

Victorian Audit of Surgical Mortality
Case Note Review
Booklet
Eleventh Edition July 2019



The Victorian
Surgical Consultative Council



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Introduction

Welcome to the 11th edition of the Victorian Audit of Surgical Mortality (VASM) case note review booklet. This is my first as the new Clinical Director following the sterling work of my predecessors Professor Colin Russell and Associate Professor Barry Beiles. You will find 20 selected cases, covering as many specialties as possible, from the hundreds that have crossed my desk over the last year. I hope they will encourage debate, some empathy and sympathy, and help prevent such issues happening again. A recent review of the Audit by Aspex Consulting has shown that these booklets are the most popular and educational of the various VASM publications.⁽¹⁾ I encourage you to include them in training programs for junior staff and make available the important lessons in this publication to all relevant healthcare professionals.⁽²⁾

The VASM is a systematic peer review audit of deaths associated with surgical care. The audit reviews all surgical deaths that have 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 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 medical records used in the review process comprise all medical notes and records relating to the patient's care and are currently de-identified (unlike all the other States and Territories in Australia).

The Qualified Privilege (QP) declaration reassures surgeon participation by strictly protecting the confidentiality of information gained through the audit. Should you require more information on QP there is an information leaflet on the VASM website and links to discussions had at a recent VASM seminar.

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 am indebted to both Associate Professor Bruce Waxman and Mr Peter Burke for helping with the general surgery cases.

The success of the VASM is dependent upon participating surgeons and hospitals, the support of Safer Care Victoria at the Department of Health and Human Services, and the highly efficient, motivated and hard-working staff members at the RACS. I am confident about the future impact of the VASM.

I hope you find this publication of value.

Associate Professor Philip McCahy,
Clinical Director, VASM

Emerging issues and recommendations

We have been highlighting emerging issues and producing recommendations in every booklet since 2011 and it is rather alarming to see that it is the same topics coming up time after time. For this year we have reduced the number of issues reported and linked them to the cases that follow, with each area appearing multiple times. There is rarely one event that leads to a surgical death and many factors may be involved in a single case. One new area is highlighted – inappropriate treatment. In a developed country such as Australia, if there is any doubt that the best results cannot be achieved because of lack of facilities or skills, then it may be best that operation should not be performed, and if appropriate, the patient transferred to a better equipped service.

1. Inappropriate treatment (Cases 1, 8, 11, 17). This can be an inappropriate operation, or an appropriate operation performed in an inappropriate hospital, or an appropriate operation performed by an inexperienced surgeon.
2. Delay (Cases 2, 6, 14, 16, 17). This can be delay in diagnosis, delay in treatment or delay in transfer.
3. Preoperative management (Cases 3, 7, 8, 9, 11, 12, 14, 15). Many patients have multiple comorbidities which can be improved before surgery by involving physicians, intensive care staff, anaesthetists and geriatricians. The improved results from orthopaedic surgery where units have ortho-geriatric teams is a good example of multidisciplinary teamwork. It is further recommended that all appropriate imaging is reviewed by the operating team prior to any surgery as several cases have involved unexpected operative findings that were potentially seen on preoperative scans.
4. Perioperative management (Cases 3, 8, 10, 13, 18). Intraoperative complications are one of the most stressful aspects of any surgeon's life and will always be a concern. Having protocols to deal with such disasters may help the operative team. Getting senior assistance as soon as possible will help deliver better results and must never be seen as a failure on the part of the operating surgeon. The care of the patient must be the goal of the whole team.
5. Documentation (Cases 2, 7, 9, 10, 12, 19). There is no excuse for the poor documentation frequently encountered by the VASM assessors. If an event such as a consultant ward round is not recorded, it may as well not have happened. All healthcare workers must document their interactions with patients/family including date, time and role of worker. Time will tell if electronic medical records will improve this important area, though they will certainly help legibility.
6. Communication (Cases 2, 5, 6, 12, 14, 15, 16, 19). There have been several cases where the goals of care have not been clearly passed on between various teams. As far as possible decisions should be made by the most senior members of teams and communication should occur between the team leaders and not left to junior staff.
7. Futile surgery (Cases 1, 10, 12, 15, 17, 18). In many cases an operation may hasten an inevitable death. Informed discussion with the patient and their family can lead to a better death without the falsely raised hope and major resources associated with surgery.

Cardiothoracic Surgery – Malignancy

Case 1: Preoperative diagnosis and inappropriate surgery - Terminal illness with limited life expectancy

Clinical details:

Diagnosis: Malignant right pleural effusion - metastatic lung cancer.

Operation: Right video-assisted thoracoscopic surgery (VATS) drainage of effusion and limited decortication to remove exudate. Pleural biopsy.

Cause of death: Palliated due to ongoing respiratory failure.

Course to death:

Very elderly patient, but independent prior to admission. Lung resection the previous year by another surgeon. Presented with massive right pleural effusion and respiratory failure. Right VATS drainage was undertaken along with pleural biopsy to confirm metastatic lung cancer. White blood cell count (WCC) $70 \times 10^9/L$ preoperatively, thought to be leukaemia reaction. Once diagnosis confirmed, the Intensive Care Unit (ICU) and treating physician decided that escalation of care was inappropriate. The patient was palliated and passed away six days after the surgical procedure.

Assessor's comments:

The decision to operate on this patient was inappropriate.

In summary, this was a patient in their late-eighties, with known metastatic lung cancer who presented with a large symptomatic malignant pleural effusion with widespread pleural metastatic disease. The appropriate treatment in this patient would have been for intercostal pleural drainage for symptomatic relief and following this, if the drainage was ongoing, could have been discharged with a PleurX catheter to enable them to live out the remainder of their life in a less symptomatic state.⁽⁹⁾ Instead, this patient was taken to theatre and underwent a bronchoscopy followed by a three-port video-assisted thoracoscopic pleurodesis taking one hour to achieve the same result. This probably expedited the patient's death even though they had a terminal illness and a limited life expectancy.

It is of concern that the surgeon has commented in the surgical case form that the overall risk of death was "expected", and if that was the belief, why would the patient be subjected to surgery with the inevitable distress for the patient and their family? It is also concerning that the surgeon has ticked the box indicating that they would not do anything differently.

Surgical lessons:

- Careful consideration must be taken when planning to operate on elderly patients with malignant effusions.
- Less invasive options, such as PleurX long-term catheters, are an alternative if there are significant symptoms and the life expectancy is expected to be short.

Reference:

3. Warren WH, Kalimi R, Khodadadian LM, Kim AW. Management of malignant pleural effusions using the Pleur(x) catheter. *Ann Thorac Surg.* 2008;85(3):1049-55.

Cardiothoracic Surgery - Trauma

Case 2: Communication, documentation and delay in treatment

Clinical details:

Diagnosis: Multi-trauma.

Operation: Right rib fixation ribs 5 to 8.

Cause of death: Respiratory failure secondary to pneumonia and multiple rib fractures.

Course to death:

Transfer from another hospital, admitted with fall from standing height with multiple rib fractures/ chest trauma. Fractures: right lateral ribs 4 to 7, comminuted ribs 8 to 9 - flail, T8 and T9 transverse process fracture. Past medical history: Type II diabetes mellitus (DM), Parkinson's disease, depression, hypertension (HTN), hypercholesterolaemia. Admitted to ICU, rib fracture repair in theatre under Cardiothoracic Unit, uncomplicated procedure, lung laceration noted intraoperatively which was sutured. That evening, developed fever, tachycardia, tachypnoea, and desaturated. Treated with vancomycin and piperacillin/tazobactam. Went on to grow *Staphylococcus aureus* in blood stream, unresponsive to antibiotics and decision made on day three to palliate as per family wishes and patient passed away two days later.

Assessor's comments:

A patient in their early seventies with a history of Parkinson's disease, Type II DM, HTN, and heavy ethanol intake. Suffered five falls in the previous six months due to the Parkinson's disease. Patient sustained an unwitnessed fall onto right side at home but was unable to get up until found about 15 minutes later by partner, who called an ambulance, following which the patient was transferred to the Emergency Department (ED) of a local hospital. The patient was felt to be "slightly disoriented" (albeit with a Glasgow Coma Scale (GCS) of 14/15) with a sinus tachycardia and a respiratory rate of 20 breaths per minute. There was tenderness over the right chest wall, with associated crepitus and subcutaneous emphysema. There was no paradoxical movement nor respiratory distress. A chest computed tomography (CT) scan confirmed fractured right ribs – six to nine with some direct impingement onto the diaphragm, together with associated subcutaneous emphysema and a small pneumothorax. The patient was admitted under a General Surgical Unit and arrangements were made for transfer to a Trauma Centre under the Cardiothoracic Surgery Unit bed card.

The progress note at the Trauma Centre on the following day contains an ICU review questioning the need for rib fixation. The patient was intermittently confused and complaining of pain, so a Ketamine infusion was commenced. The physiotherapist's note on the following day stated that the patient was unable to cough because of pain. A subsequent assessment by the Acute Pain Service felt that the patient was at high risk of respiratory deterioration because of poor pain control, Parkinson's disease, a history of smoking and a confusional state which may have been ethanol related.

An epidural was therefore inserted for pain relief. Over the next two days the patient had intermittent periods of confusion and drowsiness, was pulling out lines and a nasogastric tube (NGT) (which was inserted for abdominal distention) and had a poor cough.

The first progress note from the Cardiothoracic Surgery Unit was entered on the fifth day following admission to the Trauma Centre and stated that the patient was "asked to consent for rib fixation". The patient was still intermittently confused and had been hypertensive throughout the stay. Surgery was planned for the following day but was not carried out and was postponed to the next day (one week after the fall and six days after transfer to the Trauma Centre). This involved internal fixation of the right fifth and seventh ribs and repair of a laceration to the underlying lung. On the first postoperative day, the patient was noted to be confused and still in pain, febrile 39°C, sinus tachycardia 120 beats per minute (bpm), WCC $14 \times 10^9/L$. A diagnosis of "sepsis and pain" was made. Treatment with piperacillin/tazobactam, vancomycin and oxygen via nasal prongs proceeded. By this stage the patient was hypotensive (blood pressure 100/60) and obviously septic. On the following day, blood cultures from

two days previous yielded *Staphylococcus epidermidis* while urine culture yielded *Escherichia coli*. By this time the patient had been transferred out of Intensive Care to the Cardiothoracic Surgical Ward with a note that the patient was not for re-admission to ICU.

However, a follow-up visit by the ICU team noted that there was evidence of an acute kidney injury which was treated with intravenous furosemide. The antibiotics were discontinued and the patient was commenced on meropenem.

The WCC rose to $17 \times 10^9/L$, blood sugars were high and a C-reactive protein (CRP) test was 295 mg/L. Creatinine rose from 104 to 161 $\mu\text{mol/L}$, estimated glomerular filtration rate (eGFR) fell from 61 to 36 mL/min/1.73m² as sodium climbed to 153 mmol/L. By this stage the patient was incoherent, unable to obey commands and was still in pain. A Medical Emergency Team (MET) call was made when the heart rate was 150 bpm but did not result in any additional treatment. The MET call criteria were then apparently changed to "only for concerns". A family meeting was held, and the decision was made for palliative care. On the following day, another family meeting reviewed the patient's pre-morbid condition, when it was noted that there had been a significant physical and mental decline over several months. The decision was then made to cease all medications, as well as nasogastric feed and observations and to apply comfort measures only. The patient died the following day.

Both the quality of the record keeping and the lines of communication, from the point of view of the Cardiothoracic Surgery Unit in the Trauma Hospital, were inadequate. The first progress note from the Cardiothoracic Surgical Unit occurred on the fifth day following admission to the Trauma Centre. It is not clear from the notes which unit the patient was originally admitted to since the ICU progress notes three days after admission state that the patient was "admitted for respiratory support", but on the following day the progress notes state "patient now under cardiothoracic, but was not well communicated", a statement which was subsequently crossed out.

This is against the background that the progress notes after admission to the first hospital the day following the injury, stated "have contacted the Cardiothoracic team. Registrar suggested intercostal nerve block interim. Await further contact from Cardiothoracic Registrar". If the transfer was arranged through the Cardiothoracic Surgery Registrar, it would be expected that the Cardiothoracic Unit should see the patient on admission and make daily progress notes, clearly outlining the decision for surgery, as well as the reason why it was delayed. There is no information to document this. There is also no explanation why a patient who was clearly in pain, confused, and with respiratory distress had to wait a week before undergoing surgery. If there was any medical reason for this, it is not obvious from any of the documentation in the notes.

Conclusion: This patient had significant comorbidities which clearly contributed to a difficult post trauma course; there appears to have been poor communication and/or poor documentation throughout the patient's admission to the Trauma Centre and this is something which should be addressed to prevent further such episodes. The outcome may not have been different but the apparently inordinate delay in surgical treatment may well have contributed to the poor outcome.

Surgical lessons:

- This case highlights the importance of good communication and documentation which is imperative in all patients, especially in dealing with multiple other medical units within the hospital who may not be familiar with the surgical procedure and/or expected outcomes.

Cardiothoracic Surgery

Case 3: Preoperative workup and intraoperative difficulties

Clinical details:

Diagnosis: Severe aortic regurgitation due to failure of sorin tissue prosthesis. Ascending aorta false aneurysm. Previous ascending aorta replacement.

Operation: Re-do sternotomy, aortic root and ascending aorta replacement, peripheral cannulation. Deep hypothermia circulatory arrest, coronary artery bypass graft (CABG) × 3, extracorporeal membrane oxygenation (ECMO) insertion.

Cause of death: Bleeding and poorly protected heart intraoperatively.

Course to death:

The patient in their late sixties was admitted for elective replacement of a prosthetic aortic valve and repair of an ascending aortic false aneurysm. Past medical history included a bioprosthetic aortic valve repair, suspected childhood rheumatic fever and was an ex-smoker.

Routine follow-up showed early deterioration of the existing aortic valve as well as ascending aortic aneurysm. Surgery was deemed the only option to fix both issues and a booking was made for elective repair. After the old sternotomy was opened it became clear that the aorta was inaccessible due to the large aortic aneurysm. Peripheral cannulation was achieved and cardiopulmonary bypass (CPB) commenced after two hours. In attempts to dissect down to the false aneurysm, the aneurysm was ruptured, and it was difficult to achieve adequate views to apply cross clamp and a massive haemorrhage ensued, with the patient requiring intensive blood product support and a cross clamp was placed.

The patient was cooled rapidly to 20°C, whilst in circulatory arrest the operation completed and Bentall's procedure performed with St Jude Mechanical valve placed. Three CABG grafts were placed and temporary pacing wires as well as three drains placed.

Postoperative cardiac ultrasound showed severe global left ventricle akinesis and the patient was unable to be transitioned off bypass. A decision was made to transition to ECMO and to transfer to ICU, and then facilitate family discussion and withdrawal of care. The patient admitted to ICU, remained haemodynamically unstable despite maximal support via ECMO which could not maintain adequate flow due to loss of volume. A decision was made to discontinue ECMO in the setting of irrecoverable heart function.

Assessor's comments:

This is undoubtedly a difficult case. Premature failure with this bioprosthesis has been widespread. The arterially-placed false aneurysm presents a large problem which significantly increases risk of re-operation. However, properly approached, this should still have been manageable.

The surgeon is to be commended for their honesty and transparency, as there is acknowledgement that an error was made – the need to be fully cooled and on circulatory arrest when the aneurysm was approached. A further error was not to have the conduit already harvested ready for grafting. There is no mention of retrograde cardioplegia which is inexplicable given the problems giving an antegrade. Also, custodial histidine-tryptophan-ketoglutarate cardioplegia causes much washout and is not reliable for re-dos; with adhesions when there is too much washout numerous failures have occurred.⁽⁴⁾ Finally, the coronaries should have been reimplemented ideally via a Valsalva graft or Cabrol as preoperative scanning showed them to be 40 mm apart so would never reach a tube graft. The significance of this scan was not fully appreciated overall.

Surgical lessons:

- Myocardial protection refers to the strategies used to mitigate the heart against ischaemic insult. It is one of the most important aspects of cardiac surgery utilising CPB.
- Myocardial protection takes on more importance in difficult and prolonged cases, when the ischaemic time is extensive, and so a well-formulated plan (including how to deal with unexpected findings) is required. Failure to do so can lead to poor outcomes in already high-risk groups.

Reference:

4. Velissaris T KO, Asopa S, Calver A, Ohri SK. Myocardial protection during reoperative cardiac surgery: early experience with a new technique. *Tex Heart Inst J.* 2010;37(1):75-8.

ENT Surgery

Case 4: Rare complication of a low tracheostomy

Clinical details:

Diagnosis: T4aN1 squamous cell carcinoma (SCC) anterior maxilla.

Operation: Anterior bilateral maxillectomy, neck dissection, tracheostomy, scapula free flap reconstruction.

Cause of death: Cardiac arrest, secondary haemorrhage post-surgery.

Course to death:

Right selective neck dissection and subtotal maxillectomy for maxillary SCC, with left scapular angle myo-osseous free flap reconstruction and surgical tracheostomy insertion. Febrile day two postoperatively, some atelectasis on chest X-ray. Was on cefazolin and metronidazole since surgery. Antibiotics changed to ceftriaxone and metronidazole following MET call for agitation and decreased oxygen saturations day three postoperatively. Trachea cuff down for four hours was well tolerated. Continued trachea weaning thereafter. Trachea cuff down from morning well tolerated.

Day eight at 0300 hours the patient started profuse bleeding from maxilla/tracheostomy site—code blue called—pulseless electrical activity (PEA) arrest, intubated with endo-tracheal tube (ETT) to secure airway—massive bleeding continued—no output despite four units of packed red blood cells (PRBC) via 2 × IO access, 4 × adrenaline. Decision to withdraw.

Assessor's comments:

This case may represent the rare complication of a low tracheostomy, i.e. damage to innominate vessels (no details of tracheostomy). The anastomosis for the free flap was to the facial artery much higher than the tracheostomy. Carotid artery blowout is not seen in primary neck dissection unless there has been prior radiotherapy. The possibility of respiratory arrest cannot be ruled out but unlikely. It is speculation as to cause of death without a post-mortem. The assessor couldn't see a reference to deep vein thrombosis (DVT) prophylaxis in the notes provided.

This case involved a patient in their mid-seventies who underwent a subtotal maxillectomy, right selective neck dissection, dental clearance, and reconstruction with a scapular free flap. A preliminary tracheostomy was performed before surgery commenced.

Comorbidities: Type II DM, HTN, varicose veins, anxiety.

The tracheostomy was described as being low lying due to the patient having a short neck. A NGT was inserted intraoperatively.

Postoperative day 4: the patient was febrile with evidence of basal atelectasis and possible chest infection, treated with appropriate antibiotics and physiotherapy.

Several episodes of agitation were noted in the next few days possibly associated with the infection and mild hypoxaemia. Diabetes was well controlled, and the cuff of the tracheostomy was being let down in an effort to wean. Day five and six cuff released for four to five hours per day. Day 7, one unit of packed red blood cells given (Hb 7.2 g/dl) and noted that patient coughed up a clot of blood.

On day eight the patient was found collapsed with profuse haemorrhage around the tracheostomy site with pulseless electrical activity. It is noted that ventilation was possible through the tracheostomy tube so it was decided not to remove the tube. However, an endotracheal tube was passed above the tracheostomy.

It is unclear from the notes whether the patient was being ventilated through the tracheostomy tube or the endotracheal tube during the resuscitation (there is a note that the patient could be ventilated through both tubes). An appropriate resuscitative effort was made with administration of four units of red blood cell transfusion and four doses of adrenaline. It was noted however that there was no blood coming through the ventilation pathway and that there was the presence of a clot and some blood in the hypopharynx and pharynx, but also blood around the tracheostomy tube. After vigorous efforts to resuscitate the patient, resuscitation was ceased.

Comment: It is not logical to try and pass an endotracheal tube in the presence of a functioning tracheostomy (secure airway).

Surgical lessons:

- Delay recognising complication.

General Surgery

Case 5: Communication failures when junior doctor lacks supervision – Misdiagnosis of anticoagulants

Clinical details:

Diagnosis: Umbilical hernia.

Operation: Umbilical incisional hernia repair.

Cause of death: Haemorrhagic shock; peritoneal and rectus sheath haemorrhage complicating surgery for an incisional hernia in patient treated with warfarin.

Course to death:

A patient in their mid-eighties presented with one day of crampy abdominal pain and distention with associated nausea and vomiting. Umbilical hernia noted on CT. Similar episode of small bowel obstruction (SBO) one year earlier, treated as adhesional (past history: open appendicectomy, open cholecystectomy) and resolved conservatively (told by team in hospital not fit for general anaesthesia due to heart disease).

Previous medical history: pulmonary embolism (PE) and DVT; atrial fibrillation (AF), warfarin, Alzheimer's dementia, single kidney since birth and stage 3 renal failure.

Social: Living in high level nursing care; able to shower and dress, otherwise meals and cleaning performed by staff. Still mobilised with support. NGT inserted on admission and removed 24 hours later. SBO resolved and bowels opened. Umbilical hernia – resolved on examination, patient and family not keen to have surgical intervention because of comorbidities. Outpatient follow up.

Outpatient appointment: concerns with recurrent SBO and potential need for emergency surgery if re-presents; agreed to elective surgery; referred to anaesthetic review clinic.

Review of notes. Echocardiogram (ECHO) normal, left ventricular function tricuspid regurgitation, and moderate pulmonary HTN. On review of notes seems like obstruction will recur without surgery. OK to proceed with High Dependency Unit (HDU) standby and increased cardiac risk as well as further cognitive decline. Should have bridging clexane with history of PE and AF.

Admitted for elective repair of umbilical hernia with afternoon surgery delayed by emergency. Warfarin ceased with covering enoxaparin. Operative findings: small transverse supra-umbilical incision extended for better access on finding dense adhesions; small bowel found to be densely adherent to anterior abdominal wall especially at umbilicus; dissection of all adhesions to anterior abdominal wall; single small serosal nick with scissors/oversewn; small and large bowel good peristalsis, no ischaemic changes and no obstruction; Parietex sub-layer mesh sutured.

Day two postoperative AM: Patient complained of nausea on morning ward round (observations within normal limits). Did not take morning medications. Firm lump felt on examination – rectus sheath haematoma; pitting oedema to mid-thigh. Possible fluid overload and anticoagulation issues; medical support sought. Furosemide changed to intravenous (IV) and given.

Later MET call for hypotension/nausea; blood pressure (BP) not initially palpable, patient awake. Rapid AF noted, hypotension noted. Initially managed with fluid boluses and metaraminol on the ward with ICU support then transferred to ICU for anuria, haemodialysis support and haemodynamic support. Progressive decline; condition discussed with family and decision made for comfort measures only. The likely diagnosis: rectus sheath haematoma resulting in haemodynamic compromise resulting in renal failure and cardiac failure. Patient deceased and family present.

Discussed with Coroner:

Coroner's Report: 1a. Haemorrhagic Shock 1b. peritoneal and rectus sheath haematoma complicating surgery for an incisional hernia in a patient being treated with warfarin.

Assessor's comments:

A patient in their mid-eighties underwent umbilical hernia repair and division of small bowel adhesions. History of recurrent small bowel obstruction from adhesions, most recently six weeks prior to admission, resolving conservatively. Apparently both hernia and adhesions were involved in the obstructive episodes. Past history – open appendicectomy and open cholecystectomy; PE and DVT three years prior; AF on warfarin; stage 3 renal failure; dementia with nursing home care usually, but staying with daughter for the past two months. Warfarin was ceased five days pre-operatively, and bridging enoxaparin started three days preoperatively. Operation was prolonged by adhesions, and a small serosal nick was repaired; otherwise uneventful. Well on postoperative day one, walking with help, taking free fluids. On postoperative day two patient had nausea, and BP dropped to 100 mmHg systolic. A firm lump was noted inferior to the wound and noted to have pitting oedema to mid-thigh. Medical support was sought, but became more hypotensive and a MET call was made. Transferred to ICU but failed to respond to metaraminol and fluids. In consultation with family, patient given comfort measures only, and deceased that evening. Coroner's post-mortem findings: haemorrhagic shock with rectus sheath and peritoneal haematoma.

Answering the questions posed by the first-line assessor:

- Outpatient review by registrar.
- Consultant reversed decision six days prior that surgery was not appropriate. There were no outpatient notes available to suggest why the decision was changed from non-operative to operative management. On the history, either choice could be reasonably defended, subject to clearance by the anaesthetic/medical teams.
- Postoperative care.
- Did not return to HDU. Provision was made for standby HDU care at the pre-admission clinic, but it seems that the anaesthetic team decided the patient was well enough after surgery to not require it.
- No blood pathology day one despite known chronic renal failure.
- There was no record of blood tests on day one. This is a significant omission. It is clear the registrar was off sick, and the intern consulted him/her (presumably by phone) but no investigations were ordered.
- When did the consultant or registrar review first occur?
- Phone discussions with registrar recorded on both days one and two after intern rounds. Apparently seen by consultant after the MET call on day two (notes made in same handwriting as the operative notes).
- Was there an unplanned admission to Critical Care Unit? This should have been 'yes'.
- Was fluid balance and communication an issue: this should have been 'yes'.

The anticoagulation schedule is of concern. The medication chart shows bridging enoxaparin 105 mg daily at 0800 hours, was started three days prior to surgery, withheld on the day of surgery, and restarted on postoperative day one. According to Up-to-Date, when using anticoagulant bridging, this dose of enoxaparin is to be restarted on day two or three, when it is considered that haemostasis is secured. Starting it on day one, when only a venous thromboembolism prophylactic dose is needed (usually about 40 mg daily), means that the patient was overdosed on anticoagulant, making bleeding more likely at the surgical site. The registrar being off sick, leaving fresh interns (very inexperienced so early in the year) to carry out postoperative care and be responsible for critical medications, is a factor to be considered in this case. Hospital administrators as well as surgical teams need to arrange for experienced supervision in case of absent senior staff.⁽⁵⁾

In summary, the patient was doing well postoperatively until suffering a haemorrhage at the surgical site and went into haemorrhagic shock. A medication error may well be the main factor. Supervision of junior staff was lacking because of illness of a key team member.

Surgical lessons:

- Appropriate anticoagulation management.
- Provision of adequate supervision to junior doctors.

Reference:

5. Barry MJ, Edgman-Levitan S. Shared decision making--pinnacle of patient-centered care. *N Engl J Med.* 2012;366(9):780-1.

General Surgery

Case 6: Inadequate management of antibiotics, fluid management, and communication – Criteria for emergency treatment should be clear

Clinical details:

Diagnosis: Ampullary carcinoma.

Operation: Endoscopic retrograde cholangiopancreatography (ERCP) and insertion of stent.

Cause of death: Renal failure, metabolic acidosis.

Course to death:

Patient in their mid-eighties was referred with obstructive jaundice by general practitioner. Six-week history of feeling unwell, three weeks of diarrhoea, nausea, anorexia and vomiting. Admitted with elevated WCC, abnormal Liver Function Tests (LFTs) and acute-on-chronic renal impairment. Waited two days for an ERCP with stent successfully placed and biopsies taken. Worsening renal function and severe acidosis led to ICU admission, but despite supportive measures, continued deterioration and decision to palliate.

Assessor's comments:

An elderly patient with a history of previous cholecystectomy, resected bladder cancer, HTN, ischemic heart disease and coronary stent, chronic renal impairment and right hip replacement was admitted with painful obstructive jaundice. Observations were stable on arrival with borderline blood pressure (100/50 mmHg). Blood tests showed a mild leucocytosis, acute-on-chronic renal failure with a mixed obstructive/cholestatic liver function pattern. The bilirubin was markedly elevated. A CT scan with oral contrast performed via the Emergency Department confirmed marked biliary tree dilatation (16 mm). There was no distal stone or pancreatic mass seen. The diagnostic possibilities in these circumstances are narrow.

A magnetic resonance cholangiopancreatography was also performed according to the nursing notes, but the scan result is not available in the case notes provided. It was likely contraindicated given the patient's hip prosthesis. For some reason, a proceduralist was unavailable to perform an ERCP until after 48 hours of presentation, which found a large friable periampullary adenocarcinoma obstructing the ampulla. A 10-Fr biliary stent was placed, but no post-procedure blood tests were available to suggest the WCC, renal function or LFT's were monitored after ERCP to ensure improvement.

By the time of the MET call, it was evident that septic shock had developed with a worsening liver function picture and renal failure. The patient had also developed some episodes of melaena following ERCP, most likely due to low grade bleeding from the friable periampullary tumour and this may have led to biliary stent occlusion from blood clot or tissue debris. The patient was then admitted to the ICU for supportive treatment with worsening septic shock and renal failure. Not unexpectedly, the patient progressed poorly and was palliated on day seven after a family conference.

Case notes: This patient waited eight hours for admission; was reviewed the following morning at which time an urgent ERCP could have been arranged and then performed. Adequate documentation of this definitive plan did not occur. If the service was not available in the initial hospital, this should be discussed with a clinician in a tertiary referral centre to see if this procedure could be performed there on the day of transfer. Consultant-to-consultant discussion in these circumstances is essential. It was not performed until two days later.

There are several other clear deficiencies in this case. The diagnosis of ascending cholangitis was not made, despite the liver function pattern clearly indicating a mixed obstructive/cholestatic picture, and the raised WCC ($12.7 \times 10^9/L$) with neutrophilia suggesting early biliary sepsis and obstruction. For some reason, the term 'infective obstructive jaundice' was used. Further, antibiotics were not administered to this elderly patient with known comorbidities. The absence of antibiotic treatment is a major error in a patient with early biliary sepsis. The added problem of acute-

on-chronic renal failure was also overlooked as there was little to indicate close attention to strict fluid resuscitation despite an elevated creatinine (258 mL/min) and urea (14.0 mmol/L) in the Emergency Department. Medical consultation for worsening renal dysfunction did not occur. However, the minor coagulopathy on admission (international normalised ratio = 1.6) was corrected with Vitamin K.

Comments: Definitive management of ascending cholangitis requires urgent ERCP for biliary decompression. Ideally it should be performed within 12 hours of acute presentation. A successful outcome also requires supportive measures such as intravenous fluid resuscitation, a strict fluid balance chart and antibiotics targeted towards gram negative bacteria. In conjunction, timely management with ERCP should prevent progression of biliary sepsis.

The important issue raised in the first-line assessment is the degree of urgency for ERCP in a patient with ascending cholangitis. The presentation of abdominal pain, leukocytosis and elevated bilirubin indicated urgent ERCP was necessary. The presence of organ dysfunction (acute-on-chronic renal failure) was a marker of severe cholangitis and early intervention within 12 hours may have altered the final outcome.⁽⁶⁾

Furthermore, cephazolin alone at the time of ERCP was also inadequate in a setting of biliary sepsis, and no appropriate antibiotics were administered to this patient until six days after admission, at the time of the MET call. Despite the macroscopic findings at ERCP, the insertion of a 10-Fr (3.3 mm) biliary stent was reasonable given the surgical status of the patient was unknown and without histological evidence of a proven malignancy. A 10 mm biliary stent could have been used if the patient's expected survival was more than four months, however this is a less relevant consideration.

This case also highlights the failure of recognition and lack of supportive management of a patient with ascending cholangitis. Prompt ERCP within a certain timeframe is only beneficial if intravenous fluid therapy and tailored antibiotic treatment has begun. The degree of urgency of ERCP should be discussed with a clinician experienced in biliary cannulation and stenting to determine the likelihood of same day intervention. Hospital transfer to a tertiary centre in these circumstances can sometimes lead to further delays. In all cases, consultant discussion is vital and adequate case note documentation should exist.

Finally, there should be a protocol or pathway in place for emergency ERCP in all Acute General Surgical Units who admit patients with ascending cholangitis. It should be well known to all staff members, and criteria for emergency treatment should be clear. Any patient with evidence of end organ dysfunction such as renal failure in this setting should also have prompt medical consultation, and consideration should be given to management in a HDU if possible.

Surgical lessons:

- ERCP should be performed within 12 hours in the ideal setting.
- There should be antibiotic protocols for acute cholangitis.
- Multi-disciplinary management will improve patient outcomes.

Reference:

6. Mok SR, Mannino CL, Malin J, Drew ME, Henry P, Shivaprasad P, et al. Does the urgency of ERCP/PBD impact mortality and disease related complications in ascending cholangitis? (deim-i study). *Journal of Interventional Gastroenterology*. 2012;2(4):161-7.

General Surgery - Colorectal

Case 7: Documentation, preoperative work-up, appropriate support

Clinical details:

Diagnosis: Carcinoma of colon.

Operations: Laparotomy. Ileocolic resection, stapled closure of duodenum and gastro jejunostomy, second look laparotomy.

Cause of death: Cardiorespiratory arrest.

Course to death:

Patient with bowel cancer for elective palliative debulking surgery to prolong life and reduce suffering. Underwent laparotomy, ileocolic resection, division adhesions, duodenal closure.

Admitted to intensive care postoperatively, became unwell, palliated and died. Patient in ICU, assessed by ICU consultant, and thorough discussion with family was held. In view of the locally advanced adenocarcinoma of colon eroding duodenum, and the poor outlook in the short and longer term, the family requested the active ICU care cease.

Assessor's comments:

A patient in their mid-eighties was admitted to hospital for surgery for suspected colorectal recurrence. They underwent a prolonged operation that appeared to be a non-curative resection of cancer involving the ileocolonic region and the duodenum. Due to some difficulty at surgery, the patient was packed at the conclusion of the first operation, returned to intensive care and then re-operated on the next day for removal of packs. Over the next 24 hours the patient's course became complicated in intensive care and following discussion with the family, palliation was undertaken, and the patient died four days after the second surgery.

The first-line reviewer was concerned with the indication for surgery, whether the consent process and preoperative work up with Medical Decision Making (MDM) discussion was supportive of re-look resectional surgery as the only option for this patient, considering the subsequent outcome.

The issues in this case are four-fold:

1. Was there any reason for this patient's recurrence?
2. Was the decision to operate correct?
3. Management of the patient during the first prolonged operation.
4. Decision to palliate.

To elaborate:

1. Recurrence. It is very difficult without histology to know whether this was a true anastomotic recurrence or whether it was an extracolonic nodal recurrence.
2. Consent. In an elderly patient, although otherwise fit, cases where there are radiological recurrences need to be worked up well to exclude more widespread metastases and it is mandatory that they are discussed in a multidisciplinary team (MDT). The usual scenario is that the tumour is far more widespread than the imaging suggests, and that curative re-look surgery is rarely the outcome. The treating surgeon's intent was to undergo an elective palliative debulking surgery to "prolong life and reduce suffering". Unfortunately, neither of these aims were achieved.
3. The first operation was prolonged (at least 7½ hours). The assistant was a general practitioner (GP), and there is no mention that a further surgeon was called for assistance. We don't know what troubles occurred from the documentation in the notes, but one would assume that there

was bleeding as the patient was packed and returned intubated to intensive care. This strategy of terminating the operation, packing the patient and transferring to intensive care, stabilizing and then re-looking at 24 hours is well established but there is little documentation to know what is going on here and a second surgeon should have been called.

4. Palliation. The decision to palliate the patient following discussion by the intensive care staff and the patient's family was a good decision. It was made early on and appears to have been done for all the right reasons.

When dealing with these patients the consent process needs to be lengthy, often over several visits, with certain parameters set if things do become complicated or deteriorate in the postoperative period. Whether a lesser procedure with a bypass may have led to a different outcome is impossible to know unless one was present at the time of the surgery. The MDM is mandatory in this situation and planning to have a second surgeon to assist is vital with these major resection operations.

Surgical lessons:

- The use of the concept of 'Shared Decision Making', though relatively new, would have been ideal in this situation as alluded to by the assessor.⁽⁶⁾ This is a process in which clinicians and patients work together to select treatments based on clinical evidence and the patients' informed preferences. The clinicians' input is multidisciplinary, the evidence based on options, outcomes and uncertainties, and the patient provided with realistic information and supportive counselling with family and friends.⁽⁷⁾

Reference:

5. Barry MJ, Edgman-Levitan S. Shared decision making--pinnacle of patient-centered care. *N Engl J Med.* 2012;366(9):780-1.
7. Austin CA, Mohottige D, Sudore RL, Smith AK, Hanson LC. Tools to Promote Shared Decision Making in Serious Illness: A Systematic Review. *JAMA Intern Med.* 2015;175(7):1213-21.

General Surgery

Case 8: Decision making, preoperative work up, surgical experience – Pancreatic resections carry high risk of significant morbidity and mortality

Clinical details:

Diagnosis: Neck of pancreas adenocarcinoma.

Cause of death: Multi-organ failure.

Operation: Open Whipple's.

Course to death:

Whipple's for neck of pancreas adenocarcinoma confirmed on preoperative fine needle aspiration from endoscopic ultrasound. Intraoperative bleed from splenic vein – repaired – but lost 1L of blood – repaired with lateral wall suture. Evidence of cancer involving portal vein – therefore also a partial side wall portal vein excision en bloc with vein patch repair. Good flow at end of procedure confirmed in liver and portal vein with ultrasound. Total transfusion – 9U PRBC. Two other consultant surgeons (with one hepato-pancreato-biliary [HPB] surgeon) also in attendance to help in addition to primary surgeon.

ICU Issues:

- Severe metabolic and lactic acidosis.
- Supported with continuous renal replacement with bicarbonate buffer and sodium bicarbonate.
- Anuric renal failure.
- Continuous Renal Replacement Therapy initiated and continued throughout.
- Rhabdomyolysis related to operating theatre posture/position.
- Acute liver failure developed at day two post-op with worsening acidosis.
- Liver Doppler US – no vascular compromise – unable to obtain CT liver as patient was dependent on haemofilter. Patient passed away day two postoperatively with multi-organ failure after family decision to palliate.

Assessor's comments:

In summary, a patient in their mid-seventies, obese (body mass index = 49), with a mass at the neck of pancreas was admitted for elective Whipple's procedure. Surgery carried out by general surgeon (primary surgeon), lasted for approximately 13 hours and was complicated by perioperative injury to splenic vein and portal vein haemorrhage (cancer involving portal vein) requiring activation of massive transfusion protocol. The patient became increasingly acidotic through the procedure and required ionotropic support. In ICU postoperatively, there was worsening acidosis and disseminated intravascular coagulation and multi-organ failure.

The hospital case notes provided are adequate and the documentation of the sequence of events are clear.

The first-line assessor is justified in raising concern about the experience and appropriate case load (in pancreatic surgery) of operating surgeon.

This case was high risk at the outset and the primary surgeon should have been an HPB surgeon working in a specialist HPB Unit.

Preoperative staging was not accurate. Portal vein involvement was not appreciated until surgery. The build of the patient might have been a confounding factor. Accurate preoperative staging might have made a difference to the outcome.

The adverse event was the massive intraoperative haemorrhage. Decision to continue with surgery, while the patient became progressively acidotic through this long procedure and requiring ionotropic support, is questionable.

In conclusion, this case should be considered as an unexpected death after elective surgery caused directly as a result of intraoperative haemorrhage. The operating surgical team needs to reflect on how such an outcome could be avoided.

Pancreatic resection should be performed after adequate preoperative staging and assessment of fitness for surgery. Pancreatic resections carry high risk of significant morbidity and mortality and should only be undertaken in specialist pancreatic surgery units. Standard resection when combined with vascular resection and reconstruction should be limited to specialist units with experience in vascular reconstruction.

Surgical lessons:

- The evidence supports the concept that hospital volume-outcome ratios for pancreaticoduodenectomy favours surgical centres with higher volumes. In addition, general surgeons with low volume experience need to demonstrate insight and humility by referring patients to such centres.⁽⁶⁾
- Consider decision to operate, preoperative assessment and surgical experience as pancreatic resections carry high risk of significant morbidity and mortality and should only be undertaken in specialist pancreatic surgery unit.

Reference:

8. Hata T, Motoi F, Ishida M, Naitoh T, Katayose Y, Egawa S, et al. Effect of Hospital Volume on Surgical Outcomes After Pancreaticoduodenectomy: A Systematic Review and Meta-analysis. *Ann Surg.* 2016;263(4):664-72.

Gynaecology Surgery

Case 9: Documentation, delay in surgery or alternative surgery – Surgery should have been postponed

Clinical details:

Diagnosis: Ovarian cancer.

Operations: Laparotomy, total abdominal hysterectomy (TAH), bilateral salpingo-oophorectomy (BSO), omentectomy, adhesiolysis.

Cause of death: Cerebrovascular accident – cardiac arrest.

Course to death:

Patient admitted for laparotomy for removal of large ovarian cancer. The surgery went very smoothly and the patient was transferred to intensive care postoperatively as per routine management plan.

The first 24 hours were uneventful, however, approximately 48 hours later the patient suffered a very extensive multifocal cerebrovascular accident. Unfortunately, the patient never recovered and ultimately arrested and passed away on day three. Unfortunately, the burden of the patient's disease and comorbidities ultimately proved overwhelming.

Assessor's comments:

This case is that of an elderly patient who suffered a ST-Elevation Myocardial Infarction (STEMI) with ventricular fibrillation arrest prior to coronary angiogram and bare metal cardiac stent insertion. At the time of admission, the patient was noted to have an abdominopelvic mass suspicious of an ovarian malignancy. This was confirmed both on findings of a pelvic ultrasound and CT and a grossly elevated cancer antigen (CA) 125 level. Despite dual anticoagulant and antiplatelet therapy comprising dalteparin and both aspirin and ticagrelor, the patient's admission was then complicated by an extensive popliteal and calf vein thrombosis of the right lower leg which required acute thrombolysis. It is not clear whether this was thought to be related to the groin puncture for angiogram and subsequent coronary stent. The patient then underwent a right popliteal angioplasty with both heparin and urokinase infusions. An inferior vena cava filter was inserted as a precaution preoperatively, followed four days later by a laparotomy comprising total abdominal hysterectomy with BSO and omentectomy. Forty-eight hours postoperatively, noted clinical deterioration with confusion and a magnetic resonance image (MRI) revealed multiple thromboembolic infarcts throughout both cerebral hemispheres and the cerebellum. Twenty-four hours later, the patient suffered a cardiac arrest and on review of the notes, was not actively resuscitated and died peacefully.

Case Notes: The hospital case notes provided are adequate. However, it is difficult at times to establish when particular drugs were administered, withheld or ceased. The patient was commenced on dual antiplatelet therapy comprising aspirin and ticagrelor and subcutaneous dalteparin at the time of insertion of the patient's coronary bare metal stent. Nine days later the patient underwent a right popliteal angioplasty and both heparin and urokinase infusions were administered. The aspirin was ceased, and it is not clear why this decision was reached. The patient continued to be on ticagrelor and subcutaneous dalteparin until the ticagrelor was ceased seven days prior and the dalteparin was ceased on the day prior to the laparotomy. At the operation the estimated blood loss was 1000 mL and that both Floseal and Fibrillar were applied to the pelvic peritoneum in order to achieve haemostasis. On day one dalteparin was recommenced. Aspirin and ticagrelor were never reinstated.

An area for consideration is the possible alternative decision to commence neoadjuvant chemotherapy for ovarian cancer given that the cardiac insult of ventricular fibrillation followed by insertion of a bare metal stent requiring dual antiplatelet therapy had occurred only three and a half weeks earlier. With reference to the 2012 published paper regarding perioperative management of antiplatelet therapy in patients, author G Dimitrova considered that a minimum of four-six weeks of antiplatelet therapy

was required prior to surgery being undertaken.⁽⁹⁾ This patient had very significant medical problems including advanced age, ischaemic heart disease, HTN, a bare metal stent of the coronary artery, recent thromboembolic occlusion and advanced malignancy.

Areas of concern: Although there is no definite standard of care for the perioperative management of patients with coronary stents, it is imperative that an experienced cardiologist, anaesthetist, intensivist and surgeon develop an individual patient plan together weighing up the patient's risk of thrombosis versus the risk of bleeding. The cessation of ticagrelor seven days prior to major surgery was appropriate. However, the aspirin was ceased seven days prior to surgery and the current advice is that the impact of low dose aspirin on surgical blood loss showed that it increased the average intraoperative haemorrhagic risk by a factor of 1.5 but did not increase either mortality or morbidity. It is likely that the full implication of stopping all antiplatelet therapy was not fully appreciated because of the reasonable fear of surgical bleeding. There was no consideration given to commencing "bridging therapy" with either tirofiban or eptifibatid infusions which are stopped 4-6 hours prior to the surgical procedure and restarted as soon as possible after the surgery with agreement between the cardiologist, anaesthetist and surgeon. However, so called "bridging therapies" are controversial and may not have prevented subsequent cerebral thrombotic episodes.

Studies show that in this situation where the time between insertion of a coronary bare metal stent and surgery is less than one month, then dual antiplatelet therapy needs to be continued throughout the perioperative period.

The dalteparin was ceased and not reinstated until four days later and this, in addition, to the failure to re-institute both aspirin and ticagrelor may have contributed to the cerebral and cerebellar thromboembolic infarction.

Comments: This patient had significant comorbidities increasing the risk of a fatal outcome. It is important that an experienced team including the cardiologist, anaesthetist, intensivist and surgeon develop an individual plan weighing up the risk of thrombosis versus the risk of bleeding. Ideally the surgery should have been postponed for at least six weeks following insertion of the bare metal stent with dual antiplatelet therapy being administered and commencement of neoadjuvant chemotherapy.

However, accepting that surgery was undertaken, the significant area for concern is the actual cessation of dual antiplatelet therapy and withdrawal of subcutaneous dalteparin during the critical perioperative period.

Surgical lessons:

- Multidisciplinary assessment prior to surgery in medically complicated patients.

Reference:

9. Dimitrova G, Tulman DB, Bergese SD. Perioperative management of antiplatelet therapy in patients with drug-eluting stents. *HSR Proc Intensive Care Cardiovasc Anesth.* 2012;4(3):153-67.

Gynaecology Surgery

Case 10: Futile surgery, intraoperative complications, documentations and decision making

Clinical details:

Diagnosis: Advanced ovarian cancer.

Operations: Laparotomy, TAH and BSO.

Cause of death: Multisystem organ failure.

Course to death:

Postoperative bleed treated by interventional radiology. Patient was very cachectic and frail. Decision to operate was made on the basis that the patient was not able to be triaged to surgical or palliative care as no diagnosis of malignant disease had been made. The tumour was mobile, and the resection was fairly straight forward. General ooze was encountered in the pelvis and extensive efforts at haemostasis were made including haemostatic agents. Intraoperatively, a decision was made not to reoperate in the event that bleeding occurred.

Assessor's comments:

This was a case of a previously fit patient in their late-eighties. At presentation, the patient was initially admitted under Medical Unit for a) anaemia b) acute renal injury and c) right pleural effusion of unknown aetiology. The subsequent work-up raised possibility of malignant disease given a large abdominal mass. Further clinical and diagnostic work-up were highly suggestive of gynaecological malignancy. The attending Gynaecology Unit offered surgical debulking as the preferred mode of management and the patient underwent total abdominal hysterectomy, BSO and adhesiolysis on day 29 post-admission. Immediate day one postoperative bleeding from the laparotomy resulted in a cascade of complicating events including interventional radiology to control internal iliac vessel bleeding, bowel obstruction and further severe anaemia, all culminating in global clinical deterioration. The patient eventually succumbed to the illness on day nine post-operatively and as per the family's wishes for resuscitation. The case did not meet criteria for further Coroner's review or autopsy.

Concerns raised by first-line assessment:

- Hospital stay prior to surgery was indeed prolonged at 28 days in total; this included formal admission, interdisciplinary referrals, reviews by multidisciplinary teams both medical and non-medical units, and protracted course of management. Review of notes indicate intention to keep as inpatient for optimisation of the preoperative morbidity would NOT necessarily have contributed to an adverse event later; it may in fact have corrected the anaemia and functional capacity to undergo surgery.
- Process for deciding to operate was no doubt preferred by the operating team. However, it's questionable if goals post the surgery were met at all; was the prognosis understood by patient and family and were they under pressure to be operated on? Notes indicate that the patient perhaps had already internalised the terminal nature of the diagnosis, and, if they had not had a fall, would have lived until the cancer took over. The primary care GP was not contactable.
- Intra-operative complication and timing of recognition/action. Bleeding from left internal iliac vessels was diagnosed in a reasonable timeframe on first post-operative day in ICU and the option of managing it was appropriately thought over. Interventional radiological coiling of the involved vessels was successful, although the patient had started to deteriorate; were alternative surgical approaches, including raw suturing and pre-emptive ballooning of the internal iliac vessels considered? How likely are Surgiclips to suffer slippage? Could electro-haemostasis with bipolar device have been more definitive? Certainly, the surgeons considered delaying clexane given their findings; overall it was inadvertent and was managed appropriately.

Comments: Could patient's wishes to not have surgery be respected from the very onset, especially involving malignancy of advanced stage and poor prognosis? The histopathology in this case demonstrated at least a Fédération Internationale de Gynécologie et d'Obstétrique Stage 2B Grade 2 endometroid adenocarcinoma – ovaries.

Documentation from the surgical team could certainly improve. The adage that "what's not documented has not been discussed" is true. Overall, the surgical procedural documentation was sub-standard, poorly detailed, and very illegible which contributes to poor care after; can this be improved with typed e-notes?

Decision making becomes a complex interplay with involvement of multiple teams treating one patient; however, the care provided to this patient was genuine, timely and adequate. Involved teams appeared to have communicated well with the patient and their immediate family. Although the desired outcome is difficult to define or predict, lessons learnt from this case should improve, and better guide the thought process for crucial decision making in critical care elderly patients.

Surgical lessons:

- Decision to operate.
- Better communication to ensure the patient and family understood the perioperative risks.
- Better documentation.

Case 11: Choice of surgery, decision to operate

Clinical details:

Diagnoses: Chronic and refractory severe left sided L5 sciatica, chronic mechanical low back pain, claudication with restricted mobility.

Operations: Transforaminal interbody and posterolateral fusion, decompression, extension of spinal fusion reduction of osteoporotic fracture, complete corpectomy, extension of the spinal fusion and cement augmentation.

Causes of death: Severe chest infection, sepsis, multi-organ failure.

Course to death:

A patient in their late-seventies underwent multiple operations to try and stabilise their osteoporotic spine following initial transforaminal interbody and posterolateral fusion/decompression in segments L4/5 and L5/S1. The patient passed away following prolonged hospital admission because of progressive chest infection, sepsis and multi-organ failure.

Assessor's comments:

This patient died as a result of complications of multiple major spinal surgeries. They had a highly relevant and rather complex medical history which included polymyalgia rheumatica treated with chronic prednisolone and methotrexate therapy. The patient was apparently known to have osteoporosis, which would be expected in this context.

The patient had chronic low back pain and ongoing refractory left lumbo-sacral sciatica which had apparently become worse over recent months. There was short lasting relief after a lumbar steroid injection performed in the months prior to admission and a history of previous back surgery.

The patient underwent image guided transforaminal interbody and posterolateral fusion/decompression at segments L4/S and lumbosacral/sacroiliac from the left side with partial correction of a scoliotic deformity. There was apparently a good recovery during the first two weeks after surgery with discharge to rehabilitation and then home.

Comment: One would like to be reassured that conservative management had been fully exhausted and that the patient and family were fully appraised as to how high the risks were in this type of surgery, particularly given the osteoporosis.

The patient was readmitted 18 days after the first operation because of increasing low back pain and significant hip pain. A second operation was performed with placement of screws and interbody fixation devices. This again would logically cause further progression of the vertebral body fracture given that the posterior elements were fixed in position.

A few days after this operation, the postoperative CT scan apparently demonstrated satisfactory screw and cage positioning, but more collapse of the L4 vertebral body.

There appeared to be some improvement in the patient's pain after the second operation, although it is difficult to find the exact analgesic regime that was required to achieve that.

The neurosurgeon's opinion of the X-rays was that there was some posterior displacement of the L3 screws within the pedicle, which suggested continuing osteoporotic collapse.

A second additional operation was performed 23 days after the previous surgery. This involved an open reduction of the spinal fracture, partial correction of kyphoscoliotic deformity, and complete corpectomy of L4. The previously placed cages at the adjacent levels were removed. A large expandable titanium plate was placed and then positioned using sequential dilation. The plan was stated for further surgery depending on follow up X-rays.

Notes reveal an 8 kg weight loss in one month in an already underweight patient consistent with mild to moderate malnutrition with evidence of clear-cut muscle wasting. The patient was noted to be anaemic with an elevated WCC and neutrophilia. The patient was diagnosed with urinary tract infection and treated with trimethoprim later changed because of *Pseudomonas* in the culture.

Sixteen days later another operation was performed. On this occasion the spine was again explored directly via a lateral approach. The bone grafts and cage were removed. There was further anterior preparation of the end plates, accomplishing a L4 corpectomy (even though a complete L4 corpectomy had already been performed at the previous surgery). The surgeon then proceeded to partially remove the inferior aspect of the fractured L3 vertebra. The expanded interbody cage was repositioned against these bony buttresses to achieve some additional correction of the kyphoscoliotic deformity. The patient was then placed in the prone position and a posterior operation was performed to extend the spinal fusion from T12 to S1.

After an initial recovery from this surgery the patient deteriorated despite exemplary nursing and medical care. There was a family meeting and where it was agreed that readmission to ICU and further intensive management would not be likely to help the patient.

Final comments: None of the anterior operations appear to have been well conceived or effective. The big picture was that every time this patient had anything done, the bones adjacent to the repair continued to fail. This was always probable given that there was osteoporosis of sufficient severity to fracture the spine in the first place without significant trauma. On multiple occasions, the patient was left with a partial corpectomy, and a weight-bearing prosthesis sitting against cancellous bone of the vertebral body. Surgery was never effective in this patient at any stage.

Repetitive massive elective surgery led eventually to the death of this elderly patient. Exhaustion and nutritional depletion would appear to have been a factor that was ignored by the treating surgeon, despite it being noted in the file by the dietician. The indication in favour of surgery was weak. There is no record that non-surgical options were seriously considered.

If the patient had been managed in a decisive fashion with carefully managed analgesia, mobilisation in an appropriate brace, with rehabilitation, they would not have died in hospital. There would have been a substantial probability that the pain would have been manageable in the longer term with this approach.

Surgical lessons:

- This case demonstrates the complexities of spinal surgery and surgery in general. It is vital that all aspects of a patient's general health be considered every time surgery is contemplated. It is not sufficient to adopt the stance of performing extensive corrective surgery just because it can be done. A detailed consideration of the potential pitfalls and medical comorbidities should be weighed up against the options for surgical interventions. To that end, this case demonstrates the importance of seeking preoperative advice and the performance of extensive preoperative work-up when complex surgical patients are encountered.
- It is vital to obtain aid from colleagues particularly in complex cases. This surgeon did approach colleagues for advice after the first two operations. It is, however, better to ask for assistance early rather than mid-course.
- It may have been that without corrective surgery, the patient may have been confined to chronic pain or immobility for the remainder of their life. The situation may have been either to have such a chronic disability or have the life-threatening procedure. This case demonstrates that, in some situations, it may be better to accept the suboptimal outcome of not doing anything as opposed to death following surgery.

Case 12: Futile surgery, communication, workup

Clinical details:

Diagnosis: Melanoma, Myasthenia gravis

Operation: Stereotactic craniotomy for excision of left frontal lesion

Cause of death: Seizures, subarachnoid and intra-ventricular haemorrhage

Course to death:

Patient presented with frontal lobe syndrome – headache, confusion and expressive dysphasia. MRI suggested a glioblastoma multiforme. Family meeting held and transfer to Neurosurgical Unit for stereotactic craniotomy as previously a high functioning patient at home. Plan for debulking of lesion followed by radiotherapy and temozolamide (Stupp protocol). Background of myasthenia gravis on Azathioprine and Pyridostigmine.

Assessor's comments:

This case involves a patient in their eighties admitted for excision of a cerebral tumour. The patient had a past history of aortic valve replacement, some three years earlier, and at that time the patient was diagnosed with myasthenia gravis. The patient was admitted following investigation for falls with imaging demonstrating a right middle fossa tumour. The working diagnosis was that of glioblastoma multiforme. The patient was admitted and had preoperative work up with a view to proceeding to craniotomy and excision of tumour. As part of the procedure, the patient was administered aminolevulinic acid hydrochloride to assist with complete macroscopic excision of tumour. Postoperatively, the patient had numerous medical problems. The first, and most obvious, related to the myasthenia, and associated respiratory issues. Not surprisingly, the patient's neurological state fluctuated significantly in the postoperative period, and they never fully recovered from surgery. Furthermore, the patient had postoperative delirium, and subsequent depression. During the phase of depression, the patient stated to the psychiatrist that the patient did not wish to undergo any further treatment. Despite this, the patient continued to undergo further investigation by the managing unit and the Oncology Unit.

During this time, the Neurology Unit was asked to see the patient and commenced intravenous human immunoglobulin for treatment of myasthenia. It does not appear as though the neurologists were consulted in the preoperative or immediate postoperative period. At one week postoperatively, the diagnosis was changed from glioma to metastatic melanoma. This was based upon the pathology results. It appears that intraoperative frozen section was not performed.

At approximately two weeks postoperatively, the patient developed seizures, to the extent that code blue was called. Subsequent to this, the patient's conscious state never improved, and repeat CT scan of the brain demonstrated postoperative change with new subarachnoid and intra-ventricular haemorrhage. At this time, it was determined to palliate the patient.

There are many concerns with the management of this patient, in addition to the completion of the surgical case form. Regarding the management, the concerns relate to the poor perioperative management of myasthenia, and delayed involvement of the neurology team. In a patient of this age with this medical history, it appears that, despite the working diagnosis being completely wrong, and allowing for this fact, even if the diagnosis was that of glioma, then is it appropriate to use aminolevulinic acid hydrochloride for complete excision in an elderly patient? All the published studies using this have been with patients under the age of 75, and there is no evidence that the use of aminolevulinic acid hydrochloride improves outcomes in patients in the elderly. Furthermore, the use of such medication and treatment should require definitive diagnosis and use of intraoperative frozen section is essential.

Regarding the surgical case form, it appears it was completed by someone completely unfamiliar with the patient (it is more worrying if the treating surgeon completed the form, as it demonstrates a complete lack of appreciation for this case).

The case form reports the cause of death as being myasthenia gravis, and in the same case form the surgical diagnosis at admission as melanoma, which is incorrect as the admission diagnosis was glioma. In the description of cause of death, the very brief description only mentions glioma and does not mention melanoma and lists the cause of death as myasthenia. At no point does the surgical case form describe the real cause of death, notably postoperative seizures and intraventricular haemorrhage.

This is further exacerbated in the death certificate which states the cause of death as myasthenia gravis rather than postoperative seizures. Further, the surgical case form lists the surgery as Left Frontal, when it was actually Right Temporal. How could both the side and lobe be listed incorrectly?

There are many concerns with the management and subsequent documentation in this case. In a patient of this age group with a working diagnosis of glioma, one must be extremely cautious in proceeding to radical surgical excision, appreciating the likely postoperative risks given the age and medical condition. It would have been more appropriate to perform a stereotactic needle biopsy to confirm the diagnosis. Given that the managing unit elected to proceed with radical excision with associated use of aminolevulinic acid hydrochloride, it would have been in the patient's best interests to have sought oncological and neurological input preoperatively to determine the most appropriate course of management from both the myasthenia and tumour perspectives. Finally, the patient expressed wishes to withdraw active treatment, and it is not clear whether such discussions were had with the patient and their family preoperatively. It was apparent from the review of the clinical notes that this case would have had a poor outcome regardless of any intervention, and this raises the question as to the appropriate wisdom in performing aggressive surgery on such high-risk patients.

Surgical lessons:

- As with so many facets in medicine, documentation, or lack thereof, poses the most devastating barrier to a successful outcome in the management of all patients, surgical cases included. It is hoped that with the roll-out of electronic medical records, such lack of documentation may reduce. However, we will likely still rely on individuals to upload information onto the system for it to be accessed. From this case study, it is clear that frustration and erroneous data remain a barrier in the successful and appropriate treatment of surgical patients.
- The second issue presented is another frequently visited question – to treat or not to treat. Although reported data suggests treatment via one pathway, often the literature lags the progression made in the 'real' world. Further, as the population as a whole is living longer and healthier, it is no longer feasible to put a limit on when treatment should or should not be considered based on age. Decisions should, therefore, also consider each patient on an individual basis.

Orthopaedic Surgery

Case 13: Preoperative work-up – More awareness of DVT

Clinical details:

Diagnosis: Achilles tendon rupture.

Operation: Routine open Achilles tendon repair.

Cause of death: Pulmonary embolus.

Course to death:

Middle-aged patient was undergoing a routine Achilles tendon repair, when 20-25 minutes after anaesthetic induction, they became tachycardiac and hypotensive. The patient arrested despite the efforts of the anaesthetist. Mobile intensive care ambulance was called, Cardiopulmonary resuscitation (CPR) continued and then Lund University Cardiopulmonary Assist System (LUCAS) mechanical CPR machine was used. At no stage did the patient have sustained return of spontaneous circulation. Extensive resuscitation efforts were continued by ambulance officers on route to the tertiary hospital and continued after the arrival in ED. The patient had been intubated at first hospital and the tube position was checked on arrival at ED. Rhythm was largely PEA with some runs of ventricular tachycardia early in the resuscitation. The patient did not display any sustained return of spontaneous circulation. The use of LUCAS was maintained, with adrenalin, bicarbonate, calcium gluconate and defibrillation. During the latter part of resuscitation, Emergency Department ECHO was performed which showed cardiac standstill. Venous gas showed lactate 19 mmol/L, pH 6.8, base excess -18 mmol/L. The opinion of intensive care doctors, and cardiothoracic was obtained regarding any other potential interventions, including ECMO. It was agreed that these other interventions were futile. Resuscitation was therefore ceased.

Assessor's comments:

The patient presented, two weeks following a left Achilles tendon rupture, for a semi-elective surgical repair of the tendon rupture. The surgical case forms suggest that the calf was non-tender at time of the admission, however there are no clinical notes mentioning medical assessment prior to surgery. According to the notes, anticoagulation methods were used but it is not clear what that was, and when they were commenced.

The patient underwent a general anaesthetic, was placed in a lateral position on the operating table and had a thigh tourniquet. Thirty minutes into the procedure the patient underwent complete cardiac arrest and various (appropriate) resuscitation methods were undertaken including CPR and fluid. A mobile intensive care ambulance was called, and the patient was transferred to an ED where further attempts at resuscitation were made. According to the notes, and after consultation with cardiothoracic and ICU teams, a decision was made to stop treatment. It is noted that the patient at no time had regained any cardiac function.

In the end summary, it is noted that coroner's notes confirmed an extensive PE was the underlying cause of death. This fits with the clinical findings and sudden deterioration during surgery.

The concerns regarding this case are:

- It is unclear when the patient was first assessed by their treating surgeon regarding the left Achilles tendon rupture and which type of immobilisation was used (if any), and whether the patient was placed on any prophylactic anti-coagulation in the days leading up to surgery. The reason for this concern is that if the timeframe between the injury date and surgery (two weeks) is correct and the patient was immobilised in plaster (or similar), the risk of developing DVT is increased. This can progress to PE under periods of stress or leg manipulation (such as during surgery). The clinical evidence for PE isn't always present except for subtle tachycardia (which was present preoperatively).
- There is no mention of non-operative management of the Achilles tendon rupture with the patient, although this would not exclude the risk of DVT and PE.

- Resuscitation methods appear to be adequate, and there is no concern regarding this. It is unlikely with an extensive pulmonary embolus whether any resuscitation efforts would be successful.

Suggestions:

- Unless the patient was undergoing immediate surgery following lower limb trauma, then preoperative anticoagulation should be considered. However, while anti-coagulation can reduce risk of DVT, there is NO evidence that anticoagulation will reduce the risk of fatal pulmonary embolism.
- With extended delay to surgery (in Achilles tendon surgery) for more than five-seven days and without prior anticoagulation, perhaps a Doppler venous ultrasound should be considered, especially if the patient shows any signs of DVT such as calf swelling and pain above the area of trauma/rupture (or other associated risk factors for DVT). The difficulty with such investigations however is the uncertainty of managing small, non-deep vein thrombosis and its relevance to risk of pulmonary embolism. Anti-coagulation also can increase the risk of wound problems following surgery.
- While in hindsight the death may have been preventable, it would have required identification of the DVT prior to surgery. It appears from the clinical notes that there were minimal clinical signs of the DVT and the impending pulmonary embolus. Preoperative anticoagulation may have reduced the risk of DVT but there is little evidence on its effect on rates of fatal pulmonary embolism.
- The way forward is increased vigilance on the part of all surgeons performing such lower limb surgery, specifically in careful preoperative assessment of the calf, use of venous Doppler ultrasound, and preoperative anticoagulation in cases of surgical delay. Despite all of this, fatal pulmonary embolism remains a challenging problem, and in some cases, impossible to prevent despite best practice.

Surgical lessons:

- Consider investigation to diagnose DVT preoperatively in patients immobilised for a period prior to elective surgery.
- Consider aggressive strategies to prevent pulmonary emboli in patients with preoperative DVT.⁽¹⁰⁾

Reference:

10. Tran HA, Gibbs H, Merriman E, Curnow JL, Young L, Bennett A, et al. New guidelines from the Thrombosis and Haemostasis Society of Australia and New Zealand for the diagnosis and management of venous thromboembolism. *Med J Aust.* 2019;210(5):227-35.

Orthopaedic Surgery

Case 14: Delayed diagnosis, communication, choice of operation, medical management

Clinical details:

Diagnosis: Periprosthetic femoral fracture.

Operation: Revision total hip replacement.

Cause of death: Clostridium difficile colitis, Pseudomonas Urinary tract infection (UTI), and bacteraemia.

Course to death:

A patient in their early nineties admitted under general medicine after a collapse while attending an outpatient ECHO appointment (was being investigated for falls) – in the setting of atrial flutter, HTN, chronic renal failure and ex-smoker. Initial imaging with X-ray and CT reported as normal and the patient was eventually sent to rehab. Repeat CT demonstrated a displaced peri-prosthetic fracture and was transferred to acute setting under Orthopaedic Unit. They underwent revision total hip replacement on the following day and other than post-operative transfusion for anaemia was progressing well. The patient was discharged to rehab again a week later, developed a Klebsiella UTI and hyponatremia and was transferred to the care of a general medical unit. They were treated with IV ceftazidime for their UTI, then oral vancomycin/metronidazole for C. difficile colitis, but continued to deteriorate with hypoactive delirium, deconditioning and later sepsis. There was eventual withdrawal of care and palliation.

Assessor's comments:

A patient in their early nineties living at home with their partner and ambulating on a four wheeled frame was admitted under a general medical unit after a fall while attending for an outpatient visit while being investigated for falls. There was a history of a left total hip replacement eight years prior. The medical team felt the left hip pain was from bursitis and a sacral fracture. An X-ray and CT scan of the left hip replacement were discussed with an orthopaedic registrar. The patient made slow progress and significant pain made mobilizing difficult. On day thirty-nine of admission the patient was transferred to the orthopaedic ward after new X-rays showed a mildly displaced peri-prosthetic fracture from greater trochanter to proximal shaft, and the patient underwent a revision of the femoral component with a long-stem uncemented component with multiple cables. Post-operatively on day five the patient developed Clostridium difficile diarrhoea and urinary sepsis, and after failing to respond to antibiotics, active treatment was withdrawn and the patient passed away.

The quality of record keeping in the clinical notes was generally of a good standard. However, the reason for several decisions made by the medical staff were not explained. There were no notes to explain why revision was favoured over fixation, given the age, active medical problems, frailty and prolonged immobilization. There was no indication in the postoperative orders or later clinical notes as to the plan for weight-bearing status. Appropriate discussions with the patient's family regarding end of life care were well documented.

The first-line assessor raised concerns regarding a lack of orthopaedic input on admission, and the clinical notes confirm that the patient was probably not examined or seen by any member of the orthopaedic team in the first five weeks of admission. Review by a registrar or consultant on admission, with follow-up a week later to ensure that the patient was mobilizing, and if not, repeat the X-ray, may well have shortened the five-week delay in diagnosis to a one-week delay.

The first-line assessment also contained some inaccuracies, as the delay in reaching the main surgical diagnosis was not solely due to the Medical Unit but was also the responsibility of the Orthopaedic Unit which probably did not see the patient on and after admission. The development of the necrotic heel pressure area is an adverse event.

The first-line assessment lacked detail regarding the operation, and the notes reveal this was an appropriate procedure for revising a cement femoral stem with a cement mantle which probably was damaged. Considering the patient's significant medical problems, frailty and prolonged immobilization, simply cabling the femur to achieve stability and replacing a three and half-hour operation with a one hour operation may have been better for the patient.

There were several areas of concern relating to preoperative assessment and choice of procedure. After the fracture was diagnosed, a resident wrote of the need for an anaesthetic review but there is no documentation to show that an anaesthetic, medical or Roth-geriatric review was performed in the 36 hours between diagnosis and operation. This should have been acted on and pursued by the orthopaedic registrars while the warfarin was being reversed preoperatively. None of the notes made by members of the Orthopaedic Unit preoperatively make any reference to what investigations were needed and whether any of the patient's recent health problems required attention.

Performing a cabling of the fracture without revision, in view of the patient's recent UTI, necrotic heel pressure sore, anaemia (8 g/dL), intermittent hypotension and bradycardia, chronic renal failure, loss of 6% body weight in six weeks with hypoalbuminaemia despite dietary supplements, and prolonged immobilization, should have been given serious thought.

Also, of concern is the lack of involvement by the Orthopaedic Unit in the initial management and diagnosis of this patient's orthopaedic problem. This may have been a problem related to a single registrar, or it may be that the unit has a culture that does not encourage its registrars to see patients from other units whose orthopaedic problems are discussed with the registrars.

The patient was treated on day 12 with oral cephalexin for a positive urine culture without evidence of sepsis or leucocytosis, so this organism may have been a colonisation rather than an infection. Coupled with 48 hours of intravenous cefazolin postoperatively, as opposed to the usual recommendation of two postoperative doses, these could have contributed to the *C. difficile* diarrhoea which began eight days later, and which probably contributed to the patient's death.

An adverse event occurred in the delayed diagnosis of the peri-prosthetic fracture. While reasonable investigations were performed on admission, the medical and Rehabilitation Units relied too much on the diagnoses of sacral fracture and trochanteris bursitis to explain the patient's pain and immobility, and an earlier repeat X-ray of the hip or a review of the patient by the Orthopaedic Unit would probably have shortened the delay in diagnosis.

Suggestions: The Orthopaedic Unit should consider whether a hands-on approach for its registrars dealing with patient referrals is being implemented. Adequate anaesthetic or ortho-geriatric review of frail elderly patients undergoing major surgery should be strictly enforced. Considering less significant, shorter operations for frail elderly patients should be considered. Postoperative antibiotics should be given for the shortest effective duration, and the risks of prolonged courses of antibiotics should be considered.

Surgical lessons:

- Implement adequate preoperative assessment and consider choice of operation.
- Better documentation and improve communication.

Plastic Surgery

Case 15: Communication, preoperative workup, futile surgery

Clinical details:

Diagnosis: Burn injury house fire, out of hospital arrest post-inhalation injury.

Operation: Excision burn wound.

Cause of death: Hypoxic brain injury.

Course to death:

Taken to theatre for excision of burn. Evidence of hypoxic brain injury on return to ICU. Post-operative tests confirmed brain death.

Assessor's comments:

This case is that of a patient in their early fifties who suffered significant burns to the torso and limbs after re-entering a burning building. The patient was subsequently retrieved from the building by fire rescue and was found to be in cardiac arrest. CPR was performed by ambulance officers at the scene and a cardiac output re-established after 15 minutes, although the total down-time was unknown.

Immediate transfer was undertaken to a Burns Unit, with admission performed through the ED prior to transfer to ICU. The patient was intubated and ventilated on arrival, and aggressive fluid resuscitation was undertaken. Diagnosis on admission was of approximately 50% total body surface area burns, with lactic and respiratory acidosis, likely carbon monoxide poisoning, and suspicion for cyanide poisoning. There were no overt signs of trauma.

CT Brain performed prior to transfer to ICU showed 'global cerebral oedema in this setting most likely due to cerebral hypoxia'.


It appears that this information was not sought or communicated to the treating surgical team and the patient was taken to the operating theatre later that night for burns debridement and Biobrane (flexible temporary skin cover) application. The pre-anaesthetic assessment does document knowledge of this finding by the anaesthetic team.

Postoperatively, the patient was transferred back to ICU and the admitting nurse identified that both pupils were fixed and dilated. This was immediately communicated to the ICU consultant and Neurosurgery was consulted. In their opinion, the patient had suffered an unsurvivable, non-reversible hypoxic brain injury, as evidenced by the CT Brain performed earlier that day.

Brain death was confirmed on nuclear medicine scan the following morning. The family was kept updated on the grave nature of the situation throughout the patient's admission.

Area of Concern: The key area of concern in this case is performing an urgent burns debridement in a patient that was most likely already brain dead. Clearly, the outcome of the CT Brain should have been known by the surgical team, and almost certainly would have obviated the need for any surgical intervention. The VASM report filled in by the treating unit acknowledges this point.

This is clearly an issue of communication between the ED, ICU, the Anaesthetic Department, and the treating surgical team. There are no clear pathways to minimising this risk in the future other than encouraging and expecting open and frank communication between treating units. This can be difficult in urgent scenarios such as this, when the focus is on efficient and early burns management to improve the overall outcome. However, in this case, that narrow focus probably led to a failure to consider the patient as a whole, and to check the necessity of operating at all.



Clearly, this patient underwent an operation that was unnecessary, but it did not alter the outcome of the injury.

Surgical lessons:

- When multiple teams are involved in patient care, particularly in trauma settings, someone needs to take overall responsibility and look out for the patient's interests.

Vascular Surgery

Case 16: Delayed diagnosis, delayed treatment, inadequate facilities

Clinical details:

Diagnoses: Right brachial embolus, embolising right subclavian atherosclerosis.

Operations: Right subclavian, brachial, radial and ulnar embolectomy.

Cause of death: Embolic right middle cerebral artery stroke.

Course to death:

Patient admitted with acute arm ischaemia. CT angiography showed a large right subclavian filling defect without calcification, proximal to vertebral artery (VA). Brachial artery occlusion from mid arm. IV heparin commenced immediately. Assessed by vascular consultant as Rutherford 2a case five hours later. Isolated sensory change in hand, preserved power. Patient nominated thenar claudication and hand/wrist pain 2/52 prior to presentation. In retrospect this was distal embolization.

The patient was offered two options:

- Option 1. Complete brachial and subclavian embolectomy with protection of the VA during trawling of embolectomy balloon with transfemoral VA protection balloon.
- Option 2. Simple brachial embolectomy leaving the subclavian lesion accepting the risk of subsequent arm or vertebral embolisation.

The patient was offered and accepted a second opinion from Neurology regarding cerebrovascular accident risk associated with leaving the subclavian lesion. Neurology asked for a third opinion from tertiary hospital neuro-interventionists. General agreement for option one reached at six hours after admission.

Vascular consultant began urgent 80% symptomatic carotid case while consensus was being reached on plan One or Two.

Redo brachial embolectomy. Axillary artery stenting failed. Provisional diagnosis dissection in axillary artery resulting in new occlusion, stents placed with immediate occlusion. No inflow despite balloon thrombectomy of stents.

Operation 1: Right subclavian, brachial, ulnar and radial embolectomy. VA protection provided. Noted to have high bifurcation of brachial artery so both radial and ulnar dissected at cubital fossa and individual embolectomies performed. Completion angiogram showed residual but lesser filling defect in proximal right subclavian artery; axillary, brachial and radial artery open. Ulnar chronically occluded, unable to get significant back bleeding or pass embolectomy catheter down vessel. No stent available in hospital to address subclavian lesion such as short stent on long delivery system.

Patient handed over by email and verbally to new vascular consultant as previous surgeon was flying internationally that day. Advised that stenting the proximal lesion should be considered. Patient in ICU – slow deterioration – persistently cool and numb. Request for CT angiogram made on day 18 – request lost. Repeat CT angiogram on day 19 midday – shows new occlusion, commencing in the axillary artery. Moderate subclavian lesion persistent.

Operation 2: Simple embolectomy reattempted – inflow not achieved.

Operation 3: Commenced six hours after first. Attempted stenting of new axillary occlusion, provisional diagnosis, localised dissection. No attempt made to treat the proximal lesion. Immediate stent occlusion, unsuccessful thrombectomy. Telephone call during night to tertiary hospital who were not happy to accept transfer, advised to bypass subclavian/axillary section with inflow from right common carotid artery. Recommendation declined and insistence for transfer.

Patient transferred to ICU then to tertiary hospital arriving following morning and assessed as having non-viable arm requiring amputation. Transferred to ICU to allow arm to demarcate. Fluctuating neurological state – CT brain shows massive right Middle cerebral artery (MCA) stroke presumably from proximal subclavian lesion. Patient died.

Assessor's comments:

This is a difficult case, but there are still several concerns. Given the initial history of at least two weeks of symptoms, there was a possibility of organised clot in the subclavian lesion. With this in mind, bailout options should have been considered at the time for the embolectomy procedure. This would have included having the appropriate stents available at the time of the initial procedure. If hybrid lab/appropriate equipment was not available, such a case should not have been commenced, and the patient should have been transferred to another hospital at that point. Furthermore, performing a vertebral intervention with a C-arm in theatres would also have been less than ideal. Given the operation occurred over 12 hours after a vascular consultant assessment, a transfer if organised at presentation would not necessarily have led to significant delay in revascularisation.

The high bifurcation of the right brachial artery was also not identified until after the radial and ulnar arteries were exposed. These were noted to be small, but no attempt was made to expose the actual brachial artery. The reluctance to perform an endovascular procedure to perform a retrograde fashion from the arm probably also contributed to re-occlusion of the axillary/subclavian artery. Exposure of a larger artery at the arm at the initial procedure may have provided the necessary access for a stent delivery via a shorter system.

A carotid subclavian/axillary bypass was never suggested to the patient or considered until suggestion from the tertiary hospital (with failure of operation 3). This bypass with a concurrent brachial embolectomy may have avoided issues arising from lack of an endovascular suite and equipment. This should have been considered earlier and may have prevented the fatal embolisation stroke.

At the third operation, no attempt was made to treat the subclavian lesion for fear of vertebral embolisation. However, no vertebral protection strategies were put into place either during the procedure. Plans to transfer the patient would also have led to further delays in revascularisation that eventually led to a non-viable arm.

Whilst it is uncertain when the fatal stroke occurred, not addressing the proximal subclavian lesion at the time probably led to the re-occlusion of the subclavian/axillary artery and the fatal cerebral event.

Surgical lessons:

- Appropriate equipment and facilities required.
- Delay in diagnosis and treatment.

Vascular Surgery

Case 17: Futile surgery, delayed diagnosis

Clinical details:

Diagnosis: Ischaemic legs with infrarenal aortic occlusion.

Operations: Bilateral femoral thrombectomies. Right axillobifemoral bypass. Bilateral calf fasciotomies.

Cause of death: Severe metabolic acidosis leading to profound hypotension.

Course to death:

Presented with infrarenal aortic occlusion, ischaemic from umbilicus distally. Marked metabolic acidosis. Patient and family keen for intervention. Underwent femoral thrombectomy with poor inflow. Axillobifemoral bypass with fasciotomies. Increased inotrope requirements with progressive acidosis. Unable to support BP, death.

Assessor's comments:

A patient in their mid-sixties presented with profound acute ischaemia from umbilicus down, total sensory loss below waist, paralysis below the waist and severe metabolic acidosis. The patient was also known to have biventricular heart failure with an ejection fraction of between 10 and 25%. CT angiogram demonstrated aortic occlusion at or just above the renal arteries with occlusion of right renal artery and no enhancement of right or lower pole of left kidney. There was also occlusion of iliac and femoral arteries. The decision for rapid emergency surgery was made after a family discussion and thrombectomy was carried out followed by axillofemoral bypass grafting. There was loss of cardiac output at the end of the procedure requiring full CPR resuscitation and the patient failed to respond in ICU, deteriorated rapidly and died.

Of note, there is also a record of an ED visit (to either the same or an associated hospital) 24 to 36 hours previously, with sudden onset of left leg pain and paraesthesia or numbness. This was diagnosed as lower back pain and treated with analgesia. Although there was a neurological examination carried out and recorded, there is no documented vascular assessment – and no mention of pulses.

Record keeping: The hospital notes are complete. The typed sections are easy to read, the handwritten sections less so, but for the most part provide a good detailed record.

Comments: The comments raise several questions:

- The CT angiogram demonstrated occlusion from just below superior mesenteric artery (SMA) down to distal superficial femoral artery in both legs with poor renal perfusion (and also commented on significant right heart failure).
- The progressive acidosis appears to be due to the irreversible ischaemia, in spite of reperfusion. The symptoms and signs were suggestive of an irreversible process on presentation. Combined with the lack of renal enhancement on CT and the known severe cardiac failure, palliation without surgery would have been an acceptable choice in this situation. However, the decisions had to be made very quickly and with family requesting intervention, it is understandable why the decision to operate was made.
- It is difficult to avoid the conclusion that the presentation 24 hours earlier with acute onset left leg pain was due to the onset of the ischaemia. The assessment in ED at that time was inadequate, no vascular assessment was carried out, and so the opportunity for salvage may have been missed.

Surgical lessons:

- Preoperative assessment and involvement of surgical team at initial presentation was inadequate.

Vascular Surgery

Case 18: Futile surgery, preoperative work up

Clinical details:

Diagnosis: Endoleak and enlarging abdominal aortic aneurysm (AAA) sac, acute to chronic intestinal ischaemia related to stenosis of coeliac and superior mesenteric arteries.

Operations: Exo-collar around the neck of the aortic aneurysm. Laparotomy and bypass to the endarterectomised superior mesenteric artery and thrombectomy of the right femoral and iliac arteries.

Cause of death: Hepatic and bowel ischaemia.

Course to death:

Patient had presented to ED with abdominal pain, tenderness over aneurysm and a CT angiogram which had shown an endoleak and also the sac at 72 × 70 mm (prior 63 × 63 mm). No mention of atheroma in coeliac nor the superior mesenteric artery. Operation to band the neck of the aneurysm for a Type 1 leak, opening of the sac to under run lumbar arteries. There were some intestinal adhesions. Patient sent to ICU and noted to have a raised lactate and also worsening liver function. There may have been a twist in the small bowel as adhesions had been divided. The issue of stenoses in the coeliac and superior mesenteric vessels was not appreciated. Repeat laparotomy showed the small bowel to be dusky. The superior mesenteric artery was explored and was rigid with calcified and stenosing plaque for several centimetres. It was not possible to achieve strong inflow from the SMA. It was decided to bring a graft from the right iliac artery below the stent graft limb and to bring it to the SMA. The top anastomosis was to the SMA with a long patch, done end-to-end to try and give a better lie to the graft. This may have been an issue in not revascularising the liver via collaterals from the more proximal SMA. There was a small hole in the small bowel that needed to be repaired towards the end of the operation (ischaemic patch). It was also necessary to do a thrombectomy of the right femoral artery at the end.

It was felt that access to do any 'in-line' reconstruction was going to be hard with access limited by ischaemic bowel but also not wishing to clamp the aorta.

Back in ICU, the patient continued to have a high lactate and developed progressive liver failure and then circulatory failure. It was felt that there was no prospect for recovery. The situation was discussed with the family and active treatment was withdrawn.

There had been several consults with a gastroenterologist in the previous months and a duodenal ulcer shown on endoscopy. The gastroenterologist was concerned about the aneurysm. In retrospect chronic intestinal ischaemia was present.

Assessor's comments:

This is a second-line assessment regarding a patient in their late-eighties who was admitted under the care of a vascular surgeon for elective surgery to treat an enlarging recurrent juxta-renal AAA, which was presumed to be the cause of their recent abdominal pain.

From the notes it could be established that the patient had had an aortic aneurysm treated by endovascular aneurysm repair nine years before but had developed a juxta-renal aneurysm that had enlarged over the preceding two years from 63 mm in diameter to 72 mm in diameter. There had recently been two days in hospital with an episode of lower abdominal pain with associated mild tenderness and the decision had been made to attribute the pain to an endoleak into the aneurysm sac and open surgery was proposed. The patient had been a Type II diabetic for many years, had preserved renal function, and had previously had coronary artery bypass surgery in 1995. The haemoglobin was only 10.0 g/dL.

A three-hour procedure involved a laparotomy and two Dacron bands were used to encircle the infrarenal neck of the aortic aneurysm. The sac was then opened and at least one back bleeding lumbar artery was transfixed and a small leak from the graft was also repaired. However, a note was made by the operating surgeon that the aneurysm sac was still pulsatile at the end of the procedure after it had been closed.

Postoperatively, the patient went back to Intensive Care where a rising serum lactate and hepatic failure were noted. Repeat laparotomy was conducted eight hours after the first operation had been completed. Under a general anaesthesia, a four-and-a-half-hour operation was performed at which the gut was noted to be greyish in colour and there was no pulse felt in the superior mesenteric artery. An extensive SMA endarterectomy was performed and then a Dacron bypass from the distal right common iliac artery to the SMA was implanted. Endarterectomy was conducted of the right iliac bifurcation but following this the right leg and foot were noted to be ischaemic so the patient had a second bypass from the proximal right external iliac artery to the right common femoral artery. Two mid-ileal bowel perforations were noted and repaired, the abdomen was left open, and the patient was returned to the Intensive Care ward.

The condition continued to deteriorate with rising serum lactate and progressive liver failure and circulatory failure. After a family meeting, the circulatory support was withdrawn, and the patient died that afternoon. A discussion was had with the Coroner and the patient's death was deemed to be not notifiable.

The decision to operate was flawed. The notes comment that the patient was elderly and frail. There was a recurrent aortic aneurysm which was associated with an endoleak and consideration could and should have been given to accepting that this was a terminal event, and that repair either by open means or endovascular techniques was high risk and unlikely to be successful. It is not possible to say whether the abdominal pain was related to mesenteric ischaemia or to the aneurysm. In any case, palliation rather than operative intervention would have been a kinder choice for the patient and their family.

A second area of consideration might be the injury that apparently occurred to the intestinal blood supply during the first operation but went unrecognised and to the right lower limb arterial supply during the second operation. Both were clearly significant, and consideration could have been given to abandoning the situation at the second operation once the gravity of the situation became apparent.

Heroic prolonged surgery in a patient of extreme old age was unlikely to have a favourable outcome.

Surgical lessons:

- Decision to operate in an elderly and frail patient. Palliation would have been a kinder choice.

Urology Surgery

Case 19: Communication, documentation, delayed postoperative management, lack of experience in ICU

Clinical details:

Diagnosis: Right retroperitoneal inflammatory mass with discharging fistula to skin.

Operations: Open excision of right retroperitoneal inflammatory mass and fistula. Relook laparotomy.

Cause of death: Multi-organ failure due to presumed sepsis.

Course to death:

A patient in their mid-seventies admitted for surgical excision of inflammatory mass and sinus tract infection. Postoperatively became increasingly unstable with increasing vasopressor/inotrope support. Returned to theatre for an exploratory laparotomy. Postoperatively the patient remained intubated and continued to deteriorate despite antibiotic therapy, adrenaline, noradrenaline and vasopressin. Underwent a period of renal replacement therapy. Ultimately, a ceiling of care was established by the treating intensivist with 20 µg/min adrenaline, 20 µg/min noradrenaline, and 2.4 units/h vasopressin, and the patient continued to become increasingly hypotensive. The family were called and advised of the worsening condition. The urology team were also advised. Once the family were present and had been apprised of the situation by the doctor, the patient was extubated and palliative care commenced. The patient died 24 hours after procedure. The golden hour had passed in the care of ICU.

Assessor's comments:

A patient in their mid-seventies with nephrectomy for inflammatory mass and associated sinus. Patient had multiple comorbidities which would have compromised the immune state e.g. DM, end-stage renal failure and likely chronic sepsis. Decision to operate was sensible, as was the decision for post-operative ICU involvement and the decision for re-look laparotomy for possible peritonitis.

The main concern is the paramount lack of active treatment of septic shock with fluids. ICU consultant input was delayed and may have changed the clinical picture from septic shock to severe sepsis and control. But once the organs started failing, this patient was no longer likely to survive. The surgeon is very critical of the ICU registrar and junior staff. But documentation of these concerns are lacking. If concern was great, then consultant surgeon review and discussion with the ICU consultant is prudent.

This patient was limited in their physiological reserve and unlikely to be able to cope with entering septic shock. Surgical aspects seem fine.

Discussion: Surgeon's report and first-line assessment suggest that ICU proved an issue in the postoperative management. When turning the corner toward severe deterioration in status with apparent development of septic shock, the concern is that ICU senior staff did not get involved in a timely fashion. It does seem as though they had a well outlined plan for parameters of stability on inotropes. However, the ICU consultation wasn't until early hours of the morning.

The surgeon's concerns about running the patient too dry were apparently ignored to the detriment of the patient. The patient is highly likely to have had a similar outcome to what eventuated here, but timely and aggressive fluid and antimicrobial intervention is paramount in dealing with these patients. A low threshold should have been considered due to the high chance of septic complications due to DM and end-stage renal failure and having been recently treated for sputum positive chest infection. There is limited, if any, documentation of in-hospital concerns between teams, thus it is difficult to fully assess the case for ICU failure here.

Conclusions: From a surgical audit aspect, I would suggest that the patient had timely and appropriate surgical management during their stay and early involvement of ICU. The fact that they provided only junior cover for this deteriorating patient is more of a concern.

Clear documentation is important, especially if concerns are raised.

There should be more consultant to consultant interactions and patient care should not rely on junior doctors to assess a patient in such distress.

Surgical lessons:

- It is increasingly obvious how essential a complete team approach is to these challenging issues, and how the absence and/or delay of ICU consultant, and renal physician, can influence the outcomes.
- In this case the responsibility of a second-line assessment could well have been appropriately split between a urologist and intensivist, as fluid balance issues are primarily the realm of the dialysis expert rather than surgeon. The surgical management appeared entirely appropriate. A team approach should be instilled in the minds and teaching of our trainees, and colleagues, together with the confidence and comfort of questioning management decisions.

List of shortened forms

AAA	abdominal aortic aneurysm
AF	atrial fibrillation
BP	blood pressure
BSO	bilateral salpingo-oophorectomy
BPM	beats per minute
CA	cancer antigen
CABG	coronary artery bypass graft
CPB	cardiopulmonary bypass
CPR	cardiopulmonary resuscitation
CRP	C-reactive protein
CT	computed tomography
DM	Diabetes mellitus
DVT	deep vein thrombosis
ECHO	echocardiogram
ECMO	extracorporeal membrane oxygenation
ED	emergency department
eGFR	estimated glomerular filtration rate
ERCP	endoscopic retrograde cholangiopancreatography
ETT	endo-tracheal tube
GCS	Glasgow Coma Scale
GP	general practitioner
HDU	high dependency unit
HPB	hepato-pancreato-biliary
HTN	hypertension
ICU	intensive care unit

IV	intravenous
LFT	liver function tests
LUCAS	Lund University cardiopulmonary assist system
MDM	Multi-disciplinary meeting
MET	medical emergency team
MCA	middle cerebral artery
MRI	magnetic resonance imaging
NGT	nasogastric tube
NSAIDs	non-steroidal anti-inflammatory drugs
PE	pulmonary embolism
PEA	pulseless electrical activity
PRBC	packed red blood cells
QP	Qualified Privilege
RACS	Royal Australasian College of Surgeons
SCC	squamous cell carcinoma
SBO	small bowel obstruction
STEMI	ST-elevation myocardial infarction
SMA	superior mesenteric artery
TAH	total abdominal hysterectomy
UTI	urinary tract infection
VA	vertebral artery
VASM	Victorian Audit of Surgical Mortality
VATS	video-assisted thoracoscopic surgery
WCC	white blood cell count

VASM Management Committee Members and Staff

Title	Surname	First Name	Position
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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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