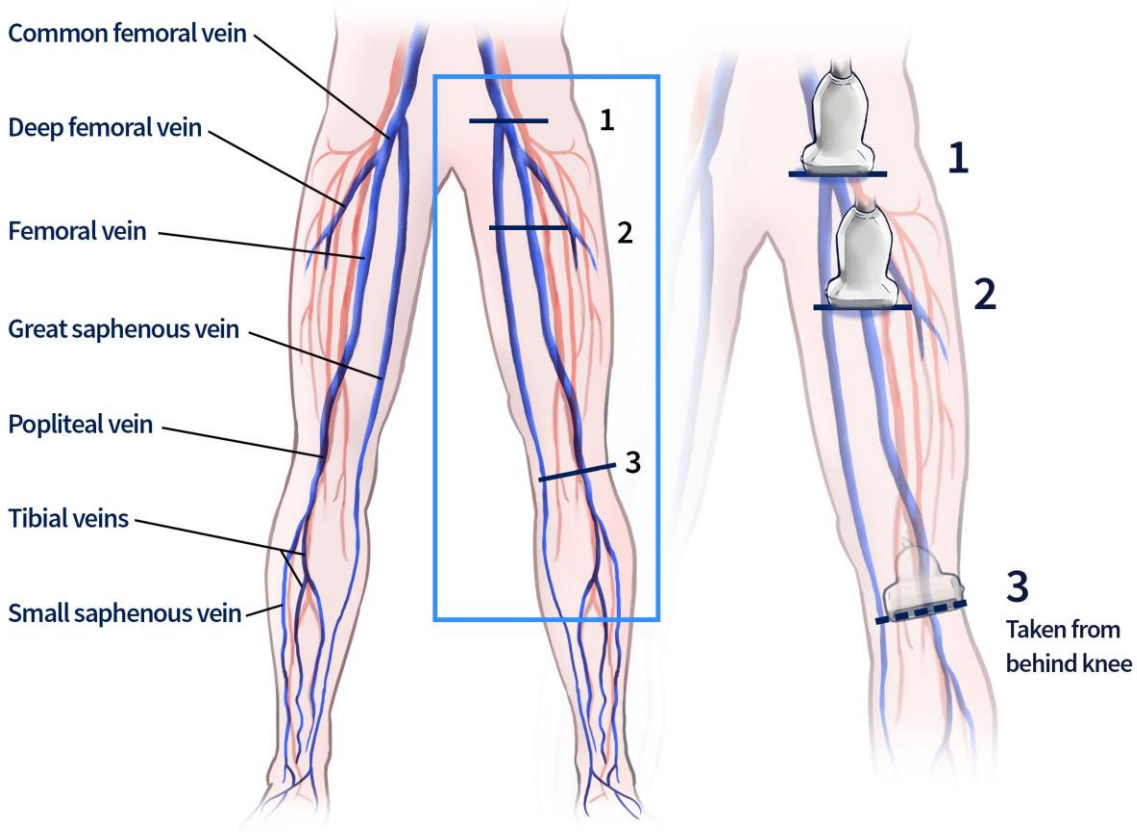
The second video shows the partial collapse of the vein, indicating the presence of a DVT.
https://www.youtube.com/watch?v=QRsZw_ZrH14

Compression ultrasound DVT technique can be easily taught to non-radiologists and nonsonographers, enabling point-of-care application, and therefore potentially saving considerable time and cost in referring patients to the medical imaging department. This technique is usually referred to as lower limb venous two- or three-point compression ultrasound, depending on the number and site of compression points, or point-of-care extended compression ultrasound.

Anatomy and overview of the sequence of DVT ultrasound

Knowledge of the venous anatomy of the lower limb is essential for the correct identification of vessels. There is some variation in the literature regarding the naming of the veins, which can cause confusion, and there has been the standardisation of nomenclature in an attempt to reduce this. Even describing the course of blood vessels and their branches or tributaries can cause confusion, as anatomical descriptions commonly follow the flow of venous blood from distal to proximal, whereas the clinician will usually scan with ultrasound from proximal to distal. The venous drainage of the lower limb is also subject to anatomical variation, and an awareness of common venous variants is helpful.

The following diagrams summarise the underlying anatomy, typical images, probe positions and sequence of proximal DVT ultrasound. It is reproduced from a review article on the subject (Canty, D., Mufti, K., Bridgford, L., & Denault, A. (2019). Point-of-care ultrasound for deep venous thrombosis of the lower limb. Australasian Journal Of Ultrasound In Medicine. doi: 10.1002/ajum)



Deep vein lower extremity anatomy and DVT sequence.

Lower Limb Proximal DVT Ultrasound Technique

The positioning and most important points on how to perform an above knee “3 point” compression proximal DVT ultrasound exam is covered in the following video.

The video demonstrates how to perform a DVT ultrasound exam, using the three main “points” of compression.

https://youtu.be/smt5sVU3yUI

Ultrasound for everyone – How?

Dr David Canty

Associate Professor of Anaesthesia, Monash University, Melbourne

So, you'd like to learn how use ultrasound or boost your skills in ultrasound to enhance your clinical practice. In this presentation you will learn how to fast-track your ultrasound training without having to leave your clinical institution. The presentation will include a guide on affordable hand-held ultrasound equipment, use of simulators to gain confidence and how to start scanning patients to improve your clinical diagnosis, haemodynamic monitoring, and percutaneous procedures as well as a guide on how to navigate credentialling.

Research in anaesthesia update

Professor Tim Short

Specialist Anaesthetist, Auckland City Hospital and University of Auckland

The ANZCA Clinical Trials Network (CTN) has run a busy programme of clinical outcomes research since its inception 12 years ago. Projects have centred around re-evaluating commonly used anaesthetic drugs and procedures where a diversity of strongly held views are expressed, but good quality evidence as to what is best is lacking. I will review some of the programmes of clinical research we have been involved with and where they are heading. There are a number of current major studies that are in their early stages that hospital departments with keen anaesthetists are welcome to join.

ENIGMA 1 & 2 Eliminating nitrous oxide in the gas mixture for anaesthesia. PI Paul Myles, Melbourne.
These studies kicked of the CTN. Nitrous was under attack, but had never undergone a formal safety evaluation, in fact its use pre-dated the existence of both the FDA and Fisherian statistics. The Enigma 1 study of 2050 patients gave a strong hint that the theoretical issue of cardiac toxicity causing MI and death may also be a clinical problem. The 7112 patient Enigma 2 study definitively nailed the answer and found that short term use in our setting did not increase complication rates, and the well-known issue of nausea was transient and easily treated. Long-live nitrous oxide!

Relief . Restrictive versus liberal fluid therapy for major abdominal surgery. PI Paul Myles
This ended up as a 2983 patient comparison of 3.7L with 6.1L of IV fluids within 24 h of surgery in patients having major procedures. There was no difference in the primary outcome of disability free survival at 1 year or how long patients stayed in hospital. However patients in the restrictive group had a higher incidence of acute kidney injury. The study ended a trend in anaesthetic practice that was based on opinion, good ideas and optimism, but lacked evidence.

Balanced 1 & 2. Anaesthetic depth and complications after major surgery: an international randomised controlled trial. PI Timothy Short, Auckland.
Balanced was a 6644 patient study comparing BIS 35 with BIS 50 anaesthesia in sick elderly patients having major surgery. This was the first large anaesthesic outcome study run out of New Zealand, and we offer a further special thanks to all the anaesthetists from 12 NZ hospitals who helped us recruit 1358 patients into it. We found no difference in 1 year mortality or serious complications. A 600 patient substudy of delirium however found significantly more delirium in the deep patients and also longer hospital stays and more cognitive dysfunction. Metaanalysis including this result tilts the balance toward unnecessary depth causing more delirium and possibly worse neurocognitive outcomes. More evidence is needed.
Balanced 2 (PI Carolyn Deng) is now planned and we have approached possible funders. The study will be of 2766 sick elderly patients presenting for major surgery and randomised to deep or light anaesthesia. Both volatile and intravenous anaesthesia will be acceptable and all brands of depth monitor may be used. The primary outcome will be the incidence of post-operative delirium. Secondary outcomes will include neurocognitive function, days alive out of hospital, all-cause mortality and awareness at 90 days.

PADDI Perioperative administration of dexamethasone and infection. PI Tomas Corcoran, Perth.
PADDI was an 8880 patient non-inferiority study of whether dexamethasone increases perioperative surgical-site infection. Patients received 8mg of dexamethasone or placebo and were followed up for 30 days after surgery. The incidence of infection was similar in each group at 8.1% for dexamethasone and 9.1% for placebo (CI95 –2.1 to 0.3) -a result close to the border for superiority of dexamethasone! There was also no difference in the incidence of infection in the 1154 diabetic patients in the study, but a 0.4% increase in the incidence of hyperglycaemia in diabetics.

POISE 1,2 & 3 Perioperative ischaemia evaluations. PJ Devereaux, Canada

Poise-1 studied 8351 patients at risk of atherosclerotic disease randomized to metoprolol or placebo. There was

a 1.5% absolute reduction in cardiac events, but a 0.8% increase in mortality, mostly due to a doubling of the incidence of stroke, this has led to a reduction of use of betablockers in the perioperative period.
Poise-2 studied aspirin and clonidine in 10,010 patients at risk of atherosclerotic disease. Clonidine was also found to not decrease the incidence of cardiac events or death. There was a 0.2% increase in the incidence of non-fatal cardiac arrest in the clonidine group. Continuation of aspirin did not decrease myocardial events but led to a 0.8% increase in major bleeding. The conclusion was with-hold aspirin.
Poise-3 was designed firstly to determine if tranexamic acid reduces the incidence of life-threatening, major, and critical organ bleeding, and whether it increases major arterial and venous thrombotic events; and secondly to determine the impact of a hypotension-avoidance strategy (stop most antihypertensives, aim MAP>80) versus a hypertension-avoidance strategy (continue all antihypertensives, aim MAP>60) on the risk of vascular death and major vascular events within 30 days of noncardiac surgery. Patients were over 45 and either undergoing major surgery or with a history of IHD.
The study stopped at 9507 patients due to a lack of funds, but an event rate above that predicted, which maintains study power. TXA significantly reduced major bleeding, HR 0.76 absolute reduction from 11.7% to 9.1%. Cardiovascular events occurred in 14.2% after TXA and 13.9% after placebo. This is a very small questionably relevant increase in cardiac thrombotic events. The hypertension and hypotension avoidance studies were bedevilled by a high non-compliance rate with the protocol, but showed no evidence of harm from continuing ace inhibitors and calcium antagonists during the perioperative period.

The Cogpoise substudy of post-operative delirium and cognitive dysfunction recruited 2816 patients and the NT-proBNP substudy of using BNP as a predictor of badness at 1071 patients. Results are awaited.

ROCKET Reduction of chronic post-surgical pain with ketamine. A multicentre double-blind parallel-group placebo controlled, randomised trial of the effect of perioperative ketamine on the risk of development of chronic post-surgical pain. PI Phil Peyton, Melbourne.
This 4884 patient study gained a large NHMRC grant in Australia, where patient recruitment started over 18 months ago. We finally have our approvals in place and the study has commenced in NZ. The target group are patients undergoing surgery with an incision over 8cm long with a post-operative opioid plan for analgesia. The ketamine arm receives an infusion of ketamine from before surgical incision to at least 24h post op. The primary outcome is the incidence of chronic post-surgical pain at 3 months. Other outcomes include 12-month outcome, perioperative pain severity, incidence of delirium, hospital stay etc. We hope this study will answer our questions about the place of ketamine in anaesthetic practice.

VAPOR-C Volatile anaesthesia and perioperative outcomes related to cancer. PI Bernhard Riedel, Melbourne.
This is a 5736 patient international, multicentre, randomised trial of inhalational versus intravenous propofol anaesthesia and also intravenous lignocaine/placebo to improve disease-free survival after cancer surgery that has been funded by NHMRC in Australia with supplementary funding from AMRF in NZ. All cancer surgery done with an intention of cure is included. We hope to start recruitment this year. This study should answer a lot of questions about the relative merits of TIVA versus volatile anaesthesia and also about some of the theoretical advantages of lignocaine in these patients.

LOLIPOP Long-term outcomes after lignocaine infusions for postoperative pain. PI Tomas Corcoran, Perth.
This is a 4400 patient international, multicentre, randomised trial of lignocaine infusion for the reduction of chronic post-surgical pain following operations with a high incidence of this complication. It is funded by NHMRC. This study should provide good quality patient centred outcome data on the effectiveness and safety of lignocaine infusion as a post-operative analgesic. There will also be a pharmacokinetic substudy as the narrow therapeutic index and lack of good PK data in the elderly means varied results from past studies may be a result of inconsistent plasma concentrations. We will be going through the compliance process later this year for NZ.

ATACAS and TRIGS Tranexamic acid to reduce Infection after gastrointestinal surgery. PI Paul Myles, Melbourne.
Atacas was a 4662 patient study of the hazards of using aspirin and tranexamic acid in cardiac surgery. Aspirin

neither increased bleeding nor prevented thrombotic events. TxA was associated with a 1.4% lower absolute risk of bleeding without increasing thrombotic complications in this setting, however there was a signal of increased seizures. A substudy of 613 patients found a 5% absolute risk reduction in infection rates.
Trigs is another large, multicentre clinical trial of TxA, funded by NHMRC. The aim is to study 3300 patients and determine whether TxA: reduces surgical site infection and other healthcare-associated infections such as pneumonia and sepsis; reduce red cell transfusion in GI surgery; reduce a composite of any serious postoperative complications, and so increase "days alive and at home up to 30 days after surgery"; and to evaluate the temporal effect of TxA on perioperative immune and inflammatory responses. We are nearly ready to start recruitment in NZ.

Masterstroke. Management of systolic blood pressure during thrombectomy by endovascular route for acute ischaemic stroke: a randomized clinical trial. PI Doug Campbell, Auckland.
Thrombectomy for ischaemic stroke done within, preferably, 6 hours of onset is associated with a profound reduction in long term disability and is significantly more effective as a treatment than thrombolysis. Surprisingly there is very little guidance on BP management in these patients, or indeed in stroke patients in general. This study compares a target systolic pressure of 140mmHg with 170 mmHg in 550 patients. The primary outcome is modified Rankin score of disability at 90 days and secondary outcomes are functional outcome and days at home in the first 90 days post stroke. The study is a milestone in developing lean outcome studies as all the postoperative data come from service databases. The study is only relevant to the three NZ centres that do clot retrieval, but the result will have much broader applicability.

SNAP Sugammadex or neostigmine and pulmonary complications. PI Kate Leslie, Melbourne
Sugammadex is a more effective reversal agent for some muscle relaxants than neostigmine, but expensive. Reliable complete reversal of neuromuscular block may reduce respiratory and other complications of anaesthesia but has not been adequately evaluated and the relative risks of the two agents are unknown. This is a 3500 patient study, we have applied for funding, here's hoping…

Further use of CTN trial data

Inclusion characteristics and outcomes of male and female participants in large international perioperative studies. PI Kate Leslie, Melbourne. Kate has combined data from 11 large outcome studies that the CTN has been involved with, totalling ~55,000 patients to investigate whether there are disparities in outcomes between male and female patients that would indicate gender bias in their treatment. No differences were found that were not accounted for by underlying patient pathology. It was noted that selection bias in who surgeons choose to treat could not be ruled out.

Quality of Recovery-15 Scores An analysis of use of the QoR-15 score in various anaesthetic trials found that it was a strong predictor of poor post-operative outcome. We are now looking at seeing whether it is a useful in the recovery room to discriminate patients in which escalation of care is indicated.

Maori Health Outcomes. We are required to gather data on ethnicity but numbers are not sufficient to analyse from the point of view of outcome. Combining all the studies above we have sufficient Maori recruited to determine if there are disparities in perioperative outcomes that need to be addressed.

Midazolam. We have sufficient data from high quality prospective studies of delirium to answer the observation that midazolam may be associated with an increased incidence of post operative delirium.

Future Directions
These big studies are expensive and future funding is uncertain. We are looking at simplified randomized study designs, for instance by using the National Minimum Data Set (NMDS), which is Health Department data for all operations in NZ, for the outcome data. This database includes days in hospital, days alive out of hospital and mortality. Doug Campbell's Masterstroke study is our flagship for this approach.
The results have often been controversial, and it is always interesting to hear what anaesthetists make of them, but they form a strong body of evidence from which to tailor our anaesthetics to individual patients. We thank all hospital departments and their research leaders who have been involved in these studies and invite all

departments in NZ to get involved in studies that seem relevant to their case mix and interests. The studies are interesting to do, and the outcomes are more relevant to us if we recruit actively into them. **Rocket, Vapor-C, Trigs** and **Lollipop** are all open for business.

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Paediatric anaesthesia update

Dr Elsa Taylor

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A year of Pediatric Anesthesia publications were reviewed, 3 papers[1–3] on topical but disparate areas within the sub-specialty were chosen. None of these publications or pieces of research are definitive, all are open to criticism wrt methodology, all however address an important or difficult question for our specialty. They form the nidus for a brief update in each of these areas.

The three topics touched on are

1) Pain management post -tonsillectomy
2) The impact of language on stress and anxiety in hospitalised children
3) The long-term neurological outcome following neonatal surgery

For all three papers I will briefly summarise current knowledge, then reflect on what the paper adds and next outline knowledge deficits and gaps that remain.

Pain Management post-tonsillectomy

Impact of a revised postoperative care plan on pain and recovery trajectory following pediatric tonsillectomy; Ped Anes 2021 31(7) 778-786

Background and what is Known

1) Up to 75%[4] of children report severe pain following tonsillectomy
2) Pain resolution generally occurs over 1 week to 10 days
3) Patterns of pain are not consistent ie peak tends to be day 2/3 and then decrease over a week in about 2/3, however for 1/3 continued moderate pain out to one week and beyond[5]
4) Analgesic use is suboptimal[4] – what is prescribed is not given regularly by parents and even when parents report their child has moderate or severe pain many parents give no analgesics
5) Analgesic prescription at discharge may be suboptimal or absent
6) NSAIDS in addition to paracetamol are superior to paracetamol alone[5]
7) Paracetamol and NSAIDS may be insufficient for 30% of children in the first few postoperative days
8) Many centres are recommending strong opioids for home discharge
9) There are frequent representations (>30%) in the week following surgery and many of these are for pain control

The paper

1) Premise: Solutions to insufficient analgesia have been postulated to include parental education, clear and thorough written information, ensuring appropriate prescription at discharge, advice to give paracetomol and NSAID regularly and strong opioid for rescue
2) Methods: In response to a prior audit at the author's institution a protocol discharge script and clear parental education, written information and parental coaching prior to discharge and an analgesic diary were introduced. Regular paracetamol and ibuprofen with prn rescue oxycodone were prescribed. Ongoing regular nursing education to support parental education was established.

Outcomes reported

3) A script at discharge was present for >90% of patients at discharge for paracetomol and ibuprofen cf 55% in the prior epoch.

4) 90% children receive analgesia on first 7 days but only 53% received the full regular regime for the first 5 days
5) For children who had their pain rated as moderate to severe by the caregiver only 50% received oxycodone rescue
6) Oxycodone disposal – 40 % of parents disposed of and mostly did not follow the recommendation to return leftovers to the pharmacy/hospital
7) 1/3 had POV or nausea
8) Pain remained poorly controlled. 1/3 severe pain day 2 to 5, mean time for mod/sever pain was 5 days (range 0 to 12)
9) 40% of patients visited GP or ED and for 40% of these visits pain was the reason

What this paper adds

1) Simple education of parents insufficient
2) Prescription, dispensing and administration of simple analgesics has improved but is still suboptimal
3) Greater compliance has not impacted on pain severity, or significant shortening of the time in pain

Further reflections and future directions

4) Need exploration of the reasons for failure to comply with prescribed analgesic regime – can be contributed to by failure to recognise pain, inconvenient dosing schedules, child refusal, parental concern re side-effects or addiction potential, actual side effects or poor understanding (eg if child is comfortable the parent may stop regime and not understand that the child is comfortable because they have stable analgesic concentrations.)
5) Need exploration of failure of analgesia
6) Role of non-pharmacological strategies

What we can do currently (even while acknowledging these are insufficient!)

1) Educate and ensure parents and staff understand importance of regular analgesics and rescue
2) Written information

The impact of language on stress and anxiety in hospitalised children

Adult behavior toward the child before surgery and pediatric emergence delirium; Pediatric Anesthesia 2022 32(1) 43-48

What is known

Stress and Anxiety in children during a hospital visit

1) Stress and anxiety during hospital admission is common
2) peaks at induction of anaesthesia
3) correlates with greater postoperative behavioural changes and these persist for up to 12% at one year
4) Anxiety and coping can be modified by language and non-pharmacological strategies that build coping
5) Parents and HCW often unwittingly use language and words that escalate stress and anxiety in children

Wake up distress or delirium

1) Common in an unmodified anaesthetic
2) Multifactorial – anaesthetic drug choices, distress at induction, child native temperament are all important

What this paper adds

1) Language styles/techniques that are known to escalate anxiety are correlated with wakeup distress
2) Reassurance and giving control of medical choices to the child positively predicted wakeup distress

What we still don't know

1) How do we teach and train staff and parents to optimise language and interactions with children?

2) Can we reduce distress, wakeup delirium and long-term behavioural outcomes in children by communicating more effectively

What we can do now

1) Inform ourselves re: language and nocebo/placebo effects with language
2) Manage anxiety and stress in children with both pharmacological and non-pharmacological techniques
3) Address systems within our institutions

The long-term neurological outcome following neonatal surgery

Intraoperative cerebral oxygen saturation and neurological outcomes following surgical management of necrotizing enterocolitis: Predictive factors of neurological complications following neonatal necrotizing enterocolitis; Pediatric Anesthesia 2022 32(3) 421-428

What is known about perioperative harm in neonates

1) A single short anesthetic is safe[6]
2) Major surgery (>120minutes) and multiple surgeries are associated with mild to moderate brain injury, impaired brain growth and mild to moderative neurodevelopmental outcomes[7]
3) Poorer neurodevelopmental outcome is known after major non cardiac congenital and neonatal surgery such as that for gastroschisis[8], oesophageal atresia and necrotising enterocolitis. There is uncertainty about the relative role of the intraoperative period in relation to prematurity, NICU course, surgery itself and other potential harm associated with /from the underlying congenital condition.
4) The neonatal brain is vulnerable. In this period there is rapid velocity of and multiple complex processes taking place in the developing brain[7].
5) Evidence suggests that the interplay of the triad of vascular immaturity, inflammation and possible drug neurotoxicity/neuroprotection are the likely pathophysiological mechanism[7]
6) Critical events (hypotension and decrease of O2 saturations to <85% the most common) occur during 35% of neonatal anaesthetics [9]
7) Complication are 16% at 30 days and mortality 3.2% at 90 days [9]
8) Co-occurrence of hypotension, hypoxemia and anaemia are associated with increased morbidity[9]
9) Up to 75% of neonates have been reported to have mild to moderate neuroimaging abnormalities such as punctate white matter injury, intraventricular and periventricular haemorrhage and subdural haemorrhage following non cardiac congenital surgery[10]. 11 % are reported to have subclinical peri and postoperative seizures unrelated to demonstrated radiological brain injury.

What is known about the use of NIRS in predicting and preventing neurological harm

1) Evidence (inconsistent) from cardiac surgery and NICU that NIRS may predict the occurrence of neurological complications and MRI lesions. Unknown whether low intraoperative NIRS predicts poor neurodevelopmental outcome[11]
2) Intraoperatively approx. 2% of <6/12 infants have episodes of severe cerebral desaturations[11]
3) Hypotension intraoperatively is common in <6/12 but poorly correlated with cerebral desaturation[7,11]

Study and findings

1) 32 neonates NEC (necrotising entercolitis) surgery
2) 25 had preoperative imaging – all normal
3) 9 had severe neurological outcome (2 IVH and 7 periventricular leukomalacia) at 1 year
4) 7 of those with a poor outcome had not had preoperative imaging (ie injury not definitively attributed to intraoperative period)
5) As expected they were all sicker NEC babies (higher Bell classification),
6) Decrease of NIRS >36% from baseline independently predicted 90% of the patients with severe neurological outcome
7) Nadir of NIRS and decreased NIRS per se are NOT associated with systemic desaturation

What this paper adds

1) Establishes a relationship between intraoperative cerebral desaturation and poor neurological outcome

2) Provides a target to avoid
3) Cerebral desaturation and systemic desaturation are NOT concurrent – the former likely represents cerebral blood flow decrease/poor cerebral autoregulation rather than poor systemic circulation
4) Cerebral saturation is a valuable intraoperative monitor

What knowledge gaps remain

1) Definitive documentation normal imaging preop and abnormal postop and association to NIRS
2) Interplay of CO2, blood pressure, oxygenation, hemoglobin, pulmonary pressures, NIRS and outcome unknown

What we can do now

1) Routinely use NIRS in neonates
2) Respond to low NIRS and low MAP
3) Aim for stability (eg hypertension may also be bad!)

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Cardiology update

Dr Fiona Stewart

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The past 2 years have been dominated by COVID, initially with concerns about the risk of myocarditis and pericarditis from the Pfizer mRNA vaccine and then about cardiac complications of COVID infections. COVID infections are associated with increased risk for myocarditis, arrhythmias and coronary events acutely and in the 2 years following infection rates of coronary events and stroke are increased. In children the multi system inflammatory syndrome MIS-C is also reported. We re beginning to understand the increased risk of surgery (and anaesthesia) in the first 2 months following a COVID infection and Long COVID is occurring in a small but significant number of previously well patients. Long COVID has many features in common with other dysautonomias including POTS (postural orthostatic tachycardic syndrome) and Orthostatic Intolerance. Patients with Long COVID can deteriorate further if anaesthetised. Throughout the COVID period many patients have not received adequate routine medical care and may have poorly controlled hypertension, undetected significant valvular heart disease or biochemical abnormalities.

In assessing risk for coronary disease the new European Guidelines now look at Lifetime Risk as well as 10 year risk. New risk factors have been identified for women including adverse pregnancy outcomes (pre-eclampsia and gestational hypertension, intrauterine growth restriction, gestational diabetes), polycystic ovaries, endometriosis, premature menopause and chest radiotherapy particularly for left sided breast cancer.

The ISCHAEMIA study utilised early CTCA for the assessment of chest pain. Patients with left main stem or proximal LAD disease all proceeded to invasive angiography but for the remaining patients, outcomes were similar with medical therapy or invasive angiography.

The appropriate duration of dual antiplatelet therapy following PCI (and triple therapy with NOACs for patients who also have AF) has been better defined according to patient risk.

TAVI AVR is now the preferred approach for most patients with severe AS aged over 75 but SAVR is preferred in younger age groups.

Several studies have shown the benefit of early rhythm control for patients with AF.

SGLT2 inhibitors are the first class of drugs to show benefit in the management of patients with HFpEF. Their benefit has been demonstrated in patients with HFrEF and in patients with impaired renal function.

Mavacamten an inhibitor of β-cardiac myosin is the first agent that has been shown to reduce hypercontractility in HCM and improve patient symptoms.

A Covid update: everyone's over Covid but Covid's not over us

Prof Rod Jackson

Professor of Epidemiology at University of Auckland, Director of EPIQ

At the time of writing this Abstract (30 June 2022), 10-15 New Zealanders were dying every day with Covid and there were approximately 400 people in hospital. Neither death rates nor hospitalisations have shown any clear sign of falling over the past few months, demonstrating that the effective reproductive rate remains above 1.

Yet many New Zealanders are trying to convince themselves that the pandemic is over and even the Government is unnecessarily loosening up a range of restrictions, due to pressure from multiple sources. For example, on 2 July Border and Corrections workers will no longer be required to be vaccinated.

Trends worldwide remain very mixed. Death rates in Northern hemisphere countries are general relatively low now that summer has arrived, but it seems unlikely that Covid is going away anytime soon. The most recent Omicron subvariants are quite distinct from the initial Omicron variants, with minimal cross-immunity and reinfection within a few months is being increasingly reported. Further, there has been a more rapid evolution of the virus since Omicron emerged. With the significant immune evasion and transmission advantage of newer Omicron subvariants, it has recently been suggested that they should be called 'SARS-3.' To make matters worse, the current vaccines are less effective at preventing severe disease and death from Omicron. Whereas vaccines were over 95% effective at preventing severe disease and death from pre-Omicron variants, this has now fallen to about 80%.

It is also now clear from multiple large studies that long Covid is a real problem affecting between 10 and 30% of infected people. Of further concern, reinfection increases the risk of harmful long-term outcomes.

If we don't 'recharge' our Covid prevention efforts, current trends would translate into at least 3500 further Covid deaths in New Zealand over the next 12 months - about 10% of all deaths. Over half of New Zealanders have already been infected by Covid and most seem unaware of the risk of reinfection and its consequences.

Simple public health interventions like staying home when you are unwell (from both flu and Covid) and wearing a high-quality mask when indoors and other crowded settings have been demonstrated to make a substantial difference to risk and need to be encouraged/mandated. Mask mandates should be reintroduced in schools (probably our most important super-spreading setting) over the winter to reduce the impact of both Covid and influenza.

In New Zealand we need a range of new programmes to encourage and support everyone eligible to get fully vaccinated against Covid-19 and against influenza. Worldwide, we need governments to allocate funding for a new Operation Warp Speed initiative to complete the development of nasal vaccines and variant-proof vaccines.

The new Covid Response Minister, Ayesha Verrall appropriately signaled today (30 June) that New Zealand will remain at the orange traffic light setting, but the huge challenge will be to encourage the majority of New Zealanders to get on board with this.

There is still a lot we don't know about Covid-19 and a new variant could change everything (for better or worse) over a matter of a few weeks or months. Watch this space!

Anaesthesia in developing countries

Dr Brigid Brown

Specialist anaesthetist, Flinders Medical centre and Pulse anaesthetics

Why We Need to Rethink Working Overseas (and why I still continue to go…)

In this presentation I will share my personal experiences in different work environments in low and middle income countries over the last decade and the lessons I have learned along the way.

While my first overseas placements as a final year medical student in Uganda and Tanzania opened my eyes and taught me many things, it was, in retrospect, disorganised, chaotic, and harmful to the patients, their families, and myself. It forced me to rethink the well-intended work being done around the developing world, whether it was actually doing any good, and how it could (AND SHOULD) be done better.

With a lot of reflection, some formal learning and training, and some absolutely amazing mentors and coaches, my practice has evolved and has included teaching and training, short term medical missions with Australian organisations, and slightly longer work with MSF. I have had the opportunity to work in countries across Australia, Africa, South East Asia, the Middle East, the Pacific, and Central and South America.

Within the context of my experience, I want to discuss how overseas work can keep the interests of the recipients as the top priority; creating a mutually beneficial partnership where the focus is on the locals rather than on our experience as western visitors.

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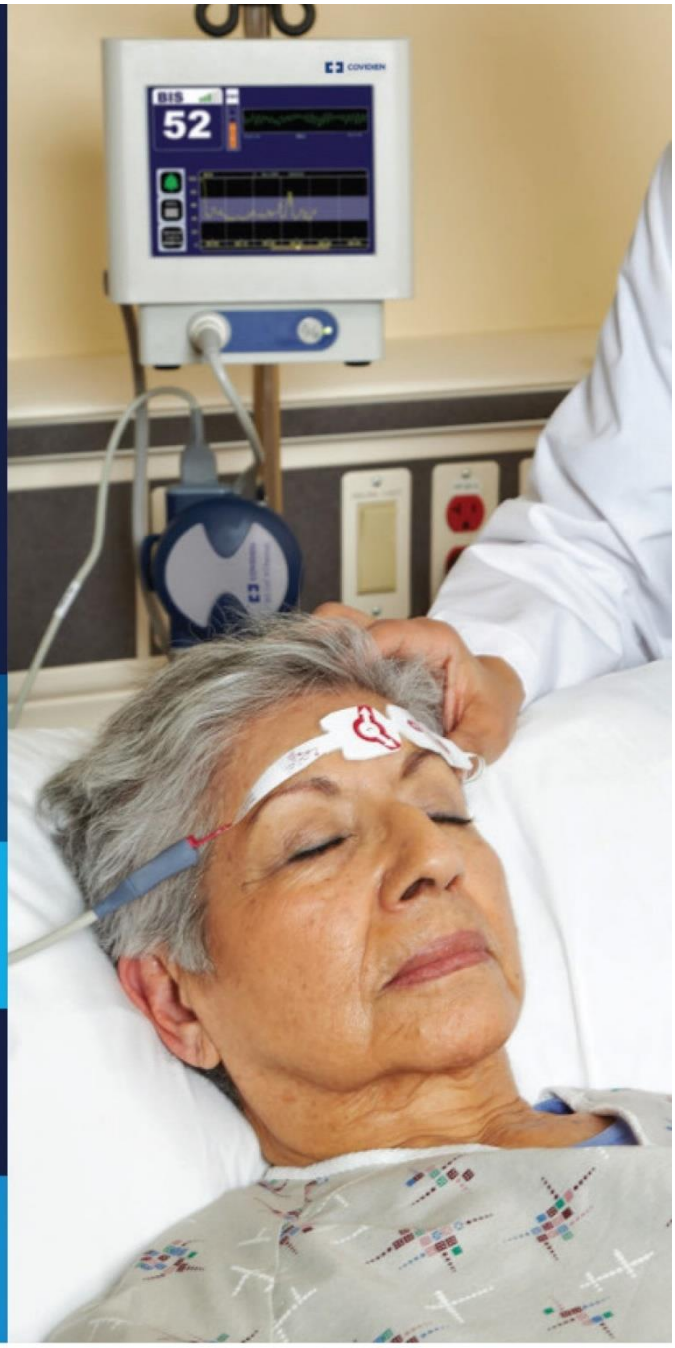

REDUCES:
- Anaesthesia use by as much as 38 per cent[5–11]
- Awareness with recall by 64 per cent[12,13]
- Incidence of post-op complications[7,14,15]
- Costs[12,16,17,19–22]

LESS INCIDENCE OF:
- Post-op delirium in elderly and at-risk patients[7,12,14,15,18,20–22,24]

IMPROVES:
- Patient satisfaction[4]
- Patient outcomes[4,6,19]
- Patient quality of life[4,17]

FASTER:
- Wake ups[5,6]
- Recovery time[4–6,11]
- Discharges from PACU[6]

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The above outcomes are based on comparisons against procedures utilising anaesthesia without depth-of-anaesthesia monitoring.

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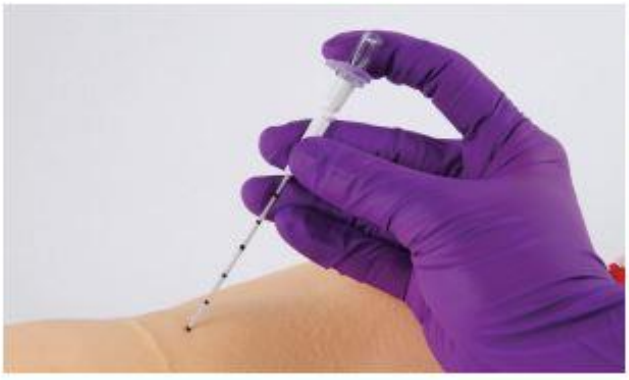

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