


**NATIONAL CASE NOTE
REVIEW BOOKLET**

LESSONS FROM THE AUDIT

VOLUME 17 | MAY 2020





Royal Australasian College of Surgeons
Australian and New Zealand Audit of Surgical Mortality
199 Ward Street
North Adelaide SA 5006

Telephone: +61 8 8219 0900
Facsimile: +61 8 8219 0999
Email: ANZASM.RACS@surgeons.org
Website: <http://www.surgeons.org/anzasm>

DISCLAIMER: This booklet is produced for Fellows of the Royal Australasian College of Surgeons. Information is obtained under a quality assurance activity.

The information contained in this case note review booklet has been prepared on behalf of the Royal Australasian College of Surgeons, Australian and New Zealand Audit of Surgical Mortality Steering Committee. The Australian and New Zealand Audit of Surgical Mortality, including the Western Australian, Tasmanian, South Australian, Australian Capital Territory, Northern Territory, New South Wales, Victorian and Queensland Audits of Surgical Mortality, has protection under the Commonwealth Qualified Privilege Scheme under Part VC of the Health Insurance Act 1973 (gazetted 25 July 2016).

Contents

Chairman's Report	2
Recommendations	3
Case Studies	4
Case 1: Do not add a second lethal injury!	4
Case 2: Futile surgery for necrotising pancreatitis could have been avoided by better end-of-life decisions	6
Case 3: Predictable iatrogenic epistaxis following futile right hemicolectomy	9
Case 4: Over-anticoagulation with delayed diagnosis of postoperative bleeding	11
Case 5: The role of a shared care model for at-risk General Surgery patient	13
Case 6: Open abdominal surgery to excise bilateral adrenal pheochromocytomas may have allowed these tumours to be safely resected	15
Case 7: Unrecognised duodenal stump leak following total gastrectomy	18
Case 8: An unexpected death due to ruptured intracranial aneurysm during joint replacement surgery	22
Case 9: Prolonged hypotension and the deteriorating patient	25
Case 10: The need to stabilise the seriously ill prior to diagnosis inevitably delays definitive treatment	28
Case 11: Urinary sepsis with obstructed kidney following stent removal without antibiotic cover	31
Case 12: Hypovolaemia and vasoconstrictor therapy in a diabetic patient undergoing coronary artery bypass graft	33
Case 13: Repairable iatrogenic cannulation injury with complicated aortic valve replacement	35
Case 14: Unfortunate iatrogenic complication of endovascular aneurysm repair in a high-risk patient	37
Abbreviations	40
Contact Details	40

Chairman's Report

Every day, surgeons must make decisions that, with the benefit of hindsight, seem less than ideal. On most occasions the consequences may be a delay in treatment, prolonged hospital stay or redo surgery. However, as this latest Case Note Review Booklet highlights, fatal outcomes can occur from poor judgement. The failure to engage senior surgical input can be disastrous.

Patients deserve, and the community expects, surgeons, to consult, participate and direct care of complex and comorbid patients. Delays in treatment, avoidance of unnecessary surgery and consultation with medical colleagues could have avoided some of the outcomes highlighted in this collection from the Australian and New Zealand Audit of Surgical Mortality (ANZASM).

Hopefully, these findings would be echoed by local M&M meetings but sometimes an external review casts a different perspective on a poor outcome. Poor planning of the surgical procedure may not always come to light at routine M&M meetings. It is often recommended that an external auditor participates in such discussions from time to time.

When an adverse second line assessment is received from the ANZASM Audit, it is designed to provide an educational experience for the surgeon receiving it. While under no obligation to discuss it further, it may be useful if the lessons learnt by the individual are shared more widely with the surgical team involved in the patient's care.

This booklet aims to disseminate lessons learnt at a national level for surgeons, trainees and students to reflect on.

Sometimes the criticisms are perhaps not balanced as all the circumstances of the case may not be known to the reviewer, but the message on the information available is always valuable.

Learn from the mistakes of others but be receptive to your own misses or near misses and share them with colleagues.

As always, any constructive feedback is gratefully received.



Guy Maddern

Chair, Australian and New Zealand Audit of Surgical Mortality (ANZASM)

Recommendations

From the cases that we have before us, several key themes can be identified that we as surgeons should consider in the evolution of our practice, and the betterment of outcomes for our patients.

- A robust decision-making process is essential in providing the best possible chance of a positive outcome for the patients. This process should incorporate an appreciation for the full clinical context of patients' situation. Understanding all the clinical facts is critical in reaching high-quality care. For complex cases, a multi-disciplinary approach is advocated.
- Effective communication between all parties will help foster the best possible therapy for our patients. Consultation with our colleagues and across specialties is strongly encouraged, with what's best for the patient kept forefront in mind. Where necessary, we must strongly advocate on our patients' behalf.
- The importance of a consultant being physically present in the theatre, particularly during complex cases, cannot be understated. This is not just to be able to directly intervene where necessary, but to also be able to provide the benefit of their experience to junior colleagues still developing their surgical expertise.

While there have been some technical failures among the cases listed, these cases serve to highlight the importance of the surgeon's non-technical skill set¹. Marrying all these facets of the surgeon's non-technical skills will doubtless lead to improved patient outcomes and fewer regrets for all concerned².

REFERENCES

1. Flin R, Maran N. Identifying and training non-technical skills for teams in acute medicine. *BMJ Quality & Safety*. 2004;13(Supp 1): i80-i84.
2. Boyle FM, Allen J, Rey-Conde T, North JB. Learning from regret. *British Journal of Surgery*. 2020;107(6): 422-431.

Case Studies

Case 1: Do not add a second lethal injury!

General Surgery

CASE SUMMARY

A male patient in his late 70s received multiple stab wounds from a knife described as having a long thin blade. His injuries included a 2 cm laceration to the third left intercostal space (immediately lateral to the sternum), three superficial lacerations to the right side of the abdominal wall, and a superficial finger wound. His comorbidities included: ischaemic heart disease (previous coronary artery bypass graft), congestive cardiac failure and cardiomegaly, hypertension and gout. His medications included aspirin, frusemide, spironolactone, metoprolol, ramipril and pantoprazole.

At presentation to a rural hospital, the patient was hypotensive and tachycardic. Air entry was decreased on the left side and a chest X-ray identified a left haemothorax. A left intercostal catheter (ICC) was inserted and approximately 300 ml of blood drained initially with minimal continuing drainage. He was transferred to a major trauma centre, where he arrived 8.5 hours after presentation at the rural hospital. The transfer was uneventful.

On admission to the trauma centre, his blood pressure was 150/82 mmHg; pulse rate 82 beats per minute; oxygen saturation 99% on six litres. Air entry was decreased on the left side. Shortly after admission, the surgical registrar reviewed the patient. A focused assessment with sonography in trauma was performed, suggesting a small pericardial effusion. Chest X-ray showed a large left haemothorax. ICC placement was described as too low (7th or 8th intercostal space). A computed tomography scan was also performed, confirming a large left haemothorax and a possible pericardial effusion. The patient was admitted to the high dependency unit within 2 hours.

He was reviewed by the surgical consultant, who—after discussion with the radiologist—advised placement of a second left ICC because the first was not well positioned to drain the haemothorax. This procedure was performed by an intensive care unit (ICU) consultant (4th intercostal space in the mid-axillary line using a blunt dissection technique). Upon opening the pleura, there was a huge rush of blood (approximately one litre). The intensivist was unable to advance the ICC. Another consultant assisted in breaking down the apparent adhesions digitally and advancing the tube. There was further heavy blood loss during this procedure.

The patient became hypotensive, requiring fluid boluses and multiple doses of

metaraminol. After further blood loss, he required intubation and activation of the massive transfusion protocol. The decision was made to transfer him to theatre, but all rooms were occupied, resulting in a 30-minute delay. By the time the patient reached theatre, he required adrenaline and had a loss of cardiac output.

A thoracotomy was performed with a clamshell approach (starting in the left 4th intercostal space). The pericardium was opened, releasing a small amount of pericardial blood, and open cardiac massage was performed. The stab wound had penetrated the right ventricle but was not bleeding at that point. The left lung was adherent to the chest wall and the ICC had penetrated the lung parenchyma with resulting haemorrhage. This was controlled by clamping the hilum of the left lung. Cardiac massage continued for 30 minutes, along with multiple doses of adrenaline and calcium gluconate, but the patient remained in asystole.

DISCUSSION

The choice of a clamshell incision for a patient who has had a previous median sternotomy was appropriate. The delay in obtaining access to the operating room was a significant issue for a major trauma centre. Performing the thoracotomy in the ICU should have been considered in this situation.

The dense adhesions at the site of insertion of the second ICC resulted in the tube being placed within the lung parenchyma and fatal haemorrhage occurring as a result. A blunt dissection technique was used, which was noted to be difficult and assistance was required. Presumably, when the pleura was opened, the adherent lung was entered, and the subsequent breakdown of adhesions was, in fact, an intraparenchymal dissection.

Several options are available if ICC placement becomes difficult, such as enlarging the wound, or using small retractors to visualise the track through the chest wall and intercostal space and into the pleural cavity. If the pleural cavity cannot be confirmed, another intercostal space may be tried. Ultrasound can be useful to identify the best approach to the collection.

CLINICAL LESSONS

Given the position of the wound beside the left sternal edge, the history of a long blade and the likely penetration of the anterior mediastinum, immediate exploration should have occurred upon arrival at the major trauma centre.

A patient with a parasternal stab injury should have been treated as having cardiac injury (unless proven otherwise). The delay in transfer of approximately 8 hours was inappropriate.

Previous chest surgery is almost always associated with a change in anatomy within the chest cavities. This is best dealt with in the operating theatre.

Case 2: Futile surgery for necrotising pancreatitis could have been avoided by better end-of-life decisions

General Surgery

CASE SUMMARY

A female patient in her late 80s was presented to the emergency department from a high-level care nursing home (HLCNH) having experienced sudden onset severe abdominal pain. Upon presentation she was unstable, septic, and had a lipase of 4,500 U/L. She had a stoma, resulting from an emergency Hartmann's procedure performed six months earlier, as well as multiple comorbidities including diabetes, cardiomyopathy, asthma and gallstones. She was registered as legally blind and required assistance for mobilisation and activities of daily living. Nursing home records noted her daughter had an enduring power of attorney, however there were no end-of-life wishes or formal goals-of-care documented in hospital notes.

A computed tomography (CT) scan of her abdomen indicated necrotising pancreatitis, a dilated central bile duct with filling defects (in keeping with gallstones), and free intraperitoneal air but with no obvious bowel perforation, resulting in her admission to the acute surgical unit. Anaesthetic assessment indicated serious concerns regarding the appropriateness of surgery and the high risk of perioperative mortality. However, surgical review by the Fellow (but not the consultant) resulted in the family agreeing to surgery in view of the high likelihood of perforation.

An emergency laparotomy was performed by the Fellow with the supervising consultant present in theatre. Necrotising pancreatitis was confirmed, though no bowel perforation was identified. Following discussions with an upper gastrointestinal (GI) surgeon, a necrosectomy was deemed inappropriate, so the abdomen was washed out and the patient admitted to the intensive care unit. Given the patient was already displaying signs of multiple organ failure, her care was capped, and she progressively deteriorated and died 24 hours later.

DISCUSSION

The key issue in this case was whether surgery could have been avoided. A dependent elderly patient requiring HLCNH care was never likely to survive an emergency laparotomy for necrotising pancreatitis, and in the very unlikely event this occurred, the hospital stay would have been prolonged and quality of life after discharge even worse than before. In this case, surgery could—indeed should—have been avoided.

There were several concerns with this case. The anaesthetist was documented as feeling that surgery was inappropriate. The surgical consultant should have personally reviewed the patient before arriving in theatre, been directly involved in the assessment, decision-making, and discussions with the anaesthetist, the family, and the upper GI consultant as necessary. There was no evidence in the records that the consultant personally reviewed the CT scan preoperatively. A potential bowel perforation increases the risk of necrotising pancreatitis and would constitute an additional reason not to operate.

Frailty is increasingly recognised as an important risk factor for surgical morbidity and mortality. In this case, a formal frailty assessment would have aided the conversation with the family. There is no record of the patient's frailty being formally scored, however, based on the notes this would likely have been at least 6, perhaps 7, on the Canadian Frailty Scale, indicative of a >60% mortality¹.

There was no indication that a formal and comprehensive risk assessment was undertaken prior to emergency laparotomy². A National Emergency Laparotomy Audit score of 41% was calculated as part of the review, although this assumed 'best case' or normal parameters for those not provided in the notes (e.g., urea), when in reality the score was probably higher. Given the patient's frailty and associated comorbidities, a risk assessment would have underscored the high mortality risk of surgical intervention and would have aided in discussions with the family. Considering the patient's age, presumed frailty, HLCNH residence and recent major surgery, it was surprising that there was no advanced health care directive in place prior to surgery. This matter should have been addressed at the time of the Hartmann's procedure or at discharge to the HLCNH.

While these factors did not influence the patient's inevitable death, if they had been considered, it is probable that her death would not have been preceded by an avoidable and futile emergency laparotomy.

CLINICAL LESSONS

This patient should have had appropriate analgesia and, if possible, a discussion regarding options and prognosis. Death seemed inevitable and appropriate in the circumstances and conservative measures toward a peaceful end-of-life should have been the goal after initial care and observation.

Surgery was inappropriate and futile. The patient had unnecessary anaesthesia, surgery and suffering inflicted on her in her final hours as a result of poor decision-making and a failure to collaborate by medical colleagues.

REFERENCES

1. Parmar KL, Law J, Carter B. Frailty in older patients undergoing emergency laparotomy: Results from the UK observational emergency laparotomy and frailty (ELF) Study. *Annals of Surgery*. 2019.
2. Royal College of Surgeons [England]. The High Risk General Surgical Patient: Raising the Standard. 2018. Available from: <https://otjonline.com/news2019/01/news07a.php>

Case 3: Predictable iatrogenic epistaxis following futile right hemicolectomy

General Surgery

CASE SUMMARY

A frail patient was admitted to hospital with polymicrobial bacteraemia. He had been admitted 16 days prior complaining of fever, persistent cough, and lethargy. The current admission was for lethargy, weakness and general decline. The previous admission followed the patient feeling unwell for a few days with cough and lethargy. He had multiple comorbidities including multiple myeloma, chronic lymphocytic leukaemia, severe chronic obstructive pulmonary disease (COPD) on steroids, obstructive sleep apnoea (OSA) on overnight continuous positive airway pressure (CPAP), permanent pacemaker, and recurrent bacteraemia.

As part of the investigation for bacteraemia, an abdominal and pelvic computed tomography scan was performed and wall thickening in the caecum and ascending colon was noted. Abdominal examination was soft and non-tender. Subsequent colonoscopy showed a traversable caecal neoplasm. Attempts to optimise the patient's nutrition with nasogastric feed failed due to epistaxis associated with nasogastric tube (NGT) insertion, so total parenteral nutrition (TPN) commenced. The patient had 3 units of packed red blood cells transfused due to a haemoglobin of 69 g/dL. Laparoscopic-assisted right hemicolectomy was performed on the day after transfusion, completed with a midline wound. He was admitted to the intensive care unit (ICU) postoperatively, where he was wheezy, coughing, and an ileus was noted. It was decided to insert an NGT, continue TPN, and continue his usual CPAP.

The patient had significant epistaxis after attempted reinsertion of the NGT, which was eventually treated using Merocel nasal packing bilaterally. The ICU doctor decided not to give the patient his usual overnight CPAP. The subsequent plan was for the patient to "be discharged from ICU with altered criteria", but he was continually observed in ICU that day. He was noted to be agitated and was prescribed haloperidol 1mg and another dose 30 minutes later. Sudden clinical deterioration occurred within 2 hours. The patient was found to be unconscious, mottled, cold, and in respiratory distress with associated desaturation (82%) and acidosis (pH 7.2). Discussion amongst the treating consultants reached the decision not to escalate treatment. The patient died the following morning.

DISCUSSION

Cardiology, Respiratory and Haematology consultants noted that this patient was high risk. A cardiologist further noted that the patient would probably not survive any significant bowel operation.

Deep vein thrombosis (DVT) prophylaxis was withheld and the dose adjusted at certain times during the admission but was not in accordance with national guidelines relating to patients with reduced renal function. Consideration should have been given to changing DVT prophylaxis from enoxaparin to unfractionated heparin if concerns were raised about bleeding from traumatic NGT insertion or poor renal function.

The patient's sudden deterioration may have been due to a lack of appreciation of his postoperative respiratory status. This was compounded by the patient's poor baseline function i.e., severe COPD and OSA requiring CPAP, as well as the upper airway disruption from epistaxis and bilateral nasal packing, haloperidol sedation to treat his agitation, omission of his usual CPAP, postoperative anaemia, and positive fluid balance.

CLINICAL LESSONS

The patient had epistaxis after postoperative NGT insertion for the treatment of postoperative ileus. This was despite recurrent epistaxis during attempts at preoperative NGT insertion.

The area of concern relates to the timing of the operation and whether further optimisation or delaying the operation may have reduced the risk of postoperative mortality. There was no abdominal peritonism or signs of obstruction from the colonic cancer to require urgent operation.

The timing of surgery was not optimal for this high-risk patient.

Case 4: Over-anticoagulation with delayed diagnosis of postoperative bleeding

General Surgery

CASE SUMMARY

A male patient in his early 70s with a significant number of comorbidities, including morbid obesity, underwent an elective laparoscopic cholecystectomy. In the perioperative period, he suffered haemorrhage from both a duodenal ulcer and the operative site. The bleeding was successfully controlled but he deteriorated postoperatively, developing cardiac arrhythmias, an acute kidney injury, metabolic disturbances and progressive respiratory distress. The decision was made—in conjunction with the family—to palliate him.

The first-line assessment questioned the perioperative anticoagulation regime for this patient, in particular the appropriateness of therapeutic Clexane at the dose delivered.

While the patient remained stable in the intensive care unit, he was recommenced on warfarin on the second postoperative night and the high dose of Clexane continued. Ongoing bleeding from the laparoscopic port sites required re-dressing, with increasingly frequent changes of dressings needed overnight on the second postoperative day and throughout the third postoperative day. Relatively low blood pressure prompted transfer of the patient from the rehabilitation ward back to the surgical ward. Throughout that day he became progressively more unwell, with nausea, abdominal pain, the passage of melaena stool and symptomatic hypotension. He was being reviewed largely by the medical unit rather than the surgical unit.

On the third postoperative day, a computed tomography (CT) scan of the abdomen confirmed a significant intra-abdominal haematoma. Despite ongoing symptoms of blood loss and relative hypotension, it was not until he had a further CT-intravenous cholangiogram the following day that the enlarging haematoma was recognised. He eventually underwent gastroscopy and laparoscopy that evening, more than 30 hours after the melaena was first reported and more than 57 hours after he first became symptomatic with signs of ongoing bleeding. Anticoagulants were withheld but the warfarin was not reversed. He was transfused one unit of blood with a stable haemoglobin.

The patient's management thereon was appropriate. He went to the operating theatre where the duodenal ulcer was discovered and appropriately treated, as

was the repeat laparoscopy and washout of the intra-abdominal haematoma. His subsequent course was probably predictable. Given his comorbidities and age, with increasing confusion, metabolic disturbance, renal failure and ongoing hypotension, the decision to palliate seemed appropriate.

DISCUSSION

Without access to previous case notes, the indication for the laparoscopic cholecystectomy in this patient was unclear. Admission notes from the elective gallbladder surgery and the patient's subsequent demise indicate an episode of acute cholecystitis, however the operative note mentions a thin walled gallbladder, with no intraoperative evidence of acute cholecystitis. No pathological report concerning the cholecystectomy was included within the case note, making it impossible to determine if this man, with his substantial comorbidities, should have undergone surgery in the first place. If the initial surgery was for pain only, it raises the question as to whether the large duodenal ulcer seen in the postoperative period was pre-existing and thus the cause of his symptoms all along.

CLINICAL LESSONS

This morbidly obese man, who was chronically steroid dependent, probably had a substantially lower lean body mass than his 100 kg weight would suggest. There is ample evidence to suggest that bleeding is a much more likely outcome in this situation than a thromboembolic event. Despite being based on the advice of a further treating physician, the perioperative anticoagulation regime seemed to be overly aggressive and recognition of the postoperative bleeding was delayed. It seems that the combination of Clexane and warfarin in the early perioperative period was unwarranted.

Furthermore, the decision to return the patient to the operating theatre for a gastroscopy and repeat laparoscopy was considered to be somewhat delayed for a man who was anticoagulated, had multiple comorbidities, and had clinical signs of bleeding.

Case 5: The role of a shared care model for at-risk General Surgery patient

General Surgery

CASE SUMMARY

A female patient in her late 50s was admitted for an elective right hemicolectomy having been diagnosed with a pedunculated, well-differentiated, submucosally invasive adenocarcinoma of the caecum. Preoperative assessment noted several significant comorbidities, including insulin dependent type 2 diabetes mellitus, morbid obesity with limited exercise tolerance due to chronic back pain, gastroesophageal reflux disease, renal impairment, pre-existing hypertension, and depression/anxiety. There was no history to suggest underlying ischaemic heart disease. The patient was assessed preoperatively and although high-risk, she was considered fit for surgery.

The patient underwent a routine right hemicolectomy with anastomosis: no intraoperative difficulties were encountered. Routine thromboembolic prophylaxis was employed, and her diabetic status monitored postoperatively by a specialist Endocrinologist.

In the days following surgery, several issues arose complicating the patient's postoperative course, including intermittent transient confusion, nausea, vomiting, hyponatraemia and hyperglycaemia. These were appropriately managed medically by the endocrine team. On the fourth postoperative day, the patient suffered a sudden cardiac arrest and could not be resuscitated.

DISCUSSION

Autopsy revealed that her death was due to ischaemic heart disease, with a 90% stenosis of the left anterior descending and left circumflex coronary arteries.

In this case, input from a General Physician may have been useful in early detection of myocardial ischaemia. Approximately 5% of at-risk patients develop postoperative asymptomatic or atypical myocardial ischaemia, only in part related to the postoperative use of analgesics¹. The risk of death within 30 days after an asymptomatic myocardial infarction is similar to that following one which presents more classically. Early diagnosis of myocardial ischaemia allows appropriate primary care and secondary prevention. The literature suggests that routine postoperative monitoring of troponin levels should be considered in patients who have risk factors.

CLINICAL LESSONS

A comprehensive preoperative review, from a generalist perspective, should be considered for General Surgery patients with multiple comorbidities. Such a shared care model with the input of General Physicians or Geriatricians could also be extended to the postoperative period, as exemplified by the successful implementation of Orthogeriatric services in most Orthopaedic units.

REFERENCES

1. Deveraux PJ, Sessler DI. Cardiac complications in patients undergoing major noncardiac surgery. *New Engl J Med.* 2015;373(23): 2258-2269.

Case 6: Open abdominal surgery to excise bilateral adrenal pheochromocytomas may have allowed these tumours to be safely resected

General Surgery

CASE SUMMARY

A female in her late 50s with known type 1 neurofibromatosis was admitted electively for resection of bilateral pheochromocytomas. These adrenal tumours were identified incidentally on computed tomography scan performed for unrelated indications. A diagnosis of bilateral pheochromocytomas was made based on significant elevation of both plasma metanephrine and plasma normetanephrine, and both lesions being metaiodobenzylguanidine avid.

The patient was initially assessed for her adrenal tumours at a tertiary hospital medical endocrinology unit which then referred her to the endocrine surgical unit at the same hospital for bilateral adrenalectomy, the generally accepted management for this diagnosis.

Medical preparation for surgery appears well managed. The medical endocrinology unit supervised preoperative alpha blockade, including during a planned six-day inpatient admission prior to surgery for titration of phenoxybenzamine dosing.

The patient had significant medical comorbidities that increased the risk for bilateral adrenalectomy. The most notable of these was anatomical, with a right diaphragmatic hernia resulting in the right kidney (and likely the right adrenal tumour) and part of the right lobe of the liver being located in the chest. Previous surgery for scoliosis, involving metal ware, seemed to have influenced the surgical team to avoid a posterior retroperitoneal approach. According to outpatient clinic documentation, open or anterior transperitoneal laparoscopic approaches were considered more suitable. Further detailed documentation of preoperative surgical decision-making regarding operative strategy (open versus laparoscopic) and surgical staffing (single consultant or dual consultant; involvement of a hepato-pancreatico-biliary [HPB] surgeon) was not easily located within the patient's record.

Surgery commenced with the patient in the supine position with a hand-assisted, transperitoneal laparoscopic approach. Two consultant endocrine surgeons were initially involved in the surgery. The left adrenal tumour was resected without incident. Resection of the right adrenal tumour was first attempted

laparoscopically, then converted to laparotomy. The operative notes document that this decision was made owing to the anatomical position of this gland in the chest making a laparoscopic approach unsafe. Significant bleeding occurred, originating from a tear in the infra-hepatic inferior vena cava (IVC). It is unclear from both operative records (handwritten and typed) whether this injury occurred during laparoscopic or open dissection. An HPB surgeon was called to assist, with the typed operative record suggesting that this surgeon was contacted after the tissues around the infra-hepatic IVC were packed to control bleeding.

Further attempts to control IVC bleeding were unsuccessful, despite supra-hepatic and infra-renal IVC control and aortic cross clamping. The patient underwent cardiac arrest on the operating table and was declared deceased following significant resuscitative measures, including 20 minutes of cardiopulmonary resuscitation and massive blood transfusion.

DISCUSSION

This patient's right diaphragmatic hernia, and the resultant migration of right kidney, right adrenal gland and part of the right lobe of the liver into the chest, posed a significant technical challenge in resecting the right adrenal tumour. This could have been anticipated preoperatively given the known anatomic anomaly.

In this case, bilateral adrenalectomy was attempted with the patient in a supine position using a laparoscopic approach. Laparoscopic adrenalectomy via a transperitoneal approach is usually performed with the patient in a lateral/jack-knife position. Performing a transperitoneal laparoscopic adrenalectomy in a supine position requires a greater use of manual retraction of the spleen on the left and the liver on the right, likely explaining the decision to use a hand port in the abdominal midline.

While not clear from the operative record, it is likely that attempted laparoscopic resection of the right adrenal tumour resulted in significant bleeding related to IVC injury, which was unable to be adequately controlled despite open conversion and the intraoperative involvement of an HPB surgeon.

CLINICAL LESSONS

Given the infrequent use of this surgical approach, it is likely that the approach was relatively unfamiliar to the surgical operating team. The decision to adopt a rarely used operative technique in a patient known to have anatomic anomaly was an error in decision-making in this case.

It is possible that the outcome for this patient would have been different had she undergone open surgery, with an experienced HPB surgeon involved in the operation from the outset. Laparotomy with the assistance of an HPB surgeon experienced in hepatic mobilisation and control of large peri-hepatic vessels may have allowed the right adrenal tumour to be resected safely. The iatrogenic haemorrhage related to the IVC injury, which ultimately caused this patient's death, may thus have been avoided.

Case 7: Unrecognised duodenal stump leak following total gastrectomy

General Surgery

CASE SUMMARY

A male patient in his early 70s diagnosed with proximal gastric cancer was admitted to a private hospital for an elective total gastrectomy and Roux-en-Y reconstruction with feeding jejunostomy. He had one dose of preoperative chemotherapy which provoked GI upset and resulted in surgery being postponed. After a six-week recovery period, the patient proceeded to surgery with an experienced anaesthetist and a surgical assistant also present. Intraoperative complications occurred during construction of the proximal anastomosis: the OrVil™ anvil was passed down to the stapled end of the distal oesophagus by the anaesthetist, whereupon the surgeon failed to control the anvil and it was accidentally pulled back up into the oesophagus. It was ultimately retrieved with the use of an endoscope (resulting in considerable delays during the operation). The stapler was deployed to create the proximal anastomosis, but no mention is made in the operating note as to whether both donuts were intact, inferring a robust anastomosis.

The patient was returned to a high-level intensive care unit (ICU) where he followed an expected course for the first postoperative day. Signs of distress began to appear by the second postoperative day, with pain management issues attributed to epidural malfunction. The patient's oxygen requirement began to rise, urine output tapered off, and left lower chest consolidation/collapse was noted on chest X-ray. On the third postoperative day, the physiotherapist noted limited compliance with deep breathing and cough due to poorly controlled pain. The patient began exhibiting episodes of confusion; a note of hypotension was recorded by the nursing staff; and 550 ml of fluid was recorded out of the abdominal drains, with the surgeon noting a serous appearance. The following morning, the patient became hypoxemic and was transitioned to nasal high flow oxygen. He still had low urine output requiring fluid challenge.

By this stage, the fluid collecting out of the abdominal drains had developed a 'dirty' appearance. Jejunostomy feeds were continued. Later that day, the patient had a temperature spike of 38.5°C and developed rigors. Intravenous antibiotics commenced. The drain fluid was now noted to be a dark brown colour, with 300 ml collected in the right drain bag over an eight-hour period. By the morning of the fifth postoperative day, there was 800 ml of fluid in the abdominal

drain bags and the patient was complaining of 'strong pain'. Surgical review noted 'frank small bowel content' from the right-sided drain tube (attributed to a potential anastomotic leak), as well as haemodynamic instability and a transient episode of rapid atrial fibrillation. No comment was made regarding an abdominal examination. Following the review, the treatment plan was for a contrast swallow, conservative management of the anastomotic leak with antibiotics, and continued jejunostomy feeds to see if the leak would settle of its own accord. Subsequently, the drain fluid grew *Klebsiella oxytoca* and *Enterococcus faecalis*. Follow-up review later that evening did not alter the management plan.

By the sixth postoperative day, ongoing large volumes of 'bilious drainage' were noted from the right-sided abdominal drain, with the patient reporting ongoing abdominal pain. ICU ordered a computed tomography (CT) scan due to increasing pain and a 'distended tense abdomen'. The CT summary described pronounced faecal loading, ileus, a small amount of free air under the diaphragm, and free fluid (felt to be within normal limits following recent surgery). The patient deteriorated rapidly in the early hours of the seventh postoperative day. He went into septic shock, with hypotension, hypoxemia, tachypnoea, and tachycardia. He was intubated and put onto vasopressors. A re-look laparotomy was conducted at 8:30am (no mention in the case notes of whether a surgical assistant was present) and a duodenal stump leak was found with copious amounts of bile throughout the abdomen. This was secured with a Foley catheter to create a controlled fistula, and an extensive washout was performed. Patient care was then transferred to an upper gastrointestinal (GI) surgical colleague as the responsible surgeon was due to go on leave.

Over the next four days, the patient developed multiple organ failure with acute kidney injury, respiratory failure and atrial fibrillation. Eleventh day postoperatively, he was returned to theatre (by the covering surgeon) due to increasing infection parameters, bile leak from all drains and a CT scan suggesting gas in the wall of the jejunum. Infarcted jejunum was found distal to the jejunostomy, and a limited small bowel resection was necessary. The duodenal stump was leaking even with the Foley catheter in situ and the proximal anastomosis had disintegrated. The surgeon controlled the various leaks with drains and closed the abdomen with a temporary dressing. The intention was to return the patient to theatre two days later for another washout and formal closure, however it became clear over the next 48 hours that further intervention was contrary to the patient's wishes. Care was withdrawn on day 15 and the patient died rapidly upon extubation.

DISCUSSION

This patient was in pain for much of his postoperative course, and quite often distressed, yet it took a considerable amount of time for the physicians caring for him to insist on a re-look laparotomy. The reasons for this are probably multifactorial, including an upper GI surgeon with tunnel vision due to problems encountered with the proximal anastomosis during the initial operation; an experienced ICU team in a low-volume hospital for major upper GI cancer operations resulting in limited knowledge regarding the normal postoperative course for patients undergoing total gastrectomy; and a paucity of documentation regarding abdominal examination.

The patient started to exhibit signs of abdominal distress on the third postoperative day, and by the next day, had very clear evidence of a duodenal stump leak. The responsible surgeon blamed the patient's rocky postoperative course on a leak from the proximal anastomosis, seemingly unaware that a leak from the proximal anastomosis is never bilious in nature. The ICU doctors had incredible difficulty controlling the patient's pain, but never questioned the responsible surgeon's management even though the patient must have exhibited signs of peritonitis. A duodenal stump blowout is a devastating complication due to both the nature and volume of fluid loss. Had the patient been returned to theatre on the fourth postoperative day (at the latest), the outcome may have been different. The multiple organ failure which ensued, as well as eventual jejunal infarction and breakdown of the proximal anastomosis, can all be explained by ongoing septic shock and vasopressors.

CLINICAL LESSONS

It is concerning that this surgeon did not believe that an adverse event had occurred. There was a clear unintended injury (duodenal stump leak) following a total gastrectomy, and this injury led to the patient's ultimate demise. This was augmented by the four-day delay in recognising the problem.

There is no doubt that major operations such as gastrectomy are better performed in hospitals with more than a handful of cases per year. Total gastrectomy has many technical components and is a major operation with little room for error. Operations such as this are best done with an experienced assistant, whether a senior surgical education and training trainee or surgical colleague. Any unplanned return to theatre with a patient in septic shock also requires an experienced surgical assistant—as much for decision-making as for technical help.

Given the patient experienced significant distress on the second postoperative day, a contrast study performed then, or optimally on day one as a routine, would have provided significant evidence to exclude an anastomotic leak and thus may have alerted the surgeon to other possible problems, such as the duodenal stump leak. It may even have revealed the duodenal stump leak then, enabling timely laparotomy.

Lack of consultation between the responsible surgeon and another surgical colleague during the first week is also worth mentioning. One cannot underestimate the importance of requesting a second opinion from a supportive surgical colleague if/when the postoperative course does not go as planned.

Case 8: An unexpected death due to ruptured intracranial aneurysm during joint replacement surgery

Orthopaedic Surgery

CASE SUMMARY

A female patient in her mid-60s with arthritis was admitted to a regional hospital for an elective total shoulder arthroplasty. Her comorbidities included rheumatoid arthritis (treatment with Plaquenil), mild asthma, gastro-oesophageal reflux disease (GORD), and depression/anxiety. She was a non-smoker and had no medical history of hypertension or vascular disease. No family history was recorded.

This patient, undergoing major joint replacement surgery with systemic comorbidities, was evaluated in a nurse-led pre-admission clinic and her preoperative bloods were organised. On the day of surgery, her preoperative medical review was conducted in the anaesthetic bay.

This case was subsequently complicated by episodes of malignant hypertension culminating in a catastrophic and terminal subarachnoid haemorrhage (SAH) (World Federation of Neurologic Surgeons [WFNS] grade 5, Fisher grade 4) secondary to an undiagnosed, ruptured right middle cerebral artery aneurysm. The patient passed away two days after her elective admission.

DISCUSSION

Several issues in this case arise for discussion. The patient was evaluated preoperatively in a nurse-led pre-admission clinic, prompting the question of whether the evaluation of a patient with significant comorbidities, about to undergo major joint replacement surgery, provided an appropriate and adequate level of medical assessment^{1,2}. In noting that no family history was recorded, it is unclear if the patient had not disclosed any relevant family history to be highlighted accordingly or if this question had not been asked. In this case, medical history seemed adequate.

It was reported that an unintended and higher dose of hypertensive medication (metaraminol) was administered during the general anaesthetic in beach-chair position. Whether the dose administered was ultimately enough to cause the hypertensive surge will require review by an independent anaesthetist, nevertheless, the lability of the blood pressure (BP) control may well have contributed to the poor outcome for this patient.

Control of BP was inadequate once a hypertensive crisis and presumed

intracranial haemorrhage had been identified^{3,4,5}. In general, advice from neurosurgery for patients with diagnosed, unsecured/untreated intracranial aneurysms is always to maintain systolic blood pressure below 160 mmHg during the anaesthetic. At anaesthetic induction, this patient's BP was 180/60 mmHg, which rose to 200/100 mmHg with a pulse rate of 130 beats per minute, approximately half an hour into the anaesthetic. Of additional concern in this context was the reported inadvertent administration of a higher dose of metaraminol. The underlying mechanism of the hypertensive crisis was likely due to the SAH, secondary to aneurysmal rupture. Adequate control and avoidance of the wide swings in BP that were recorded (ranging from 70/50 - 200/140 mmHg) must be achieved to ensure adequate cerebral perfusion, and to avoid rupture and haemorrhage of the cerebral aneurysm. In this case, the BP of 70/50 mmHg would have been inadequate to perfuse the brain given her intracranial pressure (ICP) was high initially from the SAH, and then subsequently from the hydrocephalus. As a result, although the survivability following a WFNS grade 5 SAH is poor, the periods of hypotension may have contributed to the global cerebral injury and mortal outcome.

Enrolment in the ketamine trial⁶ may have also contributed to the outcome. Ketamine and its effects on cerebral blood flow have previously been controversial. However, there is evidence to suggest that the use of ketamine as an anaesthetic adjunct does not alter cerebral blood flow velocity in anaesthetised patients undergoing craniotomy. It has been reported that mean arterial pressure, central pulse pressure and ICP are either unchanged or slightly lower following administration of ketamine.

CLINICAL LESSONS

SAH secondary to ruptured intracranial aneurysm can result in a devastating haemorrhagic stroke. In patients presenting with WFNS grade 5 SAH, the predicted proportion of patients who succumb to severe morbidity and disability or mortality approaches 75%. Therefore, the mortal outcome in this case was expected following the diagnosis of WFNS grade 5 SAH.

Undiagnosed cerebral aneurysm is uncommon, and something that would not be considered for a 66-year-old presenting for an orthopaedic operation. However, cerebral signs in a postoperative situation at this age should alert the team to an intracerebral pathology.

As our population is ageing, the incidence of elderly comorbid patients presenting for major surgery is becoming more common. In this case it may not have made a difference to the final outcome, but the evaluation of an elderly patient with

systemic comorbidities undergoing major joint replacement surgery in a nurse-led pre-admission clinic cannot be allowed to become the standard of care.

REFERENCES

1. Brown RD, Broderick JP. Unruptured intracranial aneurysms: epidemiology, natural history, management options, and familial screening. *Lancet Neurol.* 2014; 13: 393-404.
2. Rinkel GJE. Intracranial aneurysm screening: indications and advice for practice. *Lancet Neurol.* 2005; 4: 122–28.
3. Chowdhury T, Petropolis A, Wilkinson M, Schaller B, Sandu N, Cappellani RB. Controversies in the anaesthetic management of intraoperative rupture of intracranial aneurysm. *Anaesthesiology Research and Practice.* 2014.
4. Abd-Elseyed AA, Wehby AS, Farag E. Anaesthetic management of patients with intracranial aneurysms. *The Ochsner Journal,* 2014; 14:418–425.
5. Priebe HJ. Aneurysmal subarachnoid haemorrhage and the anaesthetist. *British Journal of Anaesthesia.* 2007;99(1): 102–18.
6. Mayberg TS, Lam AM, Matta BF, Domino KB, Winn HR. Ketamine does not increase cerebral blood flow velocity or intracranial pressure during isoflurane/nitrous oxide anaesthesia in patients undergoing craniotomy. *Anesth Analg.* 1995; 81:84-9.

Case 9: Prolonged hypotension and the deteriorating patient

Orthopaedic Surgery

CASE SUMMARY

An 80-year-old patient was admitted for a total hip replacement due to osteoarthritis. The patient had undergone coronary bypass grafting several years ago and had multiple comorbidities including atrial fibrillation, hypertension, hyperlipidaemia and diet-controlled diabetes. The patient had a poor exercise tolerance; medications included apixaban, metoprolol, Zocor and frusemide. Cardiology review four months prior to surgery indicated normal left ventricular size with mild impairment of systolic function. Anaesthetic review classified the patient as American Society of Anaesthesiologists grade 3. Preoperative blood pressure (BP) was 137/80 mmHg. The procedure was uneventful, and anaesthetic charts were unremarkable. Systolic blood pressure (SBP) during the operation remained around 100 mmHg.

The patient remained in the postoperative recovery room for three-and-a-half hours, during which time episodes of hypotension required fluid boluses. The SBP never rose above 100 mmHg. There was no note of a neurological deficit.

The patient was found to be unresponsive during transfer to the ward so a Medical Emergency Team (MET) call was raised by the nursing staff. The clinical picture was attributed to recovery from anaesthesia together with left lower lobe consolidation identified on chest X-ray. Oxygen saturation was 80% on room air and rose to 94% with four litres of oxygen via nasal prongs. Intravenous (IV) antibiotics were commenced. No focal neurological deficit was noted.

Nursing staff were instructed to continue hourly observations. The medical notes indicate that the orthopaedic registrar was to be contacted by the orthopaedic junior medical officer if the BP continued below the parameters of the Standard Adult General Observation (SAGO) chart.

Over the subsequent hours, the patient remained drowsy with SBP remaining at 100 mmHg and urine output at 20-30 ml/hour. Review by an intensive care unit (ICU) liaison nurse five-and-a-half hours later, noted neurological deficit in the left arm. BP had fallen to 83/43 mmHg and a Glasgow Coma Score (GCS) of 7 was recorded. Continued observation was recommended.

At the next review one hour later, the patient was unresponsive to deep pain stimuli, the left arm was in the decorticate position and the GCS remained at 7. The SBP was 85 mmHg, oxygen saturation 98% and urine output 15 ml/

hour. A further bolus of IV fluids was advised. The electrocardiogram showed ST changes consistent with ischaemia and the troponin level was 3,863 ng/l (reference range less than 16 ng/l). A MET call was placed. The neurological findings suggested that previous abnormal flexion of the left arm had resolved, but there were suggestions of abnormalities in the left leg. GCS remained at 7. Computed tomography (CT) scan of the head showed mild atherosclerotic disease in the major vessels but was otherwise normal. There was no evidence of acute intracranial haemorrhage. Cardiology requested a repeat troponin and commencement of dual antiplatelet therapy and asked to be notified if the ST elevation rose above 2mm.

An attempted rally by the patient resulted in SBP of 118 mmHg and GCS at 8. Increased tone in upper and lower limbs and positive Babinski was observed. However, a few hours later the patient deteriorated and was admitted to ICU. It was determined that the patient had sustained a perioperative anterior myocardial infarction. The patient had also developed pneumonia; GCS had dropped to 6; troponin was 11,000 ng/l; and inotropes were required to maintain BP.

The neurologist considered the clinical picture to be consistent with global hypoperfusion against a background of a non-ST elevation myocardial infarction and significant comorbidities. CT angiogram of the head showed no large vessel occlusion or aneurysm. Given the poor prognosis and continuing deterioration of the patient, following discussion with the family, treatment was withdrawn.

DISCUSSION

This was an elderly high-risk patient with multiple comorbidities having a major orthopaedic procedure. A history of ischaemic heart disease and diabetes made the patient prone to silent ischaemia. Preoperative assessment could have included some form of functional cardiac assessment (e.g. dipyridamole sestamibi scan), to assess the likelihood of perioperative myocardial ischaemia. It is unclear if the cardiologist was aware that a major operation was planned for this patient.

Hypotension was multi-factorial. Preoperative deficit due to fasting (greater than 12 hours), intraoperative blood loss, spinal anaesthesia and a cardiac event all contributed. The first troponin was in excess of 3,000 ng/l, however, it is unclear whether the ischaemia occurred during or after the operation. A preoperative cardiac scan would have highlighted whether the patient's myocardium was a considerable risk factor in this surgery. Further, the diagnostic results may have assisted the treating anaesthetist in managing the patient's hypotension. Perhaps a more aggressive approach could have been considered, such as escalating the level of intraoperative monitoring and postoperative ICU admission. The

management of this patient may have been different if the relevant information was available.

CLINICAL LESSONS

This patient had substantial risk factors to suggest that macro- and micro-vascular cerebral artery disease was present. It was this, in combination with the persistent hypotension, which was responsible for the patient's deterioration.

As a rule, the treating anaesthetist and surgeon should be notified of any patient who is in recovery after one hour and still experiencing ongoing issues preventing discharge. After two hours in recovery, the patient should be reviewed by the anaesthetist (or registrar) and a definitive plan made. After three hours in recovery, treatment needs to be escalated to involve ICU.

Control of BP should be regarded as a higher priority in at-risk patients. There is no consensus as to what is considered adequate BP control in this setting, however as a general guide, BP within 20% of baseline should be the goal, with even tighter control (aim for baseline) in those known to have cerebrovascular disease.

The patient became unresponsive on returning to the ward, with the medical and nursing notes documenting the subsequent deterioration in detail. Nevertheless, there was delay in recognising the significance of the developing clinical picture. The importance of escalation of care should be reinforced to nursing and junior medical staff when 'Between the Flags' criteria on the SAGO chart (both yellow and red zones) are met. The raw observation numbers are important but so are the trends, e.g., white line deterioration when a patient's clinical signs within the white zone are trending towards the yellow zone. When it can be anticipated that the trend will continue, a senior person should be consulted.

Case 10: The need to stabilise the seriously ill prior to diagnosis inevitably delays definitive treatment

Urology

CASE SUMMARY

A previously high-functioning, diabetic female patient in her late 70s presented to the emergency department following several days of dysuria and diarrhoea. She was found collapsed and unable to move. Her family requested full resuscitation measures.

She was diagnosed with septic shock and clinically presented as febrile with rigors, tachycardia and hypotension. Urgent inotropic support (adrenaline/noradrenaline/vasopressin) was initiated, in addition to the initial high flow oxygen, fluid resuscitation, intravenous antibiotics, and indwelling urinary catheter placement for fluid balance assessment.

Urgent urine microscopy identified 3+ bacteria and probable urinary source. Within 2 hours of presentation, an intensive care unit (ICU) consultation was sought. A computed tomography (CT) scan was performed as soon as the patient was stable enough. She was acidotic and septic. After initial agitation and then confusion, she became unresponsive in respiratory arrest and was intubated early the next morning.

The CT scan revealed that the septic shock was secondary to a 5mm left ureteric stone resulting in an infected obstructed left ureter. This was confirmed on CT chest, abdomen and pelvic scans. The CT also demonstrated pulmonary oedema and right perirenal stranding. The radiology team urgently notified the emergency team. A bedside-echocardiogram reported a severely hypokinetic and dilated mitral valve with regurgitation, suggesting a hypo-perfused state secondary to heart failure.

With multiple organ dysfunction (renal, pulmonary and cardiac), and dialysis planned, the patient was referred to the urology registrar, who discussed the case with the on-call consultant urologist.

The patient was rushed to theatre as a CAT 1 emergency for cystoscopy, bilateral retrograde pyelogram and left ureteric stent placement. Surgery was performed quickly and completed within 20 minutes. The patient left the recovery room approximately one hour after the surgery.

After consultation with her family, a Not For Resuscitation order was placed.

Despite maximal efforts, no clinical improvement was achieved, and the patient passed away early that afternoon.

The ICU consultant discussed the case with the coronial registrar the next morning. No further investigation was warranted.

DISCUSSION

It is always difficult to confirm the cause of sepsis in elderly patients who present in extremis. A delay often occurs between presentation and specialist team referral in order to safely stabilise a patient for diagnostic imaging. Given this patient's severe deterioration, despite emergency and intensivist team efforts, a delay in diagnosis and specialist referral was inevitable and unavoidable.

After the first CT scan, the urology team could have been contacted earlier. The patient was suffering from multiple organ dysfunction and was frail, thus prognosis was poor. However, urgent source control can radically alter the progression of sepsis.

Urosepsis from an infected obstructed renal system is a surgical emergency with rapidly progressing clinical deterioration. In this case, given the mixed initial symptoms of diarrhoea and dysuria, and the absence of abdominal or flank pain, a urinary obstruction was not immediately considered. However, in this setting, the positive urinalysis and severity of illness, as well as age and diabetes, should lead to urgent abdominal imaging, as clinical symptoms are often subtle in such patients. Unfortunately, timely resuscitation and intervention efforts were unable to overcome the enormous and irreversible insult to this patient's systems caused by days of illness prior to presentation.

This case demonstrates the importance of excellent interdisciplinary communication and management efforts for an immunocompromised elderly patient with multiple organ dysfunction and a surgical condition.

CLINICAL LESSONS

In the elderly patient with sepsis, comprehensive clinical assessment is critical, but urinary tract infection should be considered as a possible cause. Micro-urine and blood cultures with standard haematology and biochemistry sent early and reviewed quickly will always guide the treating practitioner.

Renal calculi with obstruction must always be considered as a possible cause for sepsis in this age group. Early imaging may demonstrate this with clarity.

Elderly patients with diabetes and sepsis need an urgent multidisciplinary approach and good communication to rapidly provide maximal treatment. For patients with a poor prognosis, early discussion about goals of care and the treatment ceiling are essential to providing compassionate care.

Case 11: Urinary sepsis with obstructed kidney following stent removal without antibiotic cover

Urology

CASE SUMMARY

A frail, but highly functioning male patient in his early 80s presented to the emergency department (ED) with confusion, lethargy and malaise. He was afebrile on presentation but reported feeling unwell and feverish prior to a cystoscopy and left ureteric (also called JJ) stent removal three days earlier. His medical history included diabetes, ischaemic heart disease (managed with coronary stents and anticoagulation), hypertension, previous urological interventions, and renal impairment.

A urinary tract infection (UTI) was diagnosed and appropriate antibiotics were prescribed. Imaging demonstrated obstruction of the left ureter by a 10mm distal stone. The patient's condition deteriorated, and fluid resuscitation was instituted for hypotension and impending septic shock. He was admitted under the general medicine team and the hypotension and hypothermia improved somewhat.

Surgical consultation resulted in immediate drainage of the obstruction by cystoscopy and placement of another JJ stent. Copious frank pus was noted draining from the kidney after this manoeuvre.

The instrumentation, while draining the primary source of sepsis, led to exacerbation of the patient's condition ('septic shower') and the development of full septic shock. He was transferred to the intensive care unit where, despite full resuscitative measures, he developed multiple organ failure and died 48 hours later.

DISCUSSION

From the information that has been supplied, this case should have been reported to the Coroner for further investigation. There are several concerning issues regarding the management of this case which, if they had been addressed in a timely manner, may have resulted in a better outcome for the patient and possibly avoided a preventable death.

The delay in recognising the clinical consequences of ureteric obstruction when the patient presented to the ED three days after stent removal, was a missed diagnosis that delayed management of the patient's obstructed urinary system and contributed to his morbidity. Prompt relief of the ureteric obstruction could have been achieved at the time of presentation via urgent insertion of a ureteric

stent or nephrostomy tube, which may have reduced the effects of sepsis and multi-organ problems to which the patient subsequently succumbed.

The decision, three days earlier, to remove a ureteric stent when the reversible obstructing cause of the problem (ureteric stone) had not been dealt with was a 'risky decision' and appropriate care was not taken to monitor the patient for postoperative complications.

The patient presented to the ED with urinary sepsis and an obstructing stone, having had a JJ stent removed by the reporting surgeon three days earlier. Within four months prior to this, the patient had presented to a tertiary hospital with a myocardial infarct and acute kidney injury secondary to the obstructing left ureteric stone. This was treated by attempted cystoscopic retrograde stent placement (which failed) and subsequent antegrade placement of a JJ stent. The plan was for future definitive management of the stone by the consulting surgeon in the private sector. This occurred three months later (when the JJ stent was removed three days prior to this admission), mainly because of the patient's other medical issues. The operation notes state that the stone would be treated electively by lasertripsy four weeks later.

The history (malaise and lethargy) and the urine sample (dipstick on the day of the cystoscopy showed large numbers of leucocytes and nitrites) at the time of stent removal indicated an active UTI and not just a reaction to the stent. Despite clear evidence that the urine was heavily infected, there was nothing in the documentation to suggest that antibiotics were given, either prophylactically or therapeutically, when the stent was removed.

The very large stone (10 mm) was also noted, indeed it was the reason for the first stent being placed. It was this stone that caused lethal obstruction to the ureter as soon as the stent was removed.

CLINICAL LESSONS

The prolonged time (more than three months) during which this patient received only incomplete treatment for his obstructing ureteric stone represents an unacceptably long delay, especially in a frail elderly patient with multiple medical comorbidities.

The principal causative factor was the decision to remove the JJ stent before treating the obstructing stone and the UTI. If the surgeon's original reason for removing the stent was to treat the obstructing stone promptly, then this should have been carried out within a few days, rather than scheduling the patient for surgery a few weeks later. It is highly unusual to remove a stent when the reversible obstructing cause has not been treated.

Case 12: Hypovolaemia and vasoconstrictor therapy in a diabetic patient undergoing coronary artery bypass graft

Cardiothoracic Surgery

CASE SUMMARY

A female patient in her late 50s was admitted for an elective coronary artery bypass graft, due to recurrent angina in relation to triple vessel disease following two previous percutaneous stenting treatments. She had significant comorbidities, including diabetes mellitus, chronic renal impairment (baseline creatinine 208 µg/mol) due to reflux nephropathy, obesity (body mass index of 33), recurrent atrial fibrillation and 'asthma' (though not taking any inhalers or steroids, FEV1/FVC 83%).

Anticoagulation was discontinued five days preoperatively. Preoperative echocardiography confirmed normal left ventricular function, no valvular pathology, normal right heart size and function, and normal estimated pulmonary pressures, suggesting no significant lung disease. The operation occurred without complication, and cardiopulmonary bypass was weaned on minimal vasopressor support (noradrenaline 1 µg/min) that continued until arrival in the intensive care unit (ICU) around noon.

The initial blood gas analysis in ICU during the first afternoon was reassuring and the patient was extubated uneventfully. During the first postoperative day, there was evidence of rising lactate levels, acidosis and hypoxia, which worsened over the evening. During the second postoperative day, she became drowsy overnight with increased work of breathing. She was significantly hypoxic and acidotic, with poor urine output, potassium 6.4 mmol/l, glucose 17.7 mmol/l and lactate 4 mmol/l. She received metaraminol and high dose noradrenaline (18 µg/min) to maintain blood pressure. She was reintubated due to respiratory failure attributed to chest sepsis. Over the next 24 hours, the noradrenaline dose was kept moderate at around 10 µg/min. Haemofiltration was initiated for acute on chronic renal failure.

On the fourth postoperative day, the cardiothoracic surgeon noted the reintubation, renal failure, moderate dose of noradrenaline (13 µg/min) and persistent raised lactate (3.6 mmol/l) and requested transthoracic echocardiography to evaluate left ventricular function (described as 'hyperdynamic with complete end systolic cavity obliteration') and the presence of pericardial effusion. Two fluid boluses were given, noradrenaline requirement reduced to 3 µg/min and lactate reduced to 4 mmol/l.

The patient subsequently developed ischaemic colitis requiring laparotomy, and sustained a leak, likely due to poor perfusion. Upon re-look laparotomy the

patient developed multiple organ failure, and vasoplegia resistant to vasopressin and high dose noradrenaline. As multiple organ failure set in, with the ischaemic gut and liver, and renal failure all well established by this stage, palliative therapy was initiated in consultation with the patient's family.

DISCUSSION

The most likely cause of this patient's decline was a combination of hypovolaemia and vasoconstrictor therapy. She was a typical patient at risk of such, being female, overweight (which makes central venous pressure a poor surrogate of left atrial filling), diabetic with microvascular complications, and suffering high work of breathing. If the hypovolaemia had been corrected more aggressively in the first 48 hours, she would have required less vasoconstrictor therapy, which in combination with her microvascular disease may have impaired her mesenteric perfusion. If transthoracic echocardiography was insufficient for evaluation, a transoesophageal echo would have been optimal, given the patient's reintubated status. Alternatively, a Swann-Ganz catheter could have been inserted when she first deteriorated in order to calculate cardiac function and left heart filling status.

Regardless, formal echocardiography should have been performed in the 24 hours after she first deteriorated, to exclude tamponade as a cause of her condition. The possibility of pulmonary oedema as a cause of her hypoxia—due to left atrial compression by clot or due to left ventricular outflow tract obliteration by hypovolaemia—does not seem to have been considered. If echo was unavailable, re-exploration in theatre seems a reasonable option to exclude any mechanical cause for a relatively low risk patient with good preoperative ventricular function subsequently requiring reintubation with anuric renal failure and persistent lactaemia.

The role of anticoagulation in this case is controversial. From the material supplied, it is not possible to tell if administration of formal anticoagulation after the first 24 hours was provided or considered, given the persistent lactate levels and the possibility of thromboembolism from the atria. The clinical picture of the multiple organ dysfunction and dusky colon is more in keeping with low cardiac output and vasoconstrictor therapy than with embolism.

CLINICAL LESSONS

An earlier estimate of cardiac function and filling status by echocardiography may have altered this patient's clinical pathway. The key to this case is early echocardiography to establish left ventricular function and filling and exclude tamponade. Use of a pulmonary artery catheter or pulse contour cardiac output could be considered to establish haemodynamics to guide inotropic/volume management.

Case 13: Repairable iatrogenic cannulation injury with complicated aortic valve replacement

Cardiothoracic Surgery

CASE SUMMARY

A female patient in her early 70s with a history of untreated hypertension and postural hypotension was admitted to hospital following an unconscious collapse. In the week prior to admission, she had also experienced an out-of-hospital cardiac arrest. Transthoracic echocardiography and coronary angiography indicated severe aortic stenosis and concentric left ventricular hypertrophy. She was subsequently transferred to a second hospital where she was to undergo an aortic valve replacement.

The surgery occurred without significant intra-operative complications under routine cardiopulmonary bypass. A 19 mm Edwards Perimount Magna Ease™ bioprosthesis was used, which was reported as being well-seated with a 6 mm mean transvalvular gradient and no observable paravalvular leaks. Aortic cross-clamp time was 89 minutes and total cardiopulmonary bypass time was 104 minutes. The anaesthetic notes indicate that the patient was weaned off cardiopulmonary bypass with low dose noradrenaline and adrenaline, and she was transferred to the intensive care unit (ICU) at a third hospital. Total postoperative bleeding was 170 ml in three hours.

Over the next several hours the patient was administered 2.5 litres of crystalloid fluid, and noradrenaline and adrenaline infusions recommenced, however she began to deteriorate, with dropping blood pressure and end tidal carbon dioxide levels, culminating in cardiac arrest. The junior surgical staff present undertook an emergency sternotomy in ICU, in accordance with emergency procedures. No evidence of bleeding, tamponade, or pneumothorax was observed. Internal cardiac massage was required to maintain output. The working diagnosis at that time was either acute hypovolaemia or acute valvular failure.

The cardiothoracic surgical team decided to transition to peripheral extracorporeal membrane oxygenation (ECMO) to act as a bridge to allow for recovery of the stunned myocardium. Initial access through the left femoral site resulted in no colour differential or oxygen gradient between venous and arterial limbs. An attempt to cannulate the right femoral site was quickly abandoned in favour of establishing central ECMO. Transoesophageal echocardiography confirmed positioning of the central cannula and that the aortic valve appeared to be in working order without compromise. The patient was resuscitated using blood products and stabilised.

Given that the central ECMO was established, it was decided to repair the groins. The right femoral cut down was repaired without incident. Upon removal of the left groin cannula and closure of the vessels, the patient developed severe hypovolaemia. Further resuscitation using crystalloid fluids and blood products was attempted, however the patient's abdomen began to swell, indicating continued intra-abdominal bleeding. An emergency laparotomy to potentially control the bleeding was decided against in favour of continued ECMO and palliation to allow time with priest and family before she died.

DISCUSSION

It remains unclear as to exactly why the patient became haemodynamically unstable some three hours post arrival in ICU. The coronial autopsy suggested there may have been a degree of obstruction or interference with coronary blood flow at the coronary ostia due to the valve struts. While this was a dynamic situation, it was the events that unfolded subsequent to the patient becoming haemodynamically unstable and hypotensive that ultimately lead to her death. This was secondary to traumatic cannulation of the femoral vessels with a probable perforation of the iliac artery leading to retro-peritoneal bleeding. It has been suggested that the bleeding could also have been from a perforation made by the venous cannula in the inferior vein cava.

While the clinical events certainly were difficult and significant decisions needed to be made in an acute time frame, it is a little unclear as to why a decision was made not to pursue repairing or correcting the retro-peritoneal bleed. This most likely was secondary to a single puncture to an iliac vessel that could have been potentially stented or controlled with a surgical repair and may have resulted in a patient with a survivable situation. It was a judgment call by the treating team that this patient would not have survived an emergency laparotomy, but other surgeons may have attempted to repair the injuries before deciding to palliate.

CLINICAL LESSONS

Consideration needs to be given to the causes of the initial haemodynamic disturbance, which the autopsy report suggests was most likely due to partial and/or dynamic obstruction to coronary artery blood flow by the prosthesis. This was compounded by injury to the femoral iliac vessels in the setting of emergency peripheral cannulation. A decision to not correct an iatrogenic perforation ultimately resulted in the patient's death.

Case 14: Unfortunate iatrogenic complication of endovascular aneurysm repair in a high-risk patient

Vascular Surgery

CASE SUMMARY

A male patient in his late 60s was admitted electively for the repair of a 5.9 cm infrarenal abdominal aortic aneurysm in association with an approximately 3 cm left common iliac aneurysm. The size of the iliac aneurysm was difficult to ascertain but to achieve an adequate seal it is generally necessary to repair the iliac aneurysm in association with the aortic aneurysm.

The patient had a number of significant co-morbidities, including dilated cardiomyopathy with an ejection fraction of 20%, renal impairment, chronic obstructive pulmonary disease, previous coronary artery bypass grafting, previous partial lung resection and diabetes mellitus.

Medical notes indicated that the patient was suitable for an endovascular approach and it was decided to perform that repair using a stent graft of the infrarenal aortic aneurysm with an iliac branch device to treat the left iliac aneurysm.

To deploy the iliac branch device, an approach from the left subclavian artery was deemed appropriate. It is probable that the approach was actually via the axillary artery as it was approached by an infraclavicular incision.

Surgery was performed in the morning. The procedure was straightforward, and unremarkable in terms of the deployment of the grafts. The patient was transferred to the intensive care unit and extubated postoperatively. Some time that night the patient had episodes of hypotension and a decrease in haemoglobin, and it was thought that the patient was actively bleeding. Inspection of the surgical sites failed to reveal any evidence of a haematoma. An urgent computed tomography (CT) angiogram was arranged and demonstrated active bleeding in the mediastinum with an associated large right and small left haemothorax. The source was uncertain but appeared to be “either from an arterial branch towards the left subclavian artery region or from the left subclavian artery itself”.

Following consultation with a cardiothoracic surgeon, right intercostal drain insertion was recommended. This was inserted by the intensivist with the vascular surgeon present. The patient stabilised following insertion and a conservative approach taken with a view to repeat CT in the morning. Unfortunately, a further fatal episode of bleeding occurred during the night and the patient succumbed to that.

DISCUSSION

Postmortem revealed 2.8 litres of clotted blood within the right pleural cavity and 100 ml in the left pleural cavity. In the aortic arch and descending aorta there were multiple areas of atheroma and ulceration. The subclavian artery, where it had been initially cannulated, was examined and showed evidence of cannulation site but no evidence of rupture. The site of the probable rupture was felt to be the tip of the aortic arch (presumably near the origin of the subclavian artery). Of note there was extensive soft tissue haemorrhage extending from the shoulder, posterior neck and mediastinum

CLINICAL LESSONS

It should be noted that endovascular aneurysm repair, while associated with significantly less risk than open aneurysm repair, still carries a significant morbidity and mortality. These risks depend on a number of factors which include patient co-morbidity and procedural complexity. This patient had a number of significant co-morbidities and the risks of the procedure versus the risk of rupture and life expectancy need to be carefully assessed. In addition, the decision to increase the complexity of the procedure by using a bifurcated iliac device needs to be considered. The risk of this patient developing significant complications or morbidity from loss of his left internal iliac, when the contralateral internal was preserved, was very low.

The cause of death was the inadvertent puncture of the aorta/origin of left subclavian artery with a wire or a catheter, not recognised at the time of the procedure, which led to bleeding. Disease of the arch and/or subclavian increases the risk of this injury and prior imaging of the arch and all access vessels before endovascular repair is important in the planning and performance of these procedures. It is unclear whether a preoperative CT angiogram of the aorta from the neck to diaphragm was performed in this case.

It should be noted that with endovascular cannulation of any vessel, extreme care needs to be taken with wires and catheters so that they don't perforate vessels. This is a recognised complication of endovascular procedures.

There was some delay in recognising the postoperative haemorrhage; under these circumstances this is unfortunately very common as it requires a recognition that post-endovascular procedure haemorrhage may occur with no external clinical signs other than hypotension. The CT angiogram demonstrated active bleeding and while it was postulated that this may have been from the access site, it is likely that the access site was actually the axillary vessel and bleeding

from this site causing haemothorax would be unusual; it was therefore much more likely to have been from the first part of the subclavian artery or aortic arch.

As the patient had stabilised, after consultation with a cardiothoracic surgeon, a conservative approach was taken, but there was indubitably a high risk of further bleeding. Arguably, exploration of the axillary wound to exclude local damage and performing angiographic examination would have provided more information as well as providing an opportunity to control the haemorrhage by covered stent or, temporarily, by balloon occlusion. It is likely however that definitive treatment would have required thoracotomy and it is highly unlikely that this patient would have survived this procedure.

Abbreviations

BP	Blood pressure
COPD	Chronic obstructive pulmonary disease
CPAP	Continuous positive airway pressure
CT	Computed tomography
DVT	Deep vein thrombosis
ECMO	Extracorporeal membrane oxygenation
ED	Emergency department
GCS	Glasgow coma score
GI	Gastrointestinal
GORD	Gastro-oesophageal reflux disease
HLCNH	High-level care nursing home
HPB	Hepato-pancreatico-biliary
ICC	Intercostal catheter
ICP	Intracranial pressure
ICU	Intensive care unit
IV	Intravenous
IVC	Inferior vena cava
MET	Medical emergency team
NGT	Nasogastric tube
OSA	Obstructive sleep apnoea
SAGO	Standard adult general observation
SAH	Subarachnoid haemorrhage
SBP	Systolic blood pressure
TPN	Total parenteral nutrition
UTI	Urinary tract infection
WFNS	World Federation of Neurologic Surgeons

Contact Details

Royal Australasian College of Surgeons
Australian and New Zealand Audit of Surgical Mortality
199 Ward Street
North Adelaide SA 5006

Telephone: +61 8 8219 0900
Facsimile: +61 8 8219 0999
Email: ANZASM.RACS@surgeons.org
Website: <http://www.surgeons.org/anzasm>

Notes

A series of horizontal dotted lines for writing notes.



Royal Australasian College of Surgeons
Australian and New Zealand Audit of Surgical Mortality
199 Ward Street
North Adelaide SA 5006

Telephone: +61 8 8219 0900

Facsimile: +61 8 8219 0999

Email: ANZASM.RACS@surgeons.org

Website: <http://www.surgeons.org/anzasm>

