

Victorian Audit of Surgical Mortality (VASM)

Case Note Review Booklet

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ROYAL AUSTRALASIAN
COLLEGE OF SURGEONS



ROYAL AUSTRALASIAN
COLLEGE OF SURGEONS



The Victorian
Surgical Consultative Council



The Royal Australian
and New Zealand
College of Obstetricians
and Gynaecologists



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Introduction

The Victorian Audit of Surgical Mortality (VASM) is a systematic peer-review audit of deaths associated with surgical care. The audit reviews all surgical deaths that occurred in Victorian hospitals following a surgical procedure, or while the patient was under the care of a surgeon, even if no procedure was performed. The audit process is intended as an educational exercise whereby causes of avoidable mortality and morbidity associated with surgery can be identified and lessons for the medical profession can be disseminated. A number of specific cases that reflect trends from the recent audits have been selected for inclusion in this booklet to serve as topical and timely lessons for all surgeons and clinical team members. Issues of patient management (such as delay in diagnosis and treatment, communication errors and deficiencies in postoperative management) that have been reported in previous editions of the Case Note Review Booklet are again highlighted in this edition. It is clear they need repeated exposure to try and reduce the recurrent pattern of these errors.

A detailed case review (second-line assessment) by a Fellow from either the Royal Australasian College of Surgeons (RACS) or the Royal Australian and New Zealand College of Obstetricians and Gynaecologists has been conducted for all cases included in this booklet. The detailed medical records used in the review process comprise all medical notes and records relating to the patient's care, and are strictly de-identified.

The Qualified Privilege declaration reassures surgeon participation by strictly protecting the confidentiality of information gained through the audit.

Feedback from the peer review is sent to the treating surgeon. Hospital management do not receive direct feedback on cases involving patients who died in their hospital. They must rely upon the reports produced by the VASM, including this booklet, to identify emerging issues. The surgeon can elect to share the outcome of their assessment(s) with relevant hospital staff.

The appropriate specialist serving on the VASM Management Committee has provided a summary of their opinion, as well as relevant literature references for each case, in the surgical lessons section that appears after each case.

I encourage you to make available the important lessons in this publication to all relevant health care professionals and to include them in training programs for junior staff.

The Targeting Zero report was released on 14 October 2016.⁽¹⁾ This report assessed the department's systems for all in-hospital care in both the public and private sectors. Implementation of the recommendations has started to produce improvements in identified areas and the VASM continues to play an important role in the revised structure.

This is my last case note review publication, as I will stand down at the end of 2017 and will be handing over to Mr Philip McCahy who will continue as clinical director. I sincerely wish to thank all who have helped us over the past ten years to get to where we are today.

The success of the VASM is dependent upon participating surgeons and hospitals, the Department of Health and Human Services, and the support of the highly efficient, motivated and hard-working staff members at the RACS and I remain confident about the future impact of the VASM. We hope you find this publication of value.

Mr Barry Beiles,
Clinical Director, VASM

Emerging issues and recommendations

These emerging issues and recommendations are points to consider and execute by hospitals and health professionals. The recommendations outlined below are lessons learned from the audited surgical mortality cases. The treating surgeons involved in these cases receive detailed reports and recommendations on issues of patient management identified by the peer-review assessors.

1. Improved leadership in patient care

- In complex cases there must be clear, demonstrable leadership in patient management.
- The treatment plan for each patient should be understood by all involved in their care.
- The lead clinician must be accountable, responsive, prepared for challenges and must focus on optimal patient care.
- During lengthy operations there should be a low threshold for seeking assistance from colleagues to avoid fatigue.
- Senior surgical opinion is essential when dealing with surgical complications and should not be delayed by team hierarchy structure.

2. Improved perioperative management

- Appropriate preoperative, intraoperative and postoperative preparation and management aims to decrease operative complications and promote successful recovery. Delay in, or unnecessary preoperative investigations can have fatal consequences.
- Preparation and management should include:
 - evaluation of both physical and psychological preparation
 - complete medical history and physical examination procedures
 - consent for the surgery and discussion of potential outcomes
 - appropriate documentation and communication of results with clinical and surgical teams, and
 - the avoidance of futile surgery through informed discussion with the patient and family.
- The patient should be discharged to the ward with comprehensive orders.
- Preventative measures should be implemented for reducing complications.
- Instructions must be given about further management when the patient is discharged from a clinical or surgical team.
- The potential outcomes from the probable clinical diagnosis must be considered when developing a treatment plan.
- The patient should be transferred to a medical unit if they are elderly, high risk and medical issues have been identified as the most prominent clinical factor during the admission episode. This is, however, on the basis that the surgical postoperative care can be performed appropriately in that setting.

3. Action on evidence of clinical deterioration

- Clinical deterioration should be monitored as it is an issue that is recognised throughout Australia and internationally.
- When clinical deterioration occurs and there is no clear cause, consideration should be given to causes outside the treating surgeon's specialty or expertise.
- Clinical findings must be considered alongside the results of investigations.
- Clinical deterioration must be acted on as well as recorded.

4. Futile surgery and end of life care

- A number of surgeons and assessors considered that some of the surgical procedures were futile.
- Decisions about whether to continue with active treatment and surgery can be very complex in frail patients, particularly when the treatment has a high risk of death or the end of life is near.
- RACS has explored the topic of futile surgery and end of life matters, and will prepare collaboratively a policy statement on this topic.

5. Improved awareness of surgical emergencies, transfers and sharing of care

- The audit revealed that patients admitted as surgical emergencies are at greater risk when their care is shared. All health professionals should increase their awareness of this risk to improve the quality and safety of patient care.
- Due to their limited physiological reserves, time delays should be minimised for elderly frail patients who need to be transferred between hospitals. Time delays can significantly affect surgical outcomes.

6. Infection control

- The audit revealed that surgical patients admitted to hospital are at an increased risk of developing infection. The risk is high, especially in such a comorbid group of patients, and stringent infection control care should be considered in this patient pool. The Australian Guidelines for the Prevention and Control of Infection in Healthcare ⁽²⁾ are designed to prevent and manage healthcare associated infection and these should be utilised at hospitals. VASM endorses the use of current hospital protocols and guidelines to reduce the incidence of infection.
- Key actions to be taken for control and management are:
 - timely recognition
 - appropriate investigation
 - rapid administration of treatment, and
 - timely involvement of expert teams.

7. Improved communication

- All health professionals and institutions should actively collaborate and communicate to support an appropriate interchange of information and coordination of patient care.
- Effective and efficient communication is required at all times during the admission episode.

Cardiothoracic surgery

Case 1: Decision to operate, failure to transfer

Clinical details:

Diagnoses: coronary artery disease and tricuspid regurgitation.

Operations: coronary artery bypass graft (CABG)x2, tricuspid valve repair and diagnostic laparoscopy.

Cause of death: ischaemic gut.

Course to death:

A patient in their mid-60s had a 3-month history of heart failure. The patient had severe, mostly right-sided heart failure (ascites, peripheral oedema), hypotension (and therefore unresponsive to diuretics) and hepatic dysfunction (due to congestion). Surprisingly the patient's renal function was maintained. A formal echocardiogram (ECHO) report was not included in the records but the left ventricular (LV) ejection fraction was 10%. There was a very large adversely remodelled left ventricle, moderate to severe mitral regurgitation, a very adversely remodelled right ventricle with severe tricuspid regurgitation with an estimated pulmonary artery pressure of 42 mmHg and right atrial pressure. The patient was in low cardiac output and throughout the first hospital admission was hypotensive with a blood pressure (BP) of 85 to 90 mmHg systolic. Four days after admission the patient had a cardiac arrest and was successfully resuscitated. There was one note to say that consideration was given to "liaising with the transplant team". A myocardial viability study was performed but was incomplete, with no 4-hour or 24-hour image, so there was no information on whether there was viable myocardium. The patient had a coronary angiogram that shows an occluded left main and a severe ostial stenosis to the right coronary artery.

It did not appear that the patient had any other major medical problems apart from hypothyroidism for which the patient was taking thyroxine. The patient was transferred to a second hospital and underwent a coronary bypass operation soon after admission. The operation comprised a left internal mammary artery to the left anterior descending artery (LAD) and a vein graft to a marginal branch of the circumflex as well as a tricuspid annuloplasty. Of note is the fact that the tricuspid regurgitation was almost as severe post-bypass as pre-bypass. The patient also had insertion of an intra-aortic balloon pump (IABP) and was weaned from cardiopulmonary bypass (CPB) with moderate inotropic support. The patient did not appear to have made any progress in the intensive care unit (ICU) with inotrope weaning. Approximately three days after the operation the patient developed a rigid abdomen, and at laparotomy was found to have extensive infarction of the entire small bowel. The patient died shortly thereafter.

Assessor's comments:

This patient died of severe low cardiac output on the basis of a likely longstanding ischaemic cardiomyopathy with a severely adversely remodelled left and right ventricle. Unfortunately, the strategy of coronary bypass surgery and tricuspid valve annuloplasty had essentially no chance of success. The LV was so adversely remodelled, the chance of coronary bypass surgery having some beneficial effect on the left ventricle was small.

Furthermore, the tricuspid valve annuloplasty:

- Would have been unlikely to have worked (as was demonstrated).
- Would not have resulted in any improvement in the patient's low cardiac output.

The best chance that this patient had of survival was referral to a heart transplant or mechanical circulatory support centre, as was entertained at the first hospital. This patient had no obvious contraindications to heart transplantation and/or mechanical circulatory support. If the patient had been transferred they would have almost certainly had a ventricular assist device as a bridge to candidacy for a heart transplant.

The areas of concern were as follows:

- Patient undergoing coronary bypass surgery and tricuspid valve repair.
- Performing coronary bypass surgery in a patient with low cardiac output and severe adversely remodelled left and right ventricles without any evidence of the extent of viability.
- No safety net in place for postoperative low cardiac output (mechanical circulatory support).
- Most importantly, the patient was not transferred to a heart transplant/mechanical circulatory support program.

Surgical lessons:

- Delays in the transfer of critically unwell patients can often lead to poor outcomes.
- Referring patients to more experienced centres that deal with specialised problems (e.g. cardiac transplant/mechanical support) is relatively easy to do-it is only a phone call away.
- It is always better to refer these complex patients too early rather than too late.⁽³⁻⁵⁾

Reference:

3. Holmes DR, Jr., Rich JB, Zoghbi WA, Mack MJ. The heart team of cardiovascular care. *J Am Coll Cardiol*. 2013 Mar 05;61(9):903-7.
4. Rural Doctors Association of Victoria [Internet]. Retrieval: Victorian rural emergency retrieval Victoria: *Rural Doctors Association of Victoria*; 2011 [updated 20 May 2008]. Available from: <http://www.rdav.com.au/retrieval.html>.
5. Francis DM. Australian Commission on Safety and Quality in Health Care- Recognising and responding to clinical deterioration. Surgical decision making. *ANZ J Surg*. 2009;79(12):886-91.

Cardiothoracic surgery

Case 2: Missed sepsis postoperatively

Clinical details:

Diagnosis: acute type aortic dissection with tamponade.

Operations: emergency repair of root/ascending aorta/arch and delayed closure of sternum.

Cause of death: urinary tract infection (UTI) and septicaemic shock associated with *Escherichia coli* (*E.coli*).

Course to death:

A patient in their 80s was admitted with an acute type A aortic dissection. That same day they underwent an extensive reconstruction of the aortic root and aortic arch. The operation was complicated by coagulopathy that required significant blood product transfusion and the use of Recombinant Factor 7. The patient went to the ICU with the chest opened. Once the patient was more stable and the bleeding was controlled the sternum was closed. The postoperative care period was prolonged due to the presence of multi-organ dysfunction. The patient was discharged to the ward. The patient required extensive nursing support for the duration of the hospital stay but was making reasonable progress. However, there was a major deterioration in the patient's condition on day 22, with the patient found unresponsive at 6.40am. A medical emergency team (MET) call was made and the patient was transferred back to the ICU but death occurred later that day. The patient was said to have Gram-negative septicaemia with *E.coli*. No cardiac, aortic or pericardial pathology noted in electronic coroner's deposition.

Assessor's comments:

The comments from the first-line assessor include a concern about the lack of detail in the reporting, including information about the operation performed. A second concern was regarding the events that preceded the patient's sudden collapse with septicaemia from the UTI. In particular, whether there were any findings that could have alerted the treating team and led to earlier diagnosis and treatment of the condition.

The notes from the treating hospital were available for review but the report from the coroner was not included. The medical record from the hospital is highly satisfactory. There were entries on every postoperative day from the surgical team.

The sudden deterioration and cardiac arrest were not anticipated. There was a note from the aged care team that raised concerns regarding diarrhoea and an increase in the white cell count from 9.5 to 11.4 $\times 10^9/L$. The observation chart did not show any fever or tachycardia to suggest sepsis. Requests for a chest and abdominal x-ray, sputum, cardiopulmonary review, and faecal micro culture and sensitivity were suggested. It is not clear if these were performed. No mention was made of a urine culture. Within 24 hours of the arrest the patient died.

Given the information provided, it appears that the patient died from a hospital acquired infection related to instrumentation of the urinary tract. The death was therefore preventable. The patient had a urinary catheter in situ for 14 days following the operation. After removal the patient developed urinary retention. There was then a traumatic reinsertion of the catheter with frank blood and clotting. That catheter was removed immediately, and after discussion with the Urology unit another indwelling catheter was reinserted. There was ongoing blood

in the urine and blood at the meatus. It seems that this settled over time. Two days prior to death there was a note from the nursing staff that the urine had heavy sediment. The catheter was removed on the day prior to death. As the laboratory results were not included in the medical record, it was not possible to review the results of any urine cultures that may have been sent.

Surgical lessons:

- As mentioned in the assessor's report, postoperative sepsis can often be missed in elderly patients, especially following major surgery when the clinical signs of infection are subtle.
- The use of prophylactic antibiotics prior to invasive procedures (including urinary tract instrumentation) is important when a prosthetic aortic graft is in situ.⁽⁶⁾

Reference:

6. Nishimura RA OC, Bonow RO, Carabello BA, Erwin JP, 3rd, Guyton RA. 2014 AHA/ACC Guideline for the management of patients with valvular heart disease: executive summary: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines. *Circulation*. 2014;129(23):2440-92.

Thoracic surgery

Case 3: No preoperative tissue diagnosis led to unnecessary surgery

Clinical details:

Diagnosis: small cell lung cancer.

Operations: right video-assisted thoracoscopic surgery (VATS) lower and middle lobectomy, re-operative right VATS evacuation of haemothorax, insertion of intercostal catheter (ICC), flexible bronchoscopy, right VATS assisted thoracotomy, decortication, revision of bronchial stump, latissimus dorsi flap, tracheostomy, debridement and vacuum-assisted closure (VAC) of the wound, percutaneous endoscopic gastrostomy (PEG) insertion.

Cause of death: respiratory failure and aspiration pneumonia.

Course to death:

This elderly diabetic patient in their 70s underwent right lower lobectomy. The postoperative course was complicated by bleeding that required a return to theatre. The patient was discharged home well on day 14 but returned to hospital on day 18 with empyema and a bronchopleural fistula, which was repaired immediately using a latissimus dorsi flap. The patient was extubated on day 20. Delirium and respiratory failure led to reintubation on day 25 and tracheostomy on day 31. The patient was de-cannulated on day 44. Wound infection was noted on day 45. Debridement and VAC of the wound were performed and percutaneous PEG inserted on day 49. The patient aspirated postoperatively and treatment was withdrawn, with death on day 50.

Assessor's comments:

A second-line assessment was requested to examine three areas: preoperative decision making, intraoperative decision making and postoperative care following the last procedure.

Point 1: Although some of the evidence and results of the preoperative investigations were not available, it appears from the information supplied by the surgeon that the surgery proceeded to a thoracotomy to remove a lung lesion without a histological diagnosis. This would seem to go against normal practice in the era of needle biopsy and sophisticated investigations, such as positron emission tomography (PET) scanning. It was stated that the right lung lesion was 17mm in diameter and not central. On the face of it, and in the absence of contraindications such as inaccessibility, anticoagulation or advanced emphysema, a needle biopsy should have been undertaken for a tissue diagnosis. It is stated that a PET scan was negative for nodal activity but there was no indication of whether the lesion itself was active. The computed tomography (CT) scan report was not available but the result would be relevant, particularly as a large number of hilar nodes were encountered at surgery. If the CT scan did demonstrate hilar nodes it would have affected the decision of the surgical approach, i.e. VATS versus formal thoracotomy with anticipated bi-lobectomy and lymph node clearance. The case was discussed at a multidisciplinary meeting but the ultimate decision still rests with the surgeon.

Point 2: It is stated that the VATS procedure was difficult (it was certainly long at 6 hours) and that visualisation was poor. The surgical notes also remark on the presence of pleural adhesions, further complicating the procedure. When faced intraoperatively with the unanticipated need for bi-lobectomy and lymph node dissection, the VATS procedure should have been abandoned in favour of a full thoracotomy for better surgical access. Proponents

of a particular technique such as minimal access surgery may, on occasion, be loath to accept what they may perceive as a 'failure' of the technique, and stubbornly persist in the face of adversity to the detriment of the patient. The second point to make is that, on encountering the extensive nodal involvement with presumed metastatic tumour, a biopsy/frozen section examination should have been immediately undertaken. In this particular case, the result of small cell carcinoma metastatic to lymph nodes would have led to the avoidance of further surgery. In turn, this would have prevented the consequences and complications that ultimately led to the patient's demise.

Further to the question of the appropriateness of the intraoperative management is the decision made on the patient's emergency return to theatre for haemorrhage. The patient's postoperative course was marked by ongoing severe blood loss, massive blood transfusion and the requirement for emergency reoperation within a few hours of the procedure. Indeed, it may be argued that the response to the ongoing blood loss was too slow, and that the blood loss in combination with hypotension (requiring inotropes), and the patient's need for blood transfusions, should have alerted the surgical team to the need for earlier surgical intervention. Notwithstanding this observation, the decision to operate via VATS was clearly a flawed one and probably contributed significantly to the patient's ultimate complications and outcome.

Point 3: This refers to the final operation to debride the infected thoracotomy wound and insert a PEG tube. There are two aspects to this point. One is the decision to undertake the procedure without full intubation and the other relates to the postoperative care, which may have led to the aspiration pneumonitis, the pre-terminal event. In terms of the first issue, the arguments are credible (such as avoiding full intubation because of the potential for difficulty in postoperative respiratory weaning, and the possibility that another tracheostomy would be needed), and any criticism of the decision not to fully intubate can only be made in retrospect. The second relates to the patient positioning and management of the PEG immediately postoperatively. Whether the patient positioning was a factor in the pulmonary aspiration incident is a moot point. Possibly if the stomach had been emptied completely by suction on the PEG the vomit could have been avoided. But this elderly, diabetic patient was already desperately ill, after a long hospitalisation and multiple major surgeries and extended ICU stays, with ongoing sepsis, wound breakdown and respiratory failure. These factors ultimately determined the outcome and the contribution of the postulated aspiration pneumonia may not have been definitive.

In summary, this case involves an elderly patient with significant risk factors, including diabetes mellitus and advanced years. The lack of a preoperative (or intraoperative) tissue diagnosis meant that the patient underwent pulmonary lobectomy that may not have been performed had the diagnosis of small cell carcinoma been obtained beforehand. A further opportunity was missed at surgery where enlarged and possibly involved lymph nodes were noted - had frozen section biopsy been undertaken, lobectomy may have been avoided. There is also potential for criticism of the decision to persist with VATS at the first (and second) operations.

Surgical lessons:

- Preoperative tissue diagnosis is important prior to embarking on a radical lung resection, e.g. a lobectomy or pneumonectomy.
- If preoperative tissue diagnosis is not feasible, on-table (intraoperative) frozen section pathological diagnosis is another option.

- The treatment for advanced small cell lung cancer is non-operative, further highlighting the importance of a preoperative diagnosis in this case.⁽⁷⁾

Reference:

7. Alvarado-Luna G, Morales-Espinosa D. Treatment for small cell lung cancer, where are we now - a review. *Transl Lung Cancer Res.* 2016;5(1):26-38.



Cardiothoracic surgery

Case 4: Iatrogenic right coronary occlusion as an unappreciated cause of postoperative cardiac failure

Clinical details:

Diagnosis: severe bicuspid aortic stenosis.

Operation: bioprosthetic aortic valve replacement (AVR) (21mm Magna Ease).

Cause of death: multiorgan failure.

Course to death:

A patient in their late 50s was admitted to ICU after insertion of a bioprosthetic tissue AVR. There had been an uncomplicated anaesthetic and operation. The patient deteriorated over the first night following the operation. Postoperative issues were:

- Severe shock/right heart failure: low systemic vascular resistance and low cardiac index postoperatively despite intravenous (IV) fluids; increasing requirements for noradrenaline in ICU which rapidly escalated and remained high.
- ECHO on day 1 showed dilated and severely impaired right ventricle with hypertrophied and empty left ventricle. Consideration was given to review in catheterisation lab but cardiology didn't feel this to be appropriate. Repeat ECHOs revealed ongoing right ventricle dilation with impaired function. Treatment with nitric oxide, steroids and inotropes was instituted.
- On day 3, there was loss of output with cardiopulmonary resuscitation (CPR) for approximately 10 minutes. Over the third day the patient had increasing noradrenaline requirements, without significant BP response. The patient became mottled and the abdomen was distended with no bowel sounds.
- Ischaemic hepatitis leading to fulminant liver failure with associated coagulopathy and elevated ammonia levels. Transfusion of blood products was required for coagulopathy.
- Aspiration after extubation requiring reintubation on day 1, and antibiotics (meropenem/vancomycin). The patient was initially paralysed to aid ventilation, ceased on day 2, and then restarted on day 4 due to increased instability.
- Acute renal failure with metabolic acidosis; commenced on renal replacement therapy.
- Rapid atrial fibrillation (AF), repeated boluses of amiodarone, and proceeded to amiodarone infusion and digoxin and positive fluid balance.

The patient deteriorated on day 5. Noradrenaline administration was unable to maintain a BP. Discussions were held with the family regarding deterioration with ongoing right heart and liver failure, and the futility of ongoing invasive treatment. Care was changed to comfort and palliation. The patient died on day 5.

Assessor's comments:

This is a report on a patient in their late 50s who was admitted electively for a planned AVR as therapy for identified aortic stenosis secondary to a bicuspid aortic valve.

The record shows that the patient had several comorbidities including increased body mass index. Recent investigations of the patient included a cardiac ECHO preoperatively that demonstrated aortic stenosis with a bicuspid aortic valve with preserved LV function, and a coronary angiogram demonstrating normal coronary vessels. The operation report indicates

that the procedure was uncomplicated and the patient had a cross-clamp time of 47 minutes. The total operation time was just in excess of 2 hours. The record also indicates that the patient returned to the ICU and at no point in time had a survivable cardiac index, with indices less than 2 L/min/m² from the outset. It appears that the diagnosis of right heart failure was made early, but for reasons that remain unclear, the cause of the right heart failure was not fully investigated. The patient ultimately succumbed to multiorgan failure secondary to a non-survivable cardiac output.

A coronal autopsy found a stitch causing obstruction or injury to the origin of the right main coronary artery, most likely associated with the aortotomy suture line closure. This was secondary to the surgical procedure and it was unrecognised intraoperatively. However, the patient died as a result of the failure to further investigate the evolving cardiogenic shock and right ventricular failure in the immediate period in ICU. It is likely that had the right coronary artery injury been diagnosed and corrected, the patient may have survived.

Surgical lessons:

- Right coronary artery territory ischaemia should always be suspected in a patient who develops new right ventricular or inferior LV impairment post-bypass following AVR.
- In this situation, re-vascularising the right coronary artery should be attended to immediately, either by replacing the valve to alleviate the coronary obstruction or bypass grafting the right coronary artery.



General surgery

Case 5: Shared care and communication issues led to delay and death

Clinical details:

Diagnosis: endoscopy showing large duodenal ulcer.

Operation: gastroscopy.

Cause of death: recurrent upper gastrointestinal (GI) bleed.

Course to death:

This patient, although in their mid-80s, was very fit and went to the gym daily. The patient presented with upper GI bleed and was resuscitated by the surgical team. Gastroscopy showed a large duodenal ulcer but no active bleed or stigmata of recent bleed in the ulcer base. Nevertheless, the ulcer base was injected and diathermied.

The patient was admitted to the ICU for observation with a plan to repeat gastroscopy on the next available assessment in about 24 to 36 hours. The patient remained well and did not require further transfusion.

Close to midnight on the following day the patient had recurrence of melaena and a drop in haemoglobin. Resuscitation was instituted. The surgical team under the on call surgeon made immediate arrangements to repeat the gastroscopy and proceed to laparotomy if needed. A major factor in this decision was the good preoperative physical condition. Consent was obtained from the relatives.

However, the ICU consultant refused to endorse a surgical intervention on the grounds that the patient was elderly and not likely to survive a procedure. In the subsequent 2 to 3 hours, intense discussions were held between the surgical team on one side and the ICU consultant and anaesthetist on the other. Agreeing with the ICU consultant, the anaesthetist refused to anaesthetise, advising continued resuscitation. The patient died a few hours later from ongoing GI bleed.

Assessor's comments:

An elderly patient presented from home with a bleeding duodenal ulcer. The patient underwent gastroscopy and endoscopic treatment for this ulcer. The patient subsequently suffered further bleeding from this ulcer, but was not given timely ICU treatment due to communication issues between treating teams. The patient expired from blood loss despite ongoing resuscitation.

Area of concern: This case highlights the complexities of shared decision making between teams and the importance of individuals understanding their roles. The surgical team was ultimately the treating team and made a treatment plan that did not have the support of other teams.

The treating surgical team made the appropriate decision to proceed with an urgent repeat gastroscopy in this patient with recurrent duodenal ulcer bleeding. This should have happened immediately when the patient deteriorated. Gastroscopy is a relatively low-morbidity procedure that may have saved this patient's life. Angio-embolisation of the gastroduodenal artery was another alternative, but availability and timeliness of this depends

on the hospital. No mention was made of this. Laparotomy with under running of this vessel should endoscopic control fail carries much higher morbidity and a lower chance of the patient retaining an acceptable quality of life. The ICU physician questioned the benefits of this, as did the anaesthetist. The anaesthetist went further in deciding that the patient was unfit for any intervention. The documented reasons make no clinical sense. This patient was going to die without intervention, and full palliation should have been instituted once this decision was made, rather than wasting precious blood products in futile resuscitation.

When an elderly patient is admitted to an ICU, the limits of treatment in particular scenarios should be discussed between ICU and surgical staff. This should have happened during the day, not at midnight when the patient had already deteriorated. The decision for gastroscopy was the surgeons call, as that is his expertise. The ICU physician may have reasonably refused to support the patient after a laparotomy, but the decision for laparotomy is again ultimately the surgeon's call. This highlights the need for a shared decision requirement among clinicians. While anaesthetists can advocate strongly about the futility of anaesthetising sick, elderly patients or preoperative patient optimisation, decisions about treatment interventions are the domain of the surgical team. In the situation of communication issues affecting timely treatment, the surgeon may have contacted the senior hospital officer to seek support. This is obviously more difficult in a time-critical situation overnight.

Surgical lessons:

- Surgical decision making for high-risk patients is complex. Senior surgical leadership is imperative in steering the multidisciplinary team towards an early consensus opinion that can be communicated to patients and their families.⁽⁸⁾

Reference:

8. Glance LG, Osler TM, Neuman MD. Redesigning surgical decision making for high-risk patients. *N Engl J Med.* 2014;370(15):1379-81.

General surgery

Case 6: Delay in treating ruptured oesophagus

Clinical details:

Diagnosis: boerhaave perforated oesophagus.

Operation: thoracotomy for perforated oesophagus.

Cause of death: boerhaave perforated oesophagus.

Course to death:

A patient in their late 70s was transferred from hospital A to hospital B with oesophageal perforation. The patient was noted to have extreme chest pain after eating a chip from a fast food restaurant. The patient had experienced intermittent chest pain for the last few months with food (dysphagia and odynophagia). A CT showed significant pneumo-mediastinum, fluid in the mediastinum and an oesophageal tear (approximately 3cm). The patient had initially presented to hospital A on day 1, where a chest x-ray (CXR) had suggested pneumo-mediastinum. The patient was transferred to hospital B the next day, then transferred to hospital C later that same day after a CT scan. The patient's past medical history included an acute myocardial infarction over 25 years ago (on aspirin); type 2 diabetes mellitus; polymyalgia rheumatic (on prednisolone); gastro-oesophageal reflux disease; hypertension (HTN) and hypothyroidism.

The patient went to theatre for gastroscopy, jejunostomy tube insertion, gastrostomy tube insertion, right thoracotomy and laparotomy. On day 8 the patient had growing loculated pleural effusion and went to theatre for thoracotomy, T-tube inserted in oesophagus and three ICCs. ICU admission postoperatively then transferred to the ward on day 12.

The patient had multiple MET calls for increased respiratory rate and heart rate. Broadening of IV antibiotics for persistent mediastinitis-polymicrobial (Staphylococcus aureus, Enterococcus, Streptococcus salivarius and Streptococcus anginosus). Because of ongoing sepsis despite adequate antibiotics and drainage of persistent right sided effusion, the decision was made to do a surgical procedure on day 23.

On day 23 the patient went to theatre for right sided thoracotomy and decortication. They had a loculated right pleural effusion – an intercostal muscle flap was used to repair the oesophagus and a new tube was inserted into the oesophagus with three right sided ICCs. The patient was transferred to ICU postoperatively and then to the ward.

The patient was stable on the ward. An Endovac was inserted on day 38 with changes every few days. On day 57 they also had a pleural tap of a left sided pleural effusion. MET calls for increased respiratory rate due to fluid overload were made on day 55. Following the pleural tap a MET call was made for hypotension, urine output decreased and the decision was made to palliate the patient. The patient was pronounced dead on day 58.

Assessor's comments:

Case note: No notes identified from hospital A. At hospital B the patient was admitted under the surgical team with medical team assistance. It was noted that significant functional decline had occurred over the past month, with poor exercise tolerance of 50m. It was documented by the emergency department (ED) consultant that treatment was discussed

with the family and that the patient would not be for invasive or aggressive management, or prolonged ICU admission. Hence the transfer to hospital B only occurred the next day. Overall there was good documentation at hospital C. There was no indication at admission of discussion with the patient and family regarding the nature of the condition, or the likely outcome of the surgical course.

Areas for consideration: It seems that the patient's treatment was discussed in hospital B, with the outcome that the patient would not be for major surgery but did want other treatment. This shows some lack of understanding of the condition, as non-intervention has 100% mortality and intervention requires major surgery. There were no notes indicating that a surgeon reviewed the patient although it may have been discussed by phone. A consultant surgical review may have been useful in assessing the suitability of the patient for treatment (versus palliation) of oesophageal perforation, and in identifying the need for urgent transfer if intervention was deemed appropriate. There was no documentation to indicate that the patient and family were aware of the exceedingly high mortality of the condition and that by 48 hours surgery was unlikely to be successful.

Areas of concern: A pneumo-mediastinum was identified on CXR in an elderly patient with a history of sudden onset retrosternal chest pain. If ruptured oesophagus is considered a possible diagnosis, discussion with a specialist upper GI surgeon regarding transfer to an appropriate unit should be held as soon as possible. The mortality from Boerhaave syndrome is 35%, however when intervention is delayed by >24 hours the mortality rate approaches 50%, and if >48 hours the mortality rate is close to 90%.⁽⁹⁾ In this case the decision to transfer to a closer regional hospital due to a lack of functioning equipment at the primary hospital resulted in a 24-hour delay.

Adverse events: An elderly patient with Boerhaave's perforation has a high risk of mortality and delayed surgical intervention increases this further. If surgical intervention is to be undertaken then all efforts should be made to get the patient to the operating theatre within 12 hours. In the instance of a delayed presentation, especially in a patient with significant comorbidities, there should be honest and open discussions with the patient and their family about the expected prognosis before undertaking surgical intervention.

Given the nature of the condition and the comorbidities, this patient's chances of survival were not high. Delay in transfer was avoidable but may not have changed the outcome. Consideration should have been given to palliation prior to major surgical intervention, as there had been significant delays and survival was unlikely.

Surgical lessons:

- Delay in the diagnosis of spontaneous oesophageal perforation of >24 hours is associated with a survival rate as low as 20%. Surgical decision making in the context of setting realistic goals of care should occur as soon as possible.

Reference:

9. Tonolini M, Bianco R. Spontaneous esophageal perforation (Boerhaave syndrome): Diagnosis with CT - esophagography. *J Emerg Trauma Shock*. 2013;6(1):58-60.

Colorectal surgery

Case 7: Delay in diagnosing anastomotic leak

Clinical details:

Diagnoses: carcinoma of the splenic flexure, locally advanced and invading lateral abdominal wall.

Operations: laparoscopically assisted left hemicolectomy, obstructing carcinoma of the splenic flexure and repair of anastomosis covering loop ileostomy.

Cause of death: anastomotic leak, intra-abdominal sepsis and multi-organ failure.

Course to death:

A patient in their 70s with a past history of iron deficiency/anaemia, ischaemic heart disease, arthritis requiring bilateral knee replacements and hypocholesterolemia, presented with abdominal pain three weeks after a coincidental mechanical fall. An abdominal examination and abdominal CT showed a mass in the left colon.

There was a one week delay between admission and surgery. The patient had a laparoscopic left hemicolectomy for a bulky tumour. The immediate postoperative management on the ward was complicated by profound hypotension leading to a MET call. The patient needed admission to ICU for 48 hours with inotrope support and five units of blood. Patient was then returned to the ward and over the next five days had a poor progression. The patient had abdominal pain, high nasogastric output and poor urine output. There was a low grade temperature. On day 7 postoperatively, the patient was hallucinating, was hypotensive and had AF and atrial flutter requiring IV amiodarone with poor control of the AF. A CT at that time was thought to show a postoperative haematoma. For two days the patient continued to be quite unwell with confusion, poor urine output, ongoing abdominal pain and poorly controlled AF. A repeat CT on the ninth postoperative day still didn't prompt a diagnosis of a leak. Total parenteral nutrition had been started on the eighth postoperative day.

On the ninth postoperative day the patient returned to theatre for surgery for a leak with contamination. Over the following week the patient continued to deteriorate and succumbed to sepsis.

Assessor's comments:

- The patient had a profoundly low BP postoperatively, and required a MET call and five units of blood over the first 24 hours. This suggests that the patient had a haemorrhage. A diagnostic laparoscopy was required.
- The profound hypotension and the required inotrope support that the patient needed to maintain a BP led to poor gut perfusion. This is certainly the cause of the anastomotic leak.
- On the seventh postoperative day the patient developed AF and atrial flutter, which were poorly controlled. Trainees are taught that AF seven days after a bowel resection with anastomosis means that there is a leak until proven otherwise. Though the patient had a CT scan, rectal contrast was not used.
- It took a further 48 hours of this patient being profoundly unwell before they were returned to theatre.

- The patient was in hospital for a week before undergoing surgery. There is no evidence that there was any attempt or thought of a nutritional preload before the surgery. Postoperatively, it was not until the eighth day that total parenteral nutrition was commenced. At that point the patient would have been quite malnourished and therefore unable to mount a significant response to the sepsis.
- The patient's admission, surgery and illness occurred during a period in which there were several major public holidays. It is not clear whether it was the same consultant/ registrar/residents looking after the patient over the holiday period. It is quite possible that a variety of individuals looked after this patient. In turn, this "tag team" approach may have resulted in periods of indecision because there wasn't a continuous team looking out for the patient or a continuous authority on hand to make decisions.

Surgical lessons:

- Clinical deterioration following colorectal surgery should prompt surgical review followed by appropriate investigation, particularly CT scan, to rule out anastomotic leak.⁽¹⁰⁾

Reference:

10. Hyman N, Manchester TL, Osler T, Burns B, Cataldo PA. Anastomotic leaks after intestinal anastomosis: it's later than you think. *Ann Surg.* 2007;245(2):254-8.



General surgery and gynaecology

Case 8: Delay in diagnosis of iatrogenic bowel injury

Clinical details:

Diagnoses: gross peritoneal adhesions and pelvic pseudocyst.

Operations: resection of pelvic pseudocyst (mucinous cystadenoma) and oversewing of small perforation in ileum.

Cause of death: pneumonia.

Course to death:

This lady in her 80s had a history of small bowel obstruction and a known recurrent large pelvic pseudocyst compressing the bladder/rectum. Extensive adhesiolysis and resection of pelvic pseudocyst (mucinous cystadenoma) were carried out by the gynaecology team. Postoperatively the patient developed renal failure. At day 6 postoperatively she discharged faeculent material through the abdominal wound. An immediate laparotomy was performed by the general surgical team. A small 5mm defect in a loop of ileum was oversewn. She had been on inotropic medication for several days due to hypotension. Discussion with family occurred and a decision was made to withdraw ventilatory support. The patient did not develop any further enterocutaneous fistula.

Assessor's comments:

The hospital case notes provided are adequate and document the sequence of events and measures taken with reasonable clarity. Not provided, however, was the postmortem information and there were very few and relatively brief notes made by the surgical team.

Documentation shows an appropriate and thorough pre-anaesthetic assessment. She had significant medical problems, including multiple previous abdominal and pelvic surgeries such that adhesive disease within the peritoneal cavity was a significant risk factor for visceral injury. Other comorbidities: obesity and diabetes made the patient a significant severe pre-operative risk. Given the likelihood of a visceral injury, thought might have been given to the skill set of the primary surgeon and any assistant surgeon; a surgeon with special expertise in GI surgery might have been useful at the time of the primary procedure.

The notes indicate that there was appropriate consideration given to performing the surgery. The patient was nursed in ICU after the first and second operations. Recovery after the first operation was marked by fever and leucocytosis, the cause of which was not clear until the small bowel injury became apparent. Earlier return to theatre to search for a cause of the patient's poor postoperative course may have led to an earlier repair of the small bowel injury.

Adverse events: Unrecognised visceral injury with a delay to diagnosis and repair after nine days. This ultimately resulted in the patient's death.

Areas of concern: There are two areas of concern. The first relates to the primary operation during which the bowel injury occurred and was not recognised. Given the likelihood of a visceral injury, it may have been prudent to have a surgeon with special expertise in GI surgery as either the primary surgeon or assisting. This may have prevented the injury or at least led to earlier recognition of the problem. The delay in diagnosis after the surgery might

have been avoided if advice from a general surgeon was sought in the first 48 to 72 hours, when it was clear that the patient's recovery was complicated.

Surgical lessons:

General surgery review:

- Consultant surgical oversight is imperative in the postoperative management of surgical patients. Delay in diagnosis and management of intestinal perforation is associated with increased mortality.⁽¹¹⁾

Reference:

11. Baggish MS. Lessons in timely recognition of laparoscopy-related bowel injury. *OBG Management*. 2008;20(7)(July 2008):55-60.

Gynaecological review:

- For cases in which significant bowel pathology is encountered, preoperative or intraoperative consultation with a general or colorectal surgeon should be considered.
- Early consideration should be given to a return to theatre for patients who are deteriorating or not improving postoperatively.⁽¹²⁾

Reference:

12. North J, Blackford F, Wall D, Allen J, Faint S, Ware R, et al. Analysis of the causes and effects of delay before diagnosis using surgical mortality data. *Br J Surg*. 2013;100(3):419-25.



Hepatobiliary surgery

Case 9: Preoperative, intraoperative and postoperative errors of judgement in the management of cholecystitis

Clinical details:

Diagnosis: acute cholecystitis.

Operations: laparoscopic cholecystectomy and operative cholangiogram.

Cause of death: multisystem organ failure.

Course to death:

A patient in their late 70s with a past history of HTN and chronic renal failure was admitted with constant right upper quadrant pain. The pain had been present intermittently for the preceding two weeks and a prior ultrasound ordered by the general practitioner confirmed cholelithiasis. The original scan result was not included in the material provided, so the assessors were unable to comment on the possibility of choledocholithiasis or acute cholecystitis. The preoperative liver function tests revealed a normal bilirubin but raised gamma-glutamyl transferase and alkaline phosphatase. Inflammatory markers were normal.

A laparoscopic cholecystectomy and operative cholangiogram were performed on the second day after admission. Operative notes comment that the gall bladder was acutely inflamed and that there were adhesions. The operative cholangiogram noted the presence of multiple stones within the common bile duct (CBD). There was some intraoperative bleeding that was controlled and a drain tube was left in situ.

The patient returned to the ward and was managed postoperatively. The drain tube drained small amounts of bile, but the main problem was pain management and, by day 3, a worsening tachypnoea. A ventilation perfusion (VP) scan was performed on day 4 postoperatively, which was normal, but the patient continued to deteriorate with tachycardia, tachypnoea and worsening renal function. The patient was transferred to ICU where intubation, inotropic support and dialysis was needed. The plan was to return to theatre to perform a laparotomy but the patient was deemed too unstable. In consultation with the family, the inotropic support was withdrawn and the patient died six days after the original operation.

Assessor's comments:

There are several issues that need scrutiny.

Firstly, the patient's symptoms appeared to have been going on for about two weeks prior to the admission. There doesn't appear to be any doubt that the gall bladder was the cause of the patient's problems. It is well known that a cholecystectomy at this stage of the disease process is always difficult-something that proved to be correct at the time of the surgery. There doesn't appear to have been any consideration given to alternatives such as admission for IV antibiotics or cholecystostomy. These alternatives may have given the surgeon more time and also assisted in maximising the patient prior to surgery.

The next issue is the CBD stones noted at the time of the operation. There was no indication that the treating surgeon considered a trans-cystic exploration or drain or an open exploration of the CBD or even consultation with a colleague.

There was a note in the chart that an endoscopic retrograde cholangiopancreatography was to be considered but not at this admission. In view of this it comes as a surprise that cholangitis was not considered when the patient was becoming unwell in the postoperative period.

There was mention of a bile leak that was controlled by the drain. The leak amount appears quite small but in view of the deterioration of the patient the reason for the leak never appears to have been considered or investigated. In fact, the only investigation that was ever performed was a VP scan, which was normal. It also appears that most of the surgical management of this patient was delivered by a series of telephone calls from the surgeon. There was no evidence in the notes that the patient was ever physically examined by the treating surgeon. This is a point of particular concern, especially when the patient's abdomen was noted to be tender and distended. Even the plan for a return to theatre appears to have been made without the surgeon seeing the patient.

In summary, there seems to be little surgical input into a patient who was rapidly deteriorating following what was supposedly a reasonably straight forward operation. A more pro-active approach in the assessment, intraoperative and postoperative phases may have prevented this patient's unexpected death.⁽⁵⁾

Surgical lessons:

- Importance of recognising and responding to clinical deterioration and the need for experienced surgical oversight.

Reference:

5. Francis DM. Australian Commission on Safety and Quality in Health Care - Recognising and responding to clinical deterioration. Surgical decision making. *ANZ J Surg.* 2009;79(12):886-91.

Orthopaedic surgery

Case 10: Adequate investigation and preparation for surgery is important

Clinical details:

Diagnosis: subcapital fractured neck of femur (NOF).

Operation: hemiarthroplasty of hip performed within 48 hours after admission in a weekend emergency theatre.

Cause of death: cardiac failure.

Course to death:

Comorbidities: vascular dementia, transient ischemic attacks, AF uncontrolled, HTN, osteoarthritis. Medications included: rivaroxaban, telmisartan, vitamin D3 and paracetamol.

This patient in their mid-90s had a fall at home resulting in a fractured right hip. Geriatrics was also treating the patient for pneumonia. During the anaesthetic there was difficulty in controlling rapid AF and difficulty maintaining BP. Towards the end of the procedure they became resistant to vasopressors and adrenaline. As the patient was not for resuscitation, it was decided to abandon active treatment. The patient died in recovery having deteriorated during the procedure.

Assessor's comments:

This case is in relation to a patient in their mid-90s who was admitted to hospital with a fractured NOF. The patient underwent hemiarthroplasty surgery to treat this and unfortunately died during the procedure.

The main area of concern is the noted preoperative AF (rate of 110 beats per minute). It seems that the main cause of death was the much higher AF rate during the procedure. It was difficult to control the AF rate and this may ultimately have precipitated the patient's death.

The patient was seen preoperatively by the orthopaedic geriatric team and it was noted that the patient was in AF with a heart rate of 110 beats per minute. There was no indication in the documentation as to whether strategies to control this rate had been considered prior to the procedure going ahead (extra medication or a cardiologist consult).

It is always difficult in an elderly patient: the quicker that someone in that age group can get to theatre with a fractured NOF, usually the better. Retrospectively, had the AF rate been controlled preoperatively, the sudden rate increase may not have occurred, and the patient's death may possibly have been preventable.

Surgical lessons:

- Adequate investigation and preparation for surgery is important in the care of patients with hip fractures. Ideally, patients should be operated on within 48 hours; this is achieved in 77% of cases in Australia.⁽¹³⁾ Although delays to theatre are known to lead to poor outcomes, there are a few conditions that should be improved prior to surgery. These include uncontrolled sepsis, diabetes, severe anaemia, severe electrolyte imbalance and tachycardia due to arrhythmia.^(14, 15)

- These patients are sick and frail and require senior input in terms of the best way to promptly improve comorbidities prior to an anaesthetic. A daily orthogeriatric service for assessment of these patients is now in place at 60% of hospitals in Australia and New Zealand that provide data to the Australian and New Zealand Hip Fracture Registry.

Reference:

13. Armstrong E, Close J, Harris I, Fleming S. 2016 ANZHFR Annual Report Sydney: *Australian and New Zealand Hip Fracture Registry*; 2016. Available from: <http://anzhfr.org/reports/>.
14. Maxwell L, White L. Anaesthetic management of patients with hip fractures: an update. *BJA Education*. 2013;13(5):179-83.
15. Griffiths R, Alper J, Beckingsale A, Goldhill D, Heyburn G, Holloway J, et al. Management of proximal femoral fractures 2011: Association of Anaesthetists of Great Britain and Ireland. *Anaesthesia*. 2012;67(1):85-98.

Neurosurgery

Case 11: Delay despite steadily dropping GCS

Clinical details:

Diagnosis: hydrocephalus.

Operations: external ventricular drain (EVD) insertion and posterior fossa decompressive craniectomy.

Cause of death: brainstem infarction.

Course to death:

A patient in their mid-30s was intending to board a flight but was sent home from the airport with nausea and vomiting. Ongoing nausea and vomiting necessitated attendance at the ED. The patient was monitored in the short stay unit overnight. There was persistent nausea and vomiting and a decrease in the Glasgow Coma Scale (GCS). Brain CT (CTB) showed cerebellar and brainstem infarction. The patient had an urgent EVD insertion and was sent to ICU overnight. Next morning the left pupil was fixed and dilated and the patient was taken for urgent posterior fossa decompression. Postoperatively the pupils were fixed and dilated and palliation was instituted.

Assessor's comment:

The first-line assessor considered that “there was a preoperative delay in confirmation of main surgical diagnosis”.

The history is that of a patient in their mid-30s who was unable to board a flight because of nausea and vomiting. The patient subsequently attended the ED of a tertiary hospital with a neurosurgical department and was treated for food poisoning. After 12 hours in the ED and short stay unit they became increasingly drowsy. The case notes reveal the following: progress note 1: GCS 15; progress note 7 (8.13pm): GCS 13; progress note 8 (8.20pm): GCS 11. The plan was for an overnight stay with a CTB mane.

This is poor management. A drop of GCS by 2 should raise alarm bells and the plan to do CTB the next morning (after two falls in the GCS) was inappropriate. Further observations, however, suggest improvement in GCS. CTB scan as quoted in the discharge summary shows marked mass effect with obstructive hydrocephalus. Entry by Neurosurgery: “GCS 7”. It was not clear when this was done but vertebral artery dissection was considered as noted in the radiology report “there is irregularity of the right vertebral artery (VA) along its entire length suggestive of a VA dissection”. An EVD +/- post fossa decompression was considered but only an EVD was done at that stage. The next morning on the ward round the patient was found to have a dilated non-reactive left pupil. This important finding is not evident in the overnight observations. Posterior fossa decompression was then performed but the patient did not show any improvement and subsequently died.

The radiological report of the investigations is slightly confusing. On the one hand: “multiple vessels not filling suggests raised intracranial pressure rather than occlusion”, while on the other hand there is “occlusion of the posterior circulation presumably following the VA dissection”.

Whilst it may be argued that occlusion of the posterior circulation resulted in extensive infarct of brain stem, cerebellum, no surgical intervention would have changed the outcome. However if a CT scan was done early identifying ischemia (before extensive infarct) and CT angiography identifying VA dissection, there may have been a case for ligating the VA, preventing further embolic dissemination, and doing an extensive decompression of the posterior fossa. Posterior fossa decompression has a place in the management of cerebellar infarct.

With obstructive hydrocephalus EVD may indeed be necessary, but not enough consideration was given to identifying the aetiology and performing confirmatory tests to reveal the causative pathology. With significant mass effect in the posterior fossa and obstructive hydrocephalus, one unanswered question is whether upward herniation was considered.

Other factors that are not clear include the extent of the consultation, the review of the imaging, and clinical assessment by a registrar of sufficient seniority or a consultant.

Surgical lessons:

- A decline in neurological function as signified by a decline in the GCS is a prelude to rapid and irreversible neurological damage. Recognition and rapid diagnosis of the cause of this decline is vital to the survival of the individual. This case illustrates the need to not only document clinical decline but to act on such a finding. A reduction in the GCS of more than two points (and in this instance, 4 points) signified impending permanent neurological damage. Early investigation via radiological imaging may have averted this patient's poor outcome. The need to act on such assessment changes is vital in the appropriate treatment of patients.⁽¹⁶⁾
- Posterior circulation strokes are extremely complex conditions to manage successfully. A positive outcome often relies on difficult decisions and timely surgical management. This may initially take the form of external cerebrospinal fluid diversion to alleviate intracranial HTN, but may also require early posterior fossa decompressive craniectomy. It is often difficult to decide to proceed with such an invasive surgical procedure but as illustrated by this case, an early decision to carry out this procedure may have changed the outcome.⁽¹⁷⁾

Reference:

16. Mostofi K. Neurosurgical management of massive cerebellar infarct outcome in 53 patients. *Surg Neurol Int.* 2013;4:28.
17. Jensen M, St Louis E. Management of acute cerebellar stroke. *Arch Neurol.* 2005;62(4):537-44.

Neurosurgery

Case 12: Decision to operate despite decision to palliate—futile surgery

Clinical details:

Diagnosis: cerebellar meningioma.

Operations: posterior removal of tumour (subtotal), insertion of EVD and removal of residual tumour.

Cause of death: cerebellar oedema and hydrocephalus.

Course to death:

This patient in their mid-80s presented with blackouts and was found to have a large posterior fossa meningioma. They were taken to theatre and underwent craniotomy and attempted excision of the tumour. At operation it was found that there was a significant dural bleeding. The tumour itself was heavily calcified, resulting in significant difficulty in excising the tumour with the cavitation ultrasonic surgical aspirator (CUSA). The decision was made to partially debulk the tumour and, if needed, return for resection of further tumour at a later date.

In the immediate days following the procedure the patient developed increasing impaired consciousness and confusion, which required the insertion of an EVD on day 3. The patient's family elected to withdraw treatment and palliate but the patient underwent placement of another EVD ten days later. Despite the history up to that date, and the family electing for palliation, the decision was made to return the patient to theatre three weeks after the first operation for excision of the residual tumour. The operation report states that virtually all the tumour was removed, but the postoperative CT scan suggests that 3.5 cm of residual tumour remained.

The histology confirmed this to be a World Health Organization grade I meningioma. Over the next few weeks the patient's general clinical state fluctuated, with confusion and general medical problems, and the palliative care physicians were asked to see the patient one month postoperatively. The palliative care physician discussed the issue with the family and it was elected to palliate the patient. The patient passed away two days later.

Assessor's comment:

Several questions arise in this case. Treating an elderly patient with such a difficult tumour is difficult at the best of times. The wisdom of attempting resection in someone of this age should be questioned. Given that the patient was minimally symptomatic, if at all symptomatic, it may have been more appropriate not to have intervened at all.

However, it was decided to proceed with the intervention and from the first operation it was evident that this was not going to be an easy tumour to manage. Despite the knowledge at that time of the problems with the CUSA and the calcified tumour on the first attempt, the operation report states that once again difficulties with the CUSA were encountered and excision of the tumour required scissors to debulk the tumour. The peridural bleeding was obviously an issue, as was the heavily calcified tumour. The fact that the tumour could not be resected even after two operations, and that the patient deteriorated rapidly despite this, reinforces the futility of operating in this situation.

Futile surgery is an ongoing issue in neurosurgery. With an ageing population and the finding of more incidental abnormalities on imaging, it is also an increasing problem. Treating surgeons must be deliberate in their assessments and honest in their discussions with families regarding the futility of intervention in such cases in order to avoid such complicated scenarios from developing. In this instance, an elderly patient died having been subjected to four operations and treated in hospital for two months, and this outcome could easily have been predicted given the patient's age and nature of the tumour.

Surgical lessons:

- Surgeons with specific clinical expertise are often expected to present facts and information to members of the public who may not have the same level of knowledge in matters related to disease states. It is a duty of the operating surgeon to inform patients and relatives as to the natural history of the disease, purpose of interventions, and need or otherwise for such interventions. This case illustrates the importance of knowing when surgery should or should not be performed, irrespective of whether surgery can be performed. In some situations, as in this case, it is better to not operate than to operate in the first instance.
- There are certain surgical conditions, not only in neurosurgery, that require advanced training in order for the surgeon to perform the definitive surgical procedure. It is vital that surgeons be aware of their individual limitations, skill level and experience, as well as the condition's various pitfalls and risks. Adequate planning for these difficult cases is vital. In this instance, adequate planning in relation to the recognised heavy calcification of the meningioma, along with a request for another neurosurgeon's assistance, may have avoided this devastating outcome. As a surgeon, it should never be an issue to ask for assistance or advice.
- Once a decision is made for palliation (following extensive discussions with family members and other staff) there may be a tendency for surgeons to persist in our approach - to try to 'complete' the procedure in the hope that something miraculous occurs. This goes completely against the first lesson learned as medical practitioners, let alone surgeons: we should first do no harm. This case illustrates how the most basic philosophy in medicine may become lost when a surgeon becomes single-minded about completing the original task, failing to recognise that it is the patient, not the disease that is the priority. Unnecessary procedures often lead to further pain and suffering along with emotional stresses on both patients and relatives.⁽¹⁸⁾

Reference:

18. Royal Australasian College of Surgeons. End of life care Melbourne: *Royal Australasian College of Surgeons*; 2017 [17 Jan 2017]. Available from: https://www.surgeons.org/media/24971463/2016-10-26_pos_fes-pst-057_end_of_life_care.pdf.

Urology

Case 13: Accidental tension pneumothorax after failed percutaneous nephrolithotomy with delayed diagnosis

Clinical details:

Diagnosis: bilateral staghorn renal calculi with ileal conduit.

Operations: nephrostomy tube placement by interventional radiology (preoperative), right percutaneous nephrolithotomy (PCNL) and anaesthetic started at 8.30am.

Cause of death: cardiorespiratory arrest.

Course to death:

A patient in their mid-40s presented preoperatively to hospital for a right PCNL on a background of bilateral staghorn calculi. Past medical history included spina bifida, restrictive lung disease, asthma, deep vein thrombosis over two years ago, hydrocephalus (ventricular peritoneal shunt), seizures, ileal conduit, ileal conduit and HTN.

The patient was admitted three days preoperatively under the urology unit at the hospital. The rationale for the early admission was to obtain an accurate urine sample to appropriately treat any current UTI. The patient underwent insertion of a right nephrostomy with urine collection and was placed in a prone position. There were multiple attempts to access the right kidney but this could not be achieved due to difficult anatomy. Two puncture attempts were made.

The anaesthetist at 12.00pm changed the reinforced endotracheal tube to a regular endotracheal tube (prior to ICU transfer). Whilst awaiting an ICU bed the patient was relatively stable, with the oxygen requirements being weaned. At 1.15pm the patient's oxygen saturations deteriorated and the BP dropped. The patient's BP initially improved with Aramine and increased FiO₂. Further hypoxia and hypotension became evident, and this was unresponsive to adrenaline. The patient became bradycardic and eventually had an asystolic arrest. Thoracic surgery was informed and a right lateral chest incision was performed. A large gush of air was noted after this. An ICC was placed in the right thorax. Although CPR was commenced the patient passed away shortly

Assessor's comment:

This patient with bilateral staghorn calculi died as a result of an attempted right PCNL.

On admission the patient was found to be febrile, possibly septic. This admission took place two months after the patient was seen in outpatients, and one month after the case was considered in the x-ray conference. Antibiotics were given prophylactically despite no positive culture gained on urine examination. There was also no mention of any blood cultures, despite staghorn stones always being associated with infection.

The patient was rated as ASA 4 but the surgeon saw no need for critical care in an ICU or high dependency unit earlier. When asked why not, there was no response from the surgeon on the correspondence. However, it was recorded on the consent form that there was considerable overall risk of death, and herein lies an inconsistency.

The attempted right PCNL failed, with the nephrostomy tract established by the x-ray department the day earlier apparently not providing the access required for the stone. Either two or four further attempts were made to access the stone percutaneously. This was made a little more difficult by the use of direct imaging of the kidney without a ureteric catheter in place, and without contrast in the collecting system due to patient's allergy to contrast. In recovery, the patient's deterioration was rapid, having a tension pneumothorax and cardiac arrest. The patient's ICC was a little too late even with the help of the thoracic surgeons in recovery.

Following an ileal conduit urinary diversion, renal function and structure should be regularly checked throughout the life of the patient. In this case, despite being cared for at home, the patient developed bilateral staghorn calculi but there was no record of renal function provided in the notes. Ileal conduits are always colonised by pathogens, as are staghorn calculi. No bug was identified in the 48 hours prior to the operation and there was no mention of blood culture, but the elective operation proceeded even though the patient had been deemed septic. This patient presented many challenges that were under-rated. Failure to prearrange a critical care bed was poor judgement, as was proceeding without an identified and sensitive organism (despite the surgeon stating that the antibiotic regimen was appropriate).

At operation, with no ureteric catheter in the renal pelvis, the staghorn was approached by direct puncture with imaging from ultrasound. After four unsuccessful attempts to access the stone the procedure was abandoned, and the patient was transferred to recovery where deterioration was rapid. With a drop in BP, lack of chest movement on the right and no breath sounds prior to the cardiac arrest, there was a delay in recognising this tension pneumothorax, hence introducing a possible anaesthetic component. However, the risk of puncturing the pleura was recognised preoperatively, and with restricted lung disease the possibility of pneumothorax should have been anticipated.

Some PCNL's are straightforward but not in this patient. There were quite a number of steps in this treatment process which could have improved the outcome, sufficient to class these in combination leading to an adverse event.

Surgical lessons:

- The surgical lessons from this case exemplify in part at least all seven of the "Emerging issues and recommendations".
- In retrospect, this patient in their mid-40s had very poor medical supervision.
- The preoperative management seemed inadequate. This case lacked good leadership - a perioperative physician was not involved, and the surgeon in charge did not recognise the complexity of the case, as evidenced by the failure to arrange care in an ICU or high dependency unit.
- At surgery, the renal pelvis could not be outlined due to allergy to contrast; however, there was always methylene blue dye, which could have been used to outline the collecting system.
- The failure to be able to use the nephrostomy tract established by radiology, and the lack of appreciation of the high risk of pleural puncture with two, three or even four attempts at another nephrostomy demonstrates at least two things. First is the skill and experience required when dealing with patients with a distorted anatomy. Second is that more planning by more clinicians during the preoperative period may have led to better identification and anticipation of potential problems, enabling a better response to the puncture failure and earlier recognition of the clinical deterioration.^(19, 20)

Reference:

19. Wein AJ, Kavoussi LR, Partin AW, Peters CA, editors. *Campbell-Walsh Urology*. 11th ed. Elsevier; 1992.
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Vascular surgery

Case 14: Retroperitoneal haemorrhage following retrograde femoral punctures do occur

Clinical details:

Diagnosis: right groin puncture site bleeding.

Operations: bilateral common femoral artery (CFA) retrograde punctures, left 5 Fr sheath, right 6 Fr sheath, diagnostic runs via right side, left common iliac artery and external iliac artery angioplasty stent after 2500U heparin, and Star Close closure right groin, pressure haemostasis left groin.

Cause of death: asystolic cardiac arrest.

Course to death:

A patient in their late 70s with a previous history of diabetes, chronic kidney disease and ischaemic heart disease with two coronary stents underwent aortobifemoral angiogram and right iliac angioplasty stenting. The operation was completed at approximately 12.30pm with a Star Close closure device deployed in the right CFA. In recovery, the patient was noted to be hypotensive and bradycardic (systolic BP 80 mmHg and heart rate 60 bpm), and was complaining of right groin pain with swelling. A MET call occurred with ICU attendance. Localised digital pressure was applied to the right groin, 25mg IV protamine was administered with fluid resuscitation, and a femstop was applied. The surgeon performed a duplex scan and no active bleeding or false aneurysms were identified. Haemoglobin (Hb) had dropped from 137 to 93 gm/dL. A cardiology review was requested due to electrocardiogram changes, and possible myocardial ischaemia, which facilitated the stabilisation of the patient.

At 3.15pm an asystolic Code Blue was called. The patient was intubated and CPR commenced. A second vascular surgeon who was in the angio suite attended and a decision was made to transfer the patient to theatre. A midline laparotomy was performed by the second vascular surgeon and an aortic cross-clamp was applied to a calcified aorta despite suspected bleeding from the right groin puncture. A retroperitoneal haematoma was noted. The primary surgeon arrived and performed a right groin incision. No active bleeding was found but the patient was hypotensive despite high inotropic support and LUCAS™ CPR. The patient died at 4.50pm.

Assessor's comments:

3.15pm Code Blue: at this point it was clear that the patient had significant retroperitoneal bleeding. The hypotension, right iliac fossa pain and large drop in Hb would suggest quite extensive blood loss. Surgical exploration at this point would be appropriate and recommended. If the patient stabilised, a conservative approach may possibly be considered. However, an urgent CT, angiogram, or further catheter angiogram would be needed to confirm that the bleeding had stopped, and then with a low threshold for surgery if the patient deteriorated. A bedside ultrasound was inadequate. The first-line assessor did not think groin pressure or femstop is useful, as this does not control retroperitoneal bleeding.

3.48pm operating theatre: at this point the patient was in extremis and CPR continued. A laparotomy and aortic cross-clamp was entirely appropriate in this situation.

This would have stopped any iliac bleeding and increased coronary perfusion. Targeted exploration of the iliac could be carried out after this manoeuvre. Unfortunately, it would seem that the patient was unsalvageable by this stage.

The FLA assessor believed that the postoperative care should have been better. A life-threatening bleed should be treated promptly and aggressively, and the assessor did not think this was the case. The surgical operation and aortic cross-clamp were appropriate, though too late to save this patient's life.

Surgical lessons:

- Retrograde punctures can cause retroperitoneal bleeding.
- Patients can die unnecessarily from delayed diagnosis or delayed intervention.⁽²¹⁾

Reference:

21. Trimarchi S, Smith DE, Share D, Jani SM, O'Donnell M, McNamara R, et al. Retroperitoneal hematoma after percutaneous coronary intervention: prevalence, risk factors, management, outcomes, and predictors of mortality: a report from the BMC2 (Blue Cross Blue Shield of Michigan Cardiovascular Consortium) registry. *JACC Cardiovasc Interv.* 2010;3(8):845-50.



Vascular surgery

Case 15: Delay in diagnosis of cardiac tamponade after insertion of permacath

Clinical details:

Diagnosis: right leg atrioventricular (AV) graft for steal syndrome (dialysis access).
Operation: attempted insertion of permacath under general anaesthesia.
Cause of death: cardiac tamponade.

Course to death:

Past medical history of this patient in their mid-50s included end stage renal failure (secondary to reflux nephropathy), triple failed renal transplants, right thigh AV fistula and was a current smoker. There were recurrent admissions for blocked right AV graft requiring thrombectomy, HTN, chronic obstructive pulmonary disease and parathyroidectomy.

The patient was admitted with lower limb claudication, thought to be related to steal syndrome from the AV fistula on the right thigh. This was shown on angiography and angioplasty was attempted. However, this failed to resolve the issue.

On the ninth day of admission an urgent permacath was arranged for the late afternoon due to an ongoing need for haemodialysis. During the procedure the right internal jugular vein was cannulated and a guide wire inserted. Dilatation was achieved but the permacath failed to thread. An open cut down was attempted, but the patient suffered cardiovascular collapse and the procedure was abandoned. An ICC was immediately inserted on the right to account for and treat any haemo-pneumothorax, but minimal output was obtained.

A bedside transthoracic ECHO demonstrated a small pericardial effusion. This was again repeated in ICU, where the effusion was again noted to be small. There was new onset LV failure. That night, requirements for inotropic support increased and a vascath was inserted into the right internal vein for the urgently required haemodialysis for acidosis and hyperkalaemia. There had been multiple attempts at other sites without success. With an unclear cause for haemodynamic deterioration, adrenaline, steroids and antibiotics were also given.

The following morning, review of an ECHO by the cardiothoracic surgery team noted the presence of cardiac tamponade due to a large pericardial effusion. Urgent pericardial drainage by pericardiocentesis was performed with a significant return of bloody fluid. There was a dramatic reduction in noradrenaline requirements but the patient remained gravely ill. Over the course of the day the patient deteriorated again, and a decision was made to palliate the patient.

Assessor's comments:

This was a difficult case in a severely comorbid patient and the treating surgeon did everything possible considering the severity of illness. Patient factors, the timing of the case and a lack of clarity in investigations all contributed to a poor outcome.

Adverse event: The concern in this case was the delay in recognition of cardiac tamponade. This was not appreciated on multiple serial bedside ECHOs until the cardiothoracic surgery team noted the tamponade many hours down the track. It seems that there was false reassurance throughout the night from the interpretation of these bedside ECHOs, and since pericardial drainage may have occurred earlier. The suggestion in the VASM form by the treating surgeon is to have a formal transoesophageal echocardiogram performed at the time of the acute deterioration. This may have been more accurate in determining the presence and extent of any cardiac injury, and therefore the potential for cardiac tamponade.

Surgical lessons:

- Always be aware that central venous access can be complicated by perforation of a major vessel or the heart.⁽²²⁾
- Any haemodynamic instability after this procedure must raise the possibility that this has occurred.

Reference:

22. Reese JC. Cardiac tamponade caused by central venous catheter perforation of the heart: a preventable complication. *J Am Coll Surg.* 1996;182(6):558.



Vascular surgery

Case 16: Untreated known *Aspergillus* infection causing ruptured mycotic mesenteric aneurysm after abdominal aortic aneurysm repair

Clinical details:

Diagnosis: large abdominal aortic aneurysm (AAA)>7cm.

Operations: open AAA repair; coil embolisation of bleeding branch of superior mesenteric artery.

Cause of death: exsanguination from ongoing bleeding, ischaemic bowel.

Course to death:

A patient in their mid-60s attended an outpatient vascular surgical review for management of an AAA. The patient had multiple pre-existing medical comorbidities, including peripheral vascular disease previously treated with a right femoral popliteal bypass graft and a left femoral embolus that resulted in an above-knee amputation. The patient was a smoker until two weeks prior to the operation with chronic respiratory disease that was complicated by a cavitating pulmonary lesion caused by infection with aspergillosis (noted in a CT scan of the chest performed during an admission to hospital two months previously with a fractured right leg). Other comorbidities included alcoholic liver disease with acute liver failure, HTN, chronic renal impairment, deep vein thrombosis, recent chronic anaemia and depression. It was also noted in the vascular surgery review that a respiratory registrar advised that it was not necessary to treat the aspergillosis pulmonary infection if it was asymptomatic.

An elective open repair of an AAA and bilateral common iliac artery aneurysm was completed in approximately 5.5 hours. A bifurcation graft was performed with an infra-renal proximal anastomosis, a right limb anastomosis to the right external iliac artery, a left limb anastomosis to the left iliac bifurcation, and a separate graft from the left iliac limb to the right internal iliac artery.

The patient was transferred to ICU for postoperative management, including treatment of hypotension, acute renal failure, low haemoglobin fibrinogen and albumin, an episode of melena, and respiratory infection. The patient developed pneumonia that was treated with antibiotics but a sputum culture revealed growth of the *Aspergillus* organism. On the advice of the infectious disease department it was decided that it was not necessary to treat this with anti-fungal agents (because it was considered unlikely to be pathogenic). The patient recovered sufficiently to be discharged from the ICU on day 11.

The patient's condition suddenly deteriorated on day 12 due to an intra-abdominal haemorrhage from mesenteric arteries. The diagnosis was confirmed by imaging and angiography that demonstrated at least two separate sites of haemorrhage. It was decided to avoid an exploratory laparotomy and to treat the haemorrhage with an endovascular coil embolisation procedure. This was performed on two separate occasions but failed to control the haemorrhage. The patient's condition continued to deteriorate due to ongoing haemorrhage and/or mesenteric ischaemia. It was decided to treat the patient palliatively and death occurred on day 13.

Assessor's comments:

The cause of death in this case was clearly an acute intra-abdominal haemorrhage from bleeding mesenteric arteries. The cause of the haemorrhage is unknown, but it is very unlikely that it was due to either the aneurysm repair or the subsequent postoperative care. However, the patient was known to have recently had a cavitating lung lesion due to an aspergillosis pulmonary infection. This organism has been documented as the cause of mycotic aneurysms, and of haemorrhage of extracranial and intracranial carotid arteries and the aorta, particularly in immune compromised patients.

Although it appears that there are no reports in the medical literature of mycotic aneurysms of mesenteric arteries caused by infection with this organism, it is reasonable to consider that this organism could cause mycotic aneurysms of other arteries including mesenteric arteries. As such, it may have been a possible cause of the mesenteric haemorrhage. This patient was known to have an aspergillosis pulmonary infection prior to the operation, and also during the postoperative care. The decision was made not to treat this either before or after the operation on the grounds that it was asymptomatic, apparently without factoring in the possibility that this organism could cause an active and systemic infection in a patient whose resistance to infection was compromised by pre-existing medical comorbidities and very major surgery.

In retrospect, the patient should not have undergone an elective major operation without prior treatment of the pre-existing aspergillosis pulmonary infection. It is likely that the decision to avoid an exploratory laparotomy was correct, as it is very unlikely that the patient would have survived the procedure. The decision to treat the patient palliatively was entirely appropriate.

Surgical lessons:

- Treat any systemic infection prior to insertion of a prosthetic graft.
- Mycotic aneurysm from *Aspergillus* infection has been reported.^(23, 24)

Reference:

23. Tonolini M, Petulla M, Bianco R. Mycotic visceral aneurysm complicating infectious endocarditis: Imaging diagnosis and follow-up. *J Emerg Trauma Shock*. 2012;5(2):201-3.
24. Oderich GS, Panneton JM, Bower TC, Cherry KJ, Jr., Rowland CM, Noel AA, et al. Infected aortic aneurysms: aggressive presentation, complicated early outcome, but durable results. *J Vasc Surg*. 2001;34(5):900-8.

List of shortened forms

AAA	abdominal aortic aneurysm
AF	atrial fibrillation
AV	atrioventricular
AVR	aortic valve replacement
BP	blood pressure
CABG	coronary artery bypass graft
CBD	common bile duct
CFA	common femoral artery
CPB	cardiopulmonary bypass
CPR	cardiopulmonary resuscitation
CT	computed tomography
CTB	computed tomography brain
CUSA	cavitationalultrasonic surgical aspirator
CXR	chest x-ray
ECHO	echocardiogram
ED	emergency department
EVD	external ventricular drain
GCS	Glasgow Coma Scale
GI	gastrointestinal
HTN	hypertension
IABP	intra-aortic balloon pump
ICC	intercostal catheter
ICU	intensive care unit
IV	intravenous
LAD	left anterior descending artery
LV	left ventricular
MET	medical emergency team
NOF	neck of femur
PCNL	percutaneous nephrolithotomy
PEG	percutaneous endoscopic gastrostomy
PET	positron emission tomography
RACS	Royal Australasian College of Surgeons
UTI	urinary tract infection
VA	vertebral artery
VAC	vacuum-assisted closure
VASM	Victorian Audit of Surgical Mortality
VATS	video-assisted thoracoscopic surgery
VP	ventilation perfusion

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Mr Ivan Kayne	Consumer Representative
Ms Claudia Retegan	Project Manager, VASM
Mr Gordon Guy	ANZASM Manager, Research, Audit & Academic Surgery Division, Australian and New Zealand Audit of Surgical Mortality

Contact details

Victorian Audit of Surgical Mortality (VASM)
Royal Australasian College Of Surgeons
College of Surgeons' Gardens
250–290 Spring Street
East Melbourne VIC 3002 Australia

Web: www.surgeons.org/vasm
Email: vasm@surgeons.org
Telephone: +61 3 9249 1154
Facsimile: +61 3 9249 1130

Postal address:
Victorian Audit of Surgical Mortality (VASM)
GPO Box 2821
Melbourne VIC 3001 Australia

The information contained in this case note review booklet has been prepared by the Royal Australasian College of Surgeons Victorian Audit of Surgical Mortality Management Committee, which is a declared quality improvement activity. The Australian and New Zealand Audit of Surgical Mortality, including the Victorian Audit of Surgical Mortality, also have protection under the Commonwealth Qualified Privilege Scheme under Part VC of the Health Insurance Act 1973 (Gazetted 25th of July 2016).

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Contact details

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Royal Australasian College Of Surgeons
College of Surgeons' Gardens
250–290 Spring Street
East Melbourne VIC 3002 Australia

Web: www.surgeons.org/vasm
Email: vasm@surgeons.org
Telephone: +61 3 9249 1154
Facsimile: +61 3 9249 1130

Postal address:
Victorian Audit of Surgical Mortality (VASM)
GPO Box 2821
Melbourne VIC 3001 Australia

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