CASE NOTE REVIEW BOOKLET

SEVENTH EDITION **AUGUST 2015**

VASM
Victorian Audit of Surgical Mortality

Royal Australasian College of Surgeons

CONTENTS

INTRODUCTION

The audits of surgical mortality review deaths that occur whilst under the care of a surgeon in the public and private hospital sectors. As this peer review process is intended as an educational exercise, we have selected a number of cases that bring out specific clinical issues. The cases do not necessarily relate to the period since the last booklet. They do, however, serve as topical and timely lessons for all surgeons and clinical team members. In successive years repeated issues of management appear, particularly, delay in diagnosis and treatment of the deteriorating patient and deficiencies in postoperative management. These are again highlighted in this seventh edition of surgical cases.

All cases selected have gone through a second-line assessment (case note review) by a Fellow from either the Royal Australasian College of Surgeons or the Royal Australian and New Zealand College of Obstetricians and Gynaecologists (RANZCOG). The cases document critical incidents, often involving system issues rather than issues that are the responsibility of the treating surgeon alone. The assessments have been edited to ensure that the patient, hospital, treating surgeon and assessor remain anonymous.

Qualified Privilege prevents us from sending assessment feedback to anybody other than the treating surgeon. This means that hospital management only receive indirect feedback on cases of patients who died in their hospital. The surgeon can, of course, share the outcome of their assessment with relevant staff. Where there are obvious system issues, it is important that hospitals are aware and react to address these issues as appropriate. It is also important that the audit attempt to address emerging adverse trends.

We feel that, as there are important lessons in this publication, it should be made available to all those responsible for delivering the care that resulted in the outcomes presented and recommend that it be used as a teaching aid. Additional copies of this publication can be provided on request.

Audit staff would like to take this opportunity to thank all surgeons and hospitals participating in this educational activity. We hope you find this publication of value.

EMERGING ISSUES AND RECOMMENDATIONS TO VASM CLINICAL STAKEHOLDERS

OBJECTIVES TO CONSIDER BY HOSPITALS AND HEALTH PROFESSIONALS ARE:

Improved leadership in patient care

- In complex cases there must be clear demonstrable leadership in patient management.
- The treatment plan for each patient should be understood by all involved with the patient's care. There should be a low threshold in calling for assistance from colleagues during a lengthy operation to avoid fatigue.
- The leader must be present, must be responsive, must be prepared for challenges and must focus on patient care.

Better documentation of clinical events and plans

The case record is an essential tool for identifying clinical trends and management plans. As such, the case record must contain clear and accurate documentation of events and plans. A repeated issue for reviewers is the lack of adequate, legible documentation.

Action on evidence of clinical deterioration

Clinical deterioration is an issue that is recognised throughout Australia and internationally. Acting early on evidence of clinical deterioration may prevent or address adverse events. Remember:

- When clinical deterioration occurs in a patient and there is no clear cause, the cause may be related to something outside your specialty knowledge base.
- Clinical findings must be considered along with the results from any investigations.
- Clinical deterioration must be acted upon and not just recorded.

Improved preoperative management

Appropriate preoperative preparation and management may decrease operative complications and promote successful recovery. Delay for unnecessary preoperative investigations can have fatal consequences. Preparation and management should include:

- Evaluation of both physical and psychological preparation.
- Complete medical history and physical examination procedures.
- Consent for the surgery and discussion of potential outcomes.
- Appropriate documentation and communication of findings with clinical and surgical teams.

Improved postoperative management

- The patient should be discharged to the ward with comprehensive orders.
- Preventative measures are to be implemented for reducing complications.
- Instructions must be given about further management if discharged from a clinical or surgical team.
- The potential outcomes from the probable clinical diagnosis must be considered when developing a treatment plan.
- The patient should be transferred to a medical unit (assuming surgical postoperative care can be performed in that setting) if elderly and high-risk and medical issues are assessed as being the prominent clinical factor during the admission episode..

Improved awareness of surgical emergencies and shared care requirements

Medical, surgical and nursing staff can improve the safety of patient care by increasing their awareness of current problem areas in the care of surgical emergencies, as revealed in clinical audit, and understanding the risks and challenges posed by shared care.

Improved communication

All health professionals and institutions should actively collaborate and communicate to guarantee an appropriate interchange of information and coordination of patient care.

CARDIOTHORACIC SURGERY

CASE 1: INADEQUATE ANTICOAGULATION AFTER MECHANICAL AORTIC VALVE REPLACEMENT

Clinical details

A patient in their early forties presented with significant aortic regurgitation. The medical history was extensive and significantly impacted the outcome. The patient had systemic lupus erythematosis and documented antiphospholipid antibodies (APLS) with previous multiple cerebral thrombo-embolic events, deep venous thrombosis' (DVTs) and recurrent pulmonary thromboembolus which was treated with warfarin.

Preoperatively the patient was on life-long clexane at 80 mg, weighed 77.5 kg and was well known to both Haematology and Rheumatology Departments. The patient also had several bouts of bleeding haemorrhoids, requiring surgical intervention, and leading up to cardiac surgery in the prior month.

An elective, mechanical aortic valve replacement (AVR) was performed. Postoperatively the patient was commenced on clexane at 40 mg subcutaneously twice daily and reviewed by Haematology and Rheumatology on day four and day five respectively and recommended clexane 1 mg/kg BD. Further Haematology review on day five subsequently recommended further clexane at 60 mg BD with ongoing Factor Xa Inhibitor (FXa) levels. FXa level was noted on day seven as 0.69 U/mL (0.5-1.0). Subsequent peri-rectal bleed occurred on the evening of day eight and clexane was withheld that evening. Overnight the patient developed severe stabbing pleuritic chest pain at 3:30am. Pulmonary thromboembolus was considered and the patient was given a subcutaneous stat dose of clexane 60 mg.

On day nine, the FXa level was 0.62 at 9:15am and the patient was transfused two units of packed red blood cells. On day 10 the patient complained of throbbing in right arm but no cause was identified. On the morning of day 12, the patient complained of severe abdominal pain. Shortly afterwards he arrested (asystole) and cardiopulmonary resuscitation (CPR) commenced.

Peripheral veno-arterial extracorporeal membrane oxygenation (VA ECMO) was then attempted 40 minutes into CPR. Unfortunately both cannulae were positioned in the venous system and no forward flow was achieved. CPR was not continued during extracorporeal membrane oxygenation (ECMO).

Comments

The decision to proceed to AVR was appropriate. Preoperatively, from the surgical letters, the patient was considered for either aortic valve repair or a replacement with a mechanical prosthesis. There was no discussion about possible aortic bioprosthesis and there is no correspondence or discussion with cardiology, haematology or rheumatology regarding this decision for mechanical AVR. Preoperative planning should have included a detailed discussion with the patient and the supporting specialities about the risks and benefits of mechanical versus bioprosthetic valve in this patient with a high thrombotic risk and recent bleeding issues. Details of the technique used to establish ECMO are very limited in the operative note. It is difficult to say how this event occurred but it is of significant concern and this technical error in part contributed to this patient's death. The patient may have survived if satisfactory VA ECMO had been achieved.

This patient suffered a life threatening thrombotic complication related to the mechanical AVR and thrombotic risk profile. With effective anticoagulation this complication may have been preventable. It is difficult to comment on the exact dosing regimen used as these details are covered (for de-identification purposes) in the notes. Of note, he was on clexane 80 mg BD prior to surgery and only on 60 mg BD at the time of death. The decision to initially hold the clexane dose on the evening of day eight was also likely to have been a critical event. The patient's FXa level, whilst therapeutic, was at the lower end of the range and was falling during serial testing. The last level was performed on day nine. In APLS, perioperative thrombotic complications are frequent among patients submitted to cardiac surgery. Most complications are related to thrombosis and bleeding. Anticoagulation must be carefully monitored to prevent haemorrhagic and thrombotic complications.

The 2014 American Heart Association/ American College Of Cardiology Guideline for the Management of Patients With Valvular Heart Disease currently states: "Anticoagulation with a Vitamin K antagonists was indicated to achieve an international normalised ratio (INR) of 3.0 in patients with a mechanical AVR and additional risk factors for thromboembolic events atrial fibrillation (AF), previous thromboembolism, left ventricle (LV) dysfunction, or hypercoagulable conditions) or an older-generation mechanical AVR (such as ball-in-cage)". In view of this patient's medical history a higher dose of clexane should have been considered.

Whether mechanical or bioprosthetic valves are preferable for patients with APLS remains a matter of debate. An advantage of bioprosthetic valves is the low incidence of thromboembolism without anticoagulation. Considering the thromboembolic complications in APLS, bioprosthetic valves may be a better choice. The choice of a mechanical AVR contributed to this patient's death which may have been preventable with a bioprosthetic valve.

CARDIOTHORACIC SURGERY

CASE 2: INADVERTENT PLACEMENT OF CATHETER IN CAROTID ARTERY LEADING TO URGENT, INSTEAD OF SEMI-ELECTIVE, CORONARY ARTERY GRAFTING

Clinical details

A patient in their mid-forties with ischaemic cardiomyopathy underwent semi-elective coronary artery bypass grafting (CABG) for severe triple vessel disease. The patient suffered an inadvertent right internal carotid artery cannulation with the Swan-Ganz catheter, which was recognised and removed. It was elected to postpone surgery for 24 hours given the arterial puncture and that the patient had been stable up to this point.

Eleven hours later, the patient suffered a cardiac arrest and was taken to theatre for salvage coronary artery bypass grafting. At the completion of the case, the patient was unable to be separated from cardiopulmonary bypass and peripheral ECMO was instituted. During the two hours of recovery in the intensive care unit (ICU) the patient deteriorated and was deemed irretrievable and died soon after.

Case Notes

This patient presented to hospital with a one year history of unstable angina. A stress thallium demonstrated anterior lateral and inferior reversible ischaemia, with an ejection fraction of 28 per cent. The patient was transferred five days after initial admission to a second hospital for coronary angiogram. Angiogram demonstrated severe triple vessel disease with reduced ventricular function and was referred for grafting.

Preoperative echocardiogram showed mild-to-moderate mitral regurgitation. There was thinning and akinesis of the entire LV apex with severe hypokinesis of the adjacent mid anterior and anteroseptal segments. Preoperative carotid duplex demonstrated no significant carotid artery disease. Background medical history included rheumatoid arthritis for which the patient was on prednisolone and gastro-oesophageal reflux disease.

Surgery was initially delayed for one week after coronary angiogram to allow for the Plavix platelet effect to clear. During this time, the patient remained pain-free and haemodynamically stable and was not requiring intravenous glyceryl trinitrate (IV GTN) or heparin.

The patient was taken to theatre for semi-elective surgery in the morning. During insertion of preoperative monitoring lines, an eight French Swan-Ganz catheter sheath was inadvertently inserted into the right internal carotid artery. The cannula was removed and pressure was applied to the neck. The surgical team was contacted and it was felt that it was no longer safe to proceed with a semi-elective bypass given the risk that full heparinisation would have to the patient in the setting of a recent puncture with a large cannula into the right internal carotid artery.

Pressure was applied to the insertion point and was transferred back to the coronary care unit and rescheduled for coronary artery bypass surgery for the following day at 8.00am. He was returned to the coronary care unit at 10.20am. A femoral arterial blood pressure line was left in and recorded a blood pressure (BP) of 76/47 mmHg. The patient was reviewed at 12.15pm and was found to be more rousable and pain-free. The blood pressure remained low at 77/49 mm Hg. The patient was reviewed by the cardiothoracic registrar at 3.00pm and remained pain free at this time. The BP was recorded as 85/57 mmHg and the patient was described as being peripherally well perfused.

At 7.10pm the patient developed severe sudden onset of central chest pain 5/10. Within 12 minutes there was a drop in Glasgow coma score (GCS) and a code blue was called. CPR was commenced and the patient was resuscitated and transferred urgently to the operating room. Prior to transfer to theatre, a sustainable rhythm was achieved. The patient was transferred to theatre at 8.15pm. On arrival the patient was relatively hypotensive with a mean pressure of 50 mmHg and on an adrenaline infusion.

The patient was prepped and draped and a rapid median sternotomy was performed. The patient was placed on cardiopulmonary bypass and was noted that there was extensive infarction of the anterior lateral wall of the left ventricle. Three grafts were performed with saphenous vein to the left anterior descending (LAD), vein to an obtuse marginal and vein to the posterior descending artery. It was not possible to place a retrograde cardioplegia cannula for cardiac protection. Grafting was conducted with first distal, then proximal aortic anastomosis. Antegrade cardioplegia was run at 10 minute intervals during the case through the root and down each vein graft as it was completed.

At the end of the case it was not possible to separate him from cardiopulmonary bypass and required ECMO support. After transfer to the intensive care unit the patient deteriorated and was unable to be supported with the ECMO circuit. At this point it was decided that this was an irretrievable situation, the patient died in the early hours of the following morning.

Conclusion

The standards of line insertion may need review. The inadvertent arterial puncture ultimately led to the chain of events which resulted in salvage coronary artery bypass grafting, rather than semi-elective. The use of vascular ultrasound (U/S) may have prevented this complication.

There was no area of concern that the surgery was delayed after inadvertent arterial cannulation. The level of monitoring after an iatrogenic injury was a concern. An ICU admission would have been more appropriate for him. This patient was persistently hypotensive whilst in the critical care unit (CCU) prior to arrest. This was a concern.

There were no areas of concern with regard to the conduct of surgery performed, in particular the cardiac protection.

Comments

The first-line assessor firstly questioned the experience in supervision of the anaesthetist during insertion of the Swan-Ganz catheter. There was no documentation provided with regard to this procedure.

Inadvertent arterial puncture can be reduced through adequate training, careful technique and the use of vascular U/S to confirm line placement. The procedure of line placement in cardiac surgery differs between institutions. In some centres, lines are placed after general anaesthetic is given. In these cases the trans-oesophageal echo can guide the anaesthetist through identification of the wire within the right atrium.

There was no documentation provided whether a vascular U/S was used to guide vena-puncture in this case. If utilised, this may have avoided the arterial puncture. The practices for line insertion may require further review.

In this case it would seem the patient had been given sedation for insertion of lines, as the patient was transferred to the coronary care unit after theatre was deferred. The decision to defer the patient's surgery for 24 hours is not unreasonable given that the patient had been stable for the 11 days that the patient had been admitted to hospital.

Of concern is that this patient, with known severe triple vessel disease and a severely impaired ventricle, was transferred to the coronary care unit rather than the intensive care unit, given they would have been expecting him later in the day if the surgery had proceeded.

The second concern of the first-line assessor was the stability of the patient from 8.00am until the patient was taken back to the operating room. It was documented on a number of occasions that the BP monitored via femoral arterial line was low at 75/47 mmHg. This was a concern given that this patient had an impaired ventricle with significant coronary artery disease. This patient should have been transferred to the ICU for closer monitoring and inotropes as required. The low perfusion pressures over many hours may have contributed to this patient's cardiac arrest.

Finally the first-line assessor questioned whether a retrograde cannula was inserted for delivering cardioplegia. On review of the operative record it was not possible to insert a retrograde cannula. There was no other information with regard to the cardiac protection strategy, except antegrade cardioplegia at 10 minute intervals, for this case. Although it was stated that a retrograde hot-shot was delivered at the end of the case, this must be an error given the earlier statement that a retrograde cardioplegia cannula could not be inserted.

CARDIOTHORACIC SURGERY

CASE 3: READMISSION WITH HAEMOPERICARDIUM POST CARDIAC SURGERY TO THE WRONG UNIT

Clinical Details

A patient in their late sixties with a past history of smoking related chronic obstructive pulmonary disease, previous posterior stroke with residual right visual field defect, Barrett's oesophagus, depression, heavy ethanol use and an ex-intravenous (IV) drug user was admitted with a non ST elevation myocardial infarction. Because of ongoing chest pain despite aspirin, persantin, IV heparin and IV GTN, he underwent urgent coronary angiography. This confirmed the presence of critical left main stem stenosis as well as moderate right CAD.

Emergency coronary revascularisation was performed later the same day with a left internal mammary artery to LAD, saphenous vein graft to obtuse marginal artery and right coronary artery. Postoperatively he was coagulopathic, but bleeding was controlled with the use of platelets, fresh frozen plasma (FFP), cryoprecipitate and prothrombinex. The patient subsequently developed an episode of AF which was treated with amiodarone and beta blockers, followed by commencement of warfarin and was discharged from hospital postoperative day six. The discharge medications included warfarin, aspirin and subcutaneous heparin. Clopidogrel was ceased on the day of discharge.

The patient was re-admitted via the emergency department (ED) six days later with "irregularities on blood tests" and some degree of exertional dyspnoea. The blood tests confirmed significant elevation of liver enzymes, impaired renal function and a raised INR (3.8). There was also a significant drop in haemoglobin (114 to 94 g/L over five days), with elevation of the white cell count and inflammatory markers. The patient was admitted under the care of a general physician, although the patient was also reviewed by the Cardiothoracic Surgery Registrar on call. The admission notes raised the possibility of pericardial pathology and mentioned the need for an echocardiogram, but this was not performed on the day of admission or on the following day.

Warfarin was withheld following the re-admission, but no attempt at reversal was made despite INR readings of 4.2 and 4.9 on the day following re-admission, and 6.4 on the following day. The patient's condition deteriorated significantly (hypotension, tachycardia, tachypnoea and diaphoresis), and a medical emergency team (MET) call was instituted, where the patient was assessed as being in a pre-arrest situation. The patient was urgently transferred to the intensive care ward where the patient in fact arrested. A "quick sub costal transthoracic echo imaging" was performed during the arrest phase and this confirmed a large pericardial effusion with no discernible cardiac contractility. Percutaneous drainage of approximately 600 ml of bloody fluid was performed. Despite resuscitative measures the patient died after 45 minutes of attempted resuscitation and the case was referred to the Coroner.

Adverse event – Delayed and unrecognised pericardial bleed culminating in cardiac tamponade and a cardiac arrest.

Areas of concern

- Management of postoperative AF. The patient was known to have high ethanol intake (exhibited withdrawal symptoms in the postoperative period). Discharged on aspirin, warfarin, subcutaneous heparin and amiodarone and given the history of intraoperative coagulopathy and long standing excess ethanol intake, it could be expected that the patient would be unusually sensitive to warfarin. There was also excessive warfarin administration. The patient was given doses of 2 mg and 2 mg on the fourth and fifth postoperative days, but subsequently received doses of 10 mg and 10 mg on the seventh and eight postoperative days at home.

- Patient re-admitted under the care of a general physician. Any early readmission raises the possibility of a postoperative complication and should always require re-admission to the Cardiothoracic Surgical Unit.

- Failure to perform an echocardiogram between the time of re-admission and the time of cardiac arrest (approximately 48 hours). This despite the fact that the progress notes make mention at several points for the need to perform this investigation, but clearly the urgency and the potential for hemopericardium in the presence of marked liver failure and an elevated INR was not recognised or acted upon.

- Management of the cardiac arrest: despite the diagnosis of a large hemopericardium and the fact that "the cardiothoracic team were present during the arrest" this complication was treated by percutaneous drainage, rather than emergency re-sternotomy.

It must be noted that perusal of the hospital notes was rendered extremely difficult because the photocopy of the notes was virtually illegible owing to "poor quality original" stamped over many of the pages. In particular this made assessment of any medication charts extremely difficult.

Comments

This patient in their late sixties developed a hemopericardium following discharge from hospital. Given the history of heavy ethanol use, it would appear that the postoperative anti-coagulation regime for a single episode AF was excessive and probably contributed to the subsequent event. However, of more concern is the fact that the patient was not admitted under the Cardiothoracic Surgical Unit despite having been seen by the Registrar, such that the surgeon involved was apparently unaware of the re-admission (according to the notes). Furthermore, the delay in obtaining a transthoracic echocardiogram right up to the time of the patient's cardiac arrest, despite the notes saying at several points that an echocardiogram was to be performed, contributed to the patient's clinical deterioration and almost certainly accounted for the patient's subsequent demise. Of further concern is the fact that, even after the hemopericardium was diagnosed, it was treated by paracentesis rather than by re-opening of the sternum, despite the fact that the records state that the cardiothoracic team were present during the arrest.

Recommendation

Hospital protocol should dictate that any early re-admission following cardiac surgery should be under the Cardiothoracic Surgical Unit bed card and the surgeon involved should immediately be notified of such admission, which should avoid leaving the responsibility of management of potentially critical situations in the hands of relatively junior staff.

GENERAL SURGERY

CASE 4: DELAY IN RECOGNITION OF BOWEL INJURY AFTER HERNIA REPAIR

Clinical Details

A patient in their late eighties, otherwise independent and healthy, presented with an incarcerated right inguinal hernia and underwent an emergency repair with mesh. The operation showed viable omentum and the sac was opened. Immediately after operation, the patient had persistent postoperative hypotension, hypothermia and tachypnoea and was transferred to CCU for monitoring later that night. Inotropes was started the following day and continued until the patient's demise on day two without any improvement. The patient had a code blue on the final morning and chest x-ray (CxR) demonstrated aspiration pneumonia. The patient continued to deteriorate and palliative care was instituted in consultation with the family.

The postmortem demonstrated generalised peritonitis secondary from intestinal perforation at the site of inguinal hernia repair. There was a circular defect in the small bowel wall.

Case notes

The case notes provided by the hospital were adequate, but the documentation was somewhat brief and lacking in detail. The preoperative abdominal x-ray (AxR) report was also missing. Preoperative assessment and decision for operation, choice and conduct of surgery and the anaesthetic consult was adequate and indicated a healthy independent patient with good pre-morbid function. During intubation, bilious regurgitation was aspirated, no signs of aspiration noted at the time. Prophylactic antibiotic was given but no DVT prophylaxis was used.

The operation was done promptly, thought the notes were brief and didn't mention any bowel involvement. This was mentioned on retrospective notes later on. Postoperatively, the patient had extreme pain and tachypnoeic – 34-47/min with hypotension. This was reviewed by anaesthetic registrar and given more analgesic and transferred to CCU. The surgical registrar reviewed the patient the next morning. The patient indicated a tender and distended abdomen in the setting of hypotension and respiratory rate, but nothing further was done apart from chest physio and IV fluid. The consultant note was brief and lacked details.

The Medical Registrar was consulted for presumed fluid management. Adrenaline was started just prior to review but no reason was documented. Upon the review, there was decreased air entry at the lung bases and it was thought that there was small lung effusion as well. More intravenous fluid was given as boluses and adrenaline continued to run. A retrospective note was later documented by the surgeon on the day. The note indicated no bowel involvement and no haematoma at the site of operation with a soft abdomen.

Adverse events

On day two postoperatively, the medical registrar was called at 5.00am to review the patient again with persistent hypotension and poor urine output with tachypnoea and abdominal pain. The abdomen was distended but there was no indication of any rigidity or guarding. The white cell count was 2.6. The clinical impression was hypovolaemia from third space loss, abdominal distension and secondary splinting of diaphragm with inadequate pain relief. The recommended actions were more fluid bolus, intubation and central venous catheter for central venous pressure monitoring.

The Medical Registrar reviewed the patient again at 7.00am and the oxygen saturation deteriorated further. The patient vomited with nasogastric tube (NGT) aspirated bilious fluid. Mobile CxR showed increased lung marking bibasally. The Surgical Registrar reviewed the patient and suggested continuous positive airway pressure for a few hours. If there were no improvement, the plan was to palliate the patient and this was discussed with the surgeon. The patient deteriorated further and palliation was discussed with family and patient passed away just after midday.

Areas of concern

The major concern is the failure of surgical team's review of the patient and delegation of the postsurgical care to a medical registrar. The patient underwent a routine emergent inguinal hernia repair, even in this age group would have a very predictable postoperative course, unless a catastrophic event such as a massive acute myocardial infarction or pulmonary embolus (PE) occurred. The postoperative course of this patient is very unusual and alarms should have been raised earlier on.

Secondly, the hypotension should have been quickly corrected without the need of starting inotropes. All causes of postoperative hypotension should be excluded. The causes would include operative complications such as blood loss, bowel injury, sepsis or myocardial infarction. Frequent surgical review should be part of the work up process in this unexpected postoperative course. Investigation such as computed tomography (CT) abdomen and pelvis should be contemplated even if there was reluctance of taking patient back to theatre.

The management of the patient in the CCU was also concerning. The failure of response with the continued use of inotropes in this patient should alert the team to look for other reasons for the failure of progress of this patient.

Comments

This case highlighted the many opportunities missed which may have made the outcome of this case preventable. The unexpected course after the operation called for frequent surgical review until major surgical complications were excluded. This patient had one surgical review on days one and two. The medical management had been wrongly targeted right from the start. The hypotension while it could be as a result of hypovolemia, having had multiple boluses of fluid and albumin with adrenaline infusion, the lack of clinical response would suggest the underlying pathology is not treated. When the treatment plan was not reviewed and not directed, the consequence in this case was then unavoidable.

Suggestion: "Frequent review by surgeon – it is a surgical complication until proven otherwise." Persistent hypotension following an uncomplicated inguinal hernia without bowel involvement should have expected recovery pattern. In the absent of cardiac event, persistent hypotension and tachypnoea with hypothermia suggested a more sinister cause. Earlier and more frequent surgical review was prudent.

The surgical care of surgical patient should not have been delegated to medical registrar unless there were any coexisting medical conditions. Inotropes should be used cautiously and frequent reviews needed. An early CT abdomen in this case could have pointed to peritoneal sepsis and potentially saved the patient.

GENERAL SURGERY - BARIATRIC

CASE 5: FAILURE TO USE A NASOGASTRIC TUBE WITH INTESTINAL OBSTRUCTION; AIRWAY MANAGEMENT ISSUES

Clinical details
General Surgery Review

This 40 year old morbidly obese patient was admitted to hospital with an upper bowel obstruction. Three weeks previously, the patient had a gastric bypass operation for obesity. The patient presented to the surgeon with abdominal pain and vomiting and was admitted to hospital in the afternoon with a diagnosis of bowel obstruction.

On admission the patient was treated with intravenous therapy and nil by mouth and arrangements were made for operation the following day. Intended operation was gastroscopy and possibly laparotomy. The operation was commenced, but during induction of the anaesthetic the patient aspirated gastric content. The operation proceeded with a gastroscopy showing no intraluminal obstruction and the gastroenterostomy was patent.

Laparotomy showed extensive adhesions distal to the anastomosis. An enterotomy was performed and the anastomosis was examined and was judged to be of adequate calibre. A nasogastric tube was fed into the small bowel. Postoperatively the patient was transferred to intensive care and remained intubated and ventilated. The problems for the next postoperative 10 days included respiratory difficulties- she developed marked acute respiratory distress syndrome (ARDS). The patient was anaemic requiring three units of blood transfusion. The patient's white cell count was raised and was given appropriate antibiotics.

The gastrointestinal (GI) tract never really settled down, attempts at nasogastric feeding failed and the patient continued to drain from the nasogastric tube.

Six days postoperation, the patient required a tracheostomy- this was performed under general anaesthetic and a tracheostomy done with a flap. The patient continued to struggle until an acute episode on the tenth postoperative night. The patient complained of acute difficulty with breathing and had a cardiorespiratory arrest.

It was apparent that there was some respiratory obstruction, the patient developed surgical emphysema, the tracheostomy was removed, cleaned, re-inserted and standard CPR performed. Resuscitation was unsuccessful and the patient deceased on day 11.

First-line assessor's comments

- During initial management the surgeon did appreciate that this was a small bowel obstruction – the surgeon may have thought that this was due to anastomotic narrowing or adhesions. Was a second surgeon involved?

- Was a nasogastric tube used preoperatively? There was no record of preoperative nasogastric drainage. The patient was admitted with orders for 'Nil Orally' and intravenous therapy, and this omission was a major factor in the patient aspirating. There were no anaesthetic details regarding the aspiration, but apparently the decision was made to proceed with the operation.

- It was uncertain what the rational was for gastroscopy- presumably the surgeon who had done the operation three weeks previously was concerned there may have been an anastomotic narrowing. In retrospect, this was an unnecessary procedure.

- There was no CT scan performed preoperatively.

- The patient was morbidly obese and had a persistent albumin of 2.5g/dL - nutritional status was not good. There was no record of consideration of intra-abdominal sepsis.

This patient's demise relates to two incidents; Firstly, aspiration pneumonia due to vomiting at the time of induction of anaesthetic. There was no preoperative attempt to drain the gastric content, i.e. no nasogastric tube, and this was a significant factor in the patient's aspiration and pneumonia and ARDS ultimately led to the patient's demise. The second incident was the acute respiratory failure 10 days postoperatively- the patient developed surgical emphysema and had difficulty breathing. The cause of this respiratory problem could have been possibly overwhelming ARDS or possibly a technical defect in the tracheostomy- the development of surgical emphysema and the acute onset of the problem was a concern – a review by an anaesthetist may be beneficial.

Anaesthetic review

This patient had a preoperative anaesthetic assessment noted an American Society Of Anesthesiologists (ASA) score of 2E. Their airway was assessed as Mallampati class III. Anaesthesia was induced with fentanyl, propofol and suxamethonium. A cuffed oral endotracheal tube was placed. Intubation was described as easy with proper positioning, although poor mouth opening was noted. During surgery the patient's oxygen saturations were recorded as between 89 per cent (at the start of the case) on 100 per cent fractional inspired oxygen (FiO_2), and 71 per cent on 100 per cent FiO_2 at the end of the case. A blood gas with a partial pressure of oxygen in arterial blood (PaO_2) of 52 was recorded.

At the end of the procedure, the patient was transferred directly to the ICU with a diagnosis of aspiration pneumonitis. The patient remained intubated, ventilated and sedated. Treatment included intravenous antibiotics. The patient went on to develop ARDS with persistent CxR infiltrates, stiff lungs and slow progression with respiratory weaning. Enterobacter was grown from the sputum.

On day 12 a Code Blue was called. Nursing notes described the ventilator alarming, followed by unsuccessful attempts to pass a suction catheter down the tracheostomy. The inner cannula was removed but did not appear blocked. The patient became agitated saying they "can't breathe properly" and "felt sick". Ventilation attempts via a bagging circuit were unsuccessful.

The tracheostomy tube was assumed to be blocked and removed. Another tracheostomy tube was inserted, but staff were still unable to ventilate. The patient was "bagged" by face mask. Facial swelling developed within one to two minutes (described as significant, entire face, and lips and mouth). Electromechanical dissociation arrest occurred, CPR was commenced and adrenaline given.

The intensivist liaised with the hospital Code Blue team while en route to hospital. Removal of the tracheostomy tube, occlusion of the stoma, and oral intubation were advised (the tracheostomy was less than one week old, which made a formed tract unlikely but could lead to an extremely high risk of false passage formation with subcutaneous emphysema).

A difficult intubation tray was obtained from theatre (it was noted no anaesthetist was present in the hospital). An attempt to intubate was unsuccessful (post-suxamethonium, midazolam and propofol) - the patient's jaws were noted to be clenched and the airway grossly oedematous. Subcutaneous emphysema was reported in the upper chest, face and periorbital areas. Rocuronium was suggested. The resuscitation record notes administration of vecuronium. It appears a further oral intubation attempt was unsuccessful. The patient had become asystolic during this period.

The intensivist arrived and noted the patient was cyanosed with CPR in progress, with no meaningful chest wall movement with Bag Valve Mask ventilation. A very difficult laryngoscopic view was noted with "florid" subcutaneous emphysema (to the eyebrows) distorting the submental tissues and base of the tongue. Two attempts at oral intubation were made using Mac 4 and Miller (straight) laryngoscopic blades and bougies. The first tube was removed (unable to ventilate, no change in capnograph) and bag ventilation through the second tube was described as still very hard. The tracheostomy stoma was digitally explored and a 7.0 tracheostomy tube passed - bag ventilation using this tube was described as difficult. Resuscitation efforts were ceased after approximately 50 minutes of CPR with no return of spontaneous circulation.

The medical deposition to the Coroner noted the possible cause of death as loss of airway from dislodged tracheostomy, hypoxia, cardiac arrest, pulseless electrical activity decaying to asystole. Postmortem examination findings were not available for review.

Comments

Area for consideration

Regarding the aspiration:

The operation note documents bile stained fluid draining from the endotracheal intubation in the operating theatre (OT), consistent with aspiration. However it was not possible to determine from the documentation provided at what point in time aspiration occurred. The available anaesthetic notes do not comment on an aspiration event. In the operation note, the surgeon noted that the patient was extremely distressed, and tachycardic with low saturations, but unable to ascertain at what time this assessment occurred. There was no documentation of preoperative nasogastric drainage.

Area for consideration

In a patient with a bowel obstruction, the presence of a freely draining nasogastric tube makes induction of general anaesthesia safer.

Regarding the acute respiratory event on Day 12:

While the primary cause of the acute respiratory event on Day 12 was not known for certain, one of the main and most important reasons for difficulty ventilating through a recently placed tracheostomy tube is tube dislodgement.

If this occurs within a few days of the tracheostomy procedure, replacing the tube may be extremely difficult as a tract is unlikely to have formed, and there is a very real risk of creating a false passage with attempted reinsertion- ventilation through a false passage will likely result in subcutaneous emphysema. Development of a false passage and subcutaneous emphysema can seriously compromise subsequent attempts to secure an airway orally or via the stoma, and to bag mask ventilate.

In this case, during management of the acute respiratory event, the four-day old tracheostomy tube was removed as it was thought to be blocked. A new tracheostomy tube was inserted, but ventilation remained unsuccessful through the new tube. Significant subcutaneous emphysema developed within minutes, and appeared to affect subsequent ventilation and oral intubation attempts.

Areas for consideration

Tracheostomy airway emergencies are uncommon but can have dire consequences and can be extremely complex to manage. Tube dislodgement in a patient with a recently placed tracheostomy , where the patient is not breathing, but has a known patent upper airway, may best be managed by early attempts at oral airway manoeuvres and /or oral intubation, to minimise the risk of false passage creation and the development of subcutaneous emphysema.

Of note, multidisciplinary guidelines for the management of tracheostomy and laryngectomy airway emergencies were recently published in the journal Anaesthesia.(1) The algorithms within these guidelines were produced as part of the National Tracheostomy Safety Project in the United Kingdom, and were designed to provide a universal approach for first responders to such emergencies.

The emphasis is on oxygenation as a priority, seeking the best assistance early, quickly assessing whether the patient is breathing or not, and assessing tracheostomy patency. Primary and secondary emergency oxygenation pathways are outlined for patients who are not breathing after removal of a non-patent tracheostomy tube.

The choice of non-depolarising neuromuscular blocking agent appears to have had no influence on outcome in this case. However, in principle, rocuronium, rather than vecuronium (or any other non-depolarising agent), would be a superior choice in situations where management of the patient's airway is difficult, because the muscle paralysis caused by rocuronium can be rapidly reversed with the new agent sugammadex. This was not to suggest that use of a non-depolarising muscle relaxant is routine in the management of a difficult airway.

Reference

1. McGrath, B. A., Bates, L., Atkinson, D., & Moore, J. A. (2012). Multidisciplinary guidelines for the management of tracheostomy and laryngectomy airway emergencies. *Anaesthesia,* 1025-1041.

GENERAL SURGERY – CARDIOLOGY

CASE 6: DELAY IN DIAGNOSIS OF OESOPHAGEAL INJURY FOLLOWING CARDIAC RADIOFREQUENCY ABLATION

Clinical Details

A patient in their mid-thirties who had a family history of AF was referred from an interstate hospital where they underwent a radiofrequency ablation. The patient was transferred back to a regional hospital and then transferred to a tertiary hospital on day10 with increasing pleuritic chest pain. The patient had been investigated with an echocardiogram which showed a significant pericardia/ effusion. The CT scan was performed at the tertiary hospital where atrial-oesophageal fistulas were diagnosed.

The patient was appropriately assessed and the decision was made to repair this and surgery was performed on day 11. In an operation that took 11 hours, the patient underwent a sternotomy, repair of the left atrium and then a thoracotomy with intercostal patch to a ruptured oesophagus. A gastroscopy and jejunostomy were then performed.

The patient was ventilated for four days following the procedure and was noted to have some neurological deficit on recovery. The CT scan suggested that they had some cerebral emboli. On day 12 it was noted that the blood cultures grew a fungus Candida Krusei and appropriate antibiotic treatment was commenced. The patient required a further thoracotomy on day 23 for a leaking oesophageal repair and on day 25 an oesophageal stent was inserted.

On day 32 there was a dramatic deterioration with vomiting of blood and major deteriorating in mental state. CT scan suggested that they had multiple air emboli within the brain and did not recover from this.

Unfortunately this patient was doomed from the time of their radiofrequency ablation. Obviously significant damage was done to the left atrial wall through to the oesophagus. This was not recognised at the time and probably there was no way of recognising it at the time. The damaged tissue subsequently infarcted and perforated leading to the clinical presentation. The problem seems to have been recognised quite quickly even though this must be a very rare complication follow radiofrequency ablation. The recognised pericardial effusion was promptly drained in surgery. The atrial defect was repaired under cardiopulmonary bypass and nothing could have been done differently in this part of the procedure. The ruptured oesophagus was then repaired with an intercostal muscle patch.

This was considered acceptable treatment for this condition but from experience the ruptured oesophagus is better managed with a wash out of the contaminated mediastinum and pleural cavity and insertion of an oesophageal stent. Localised repair such as intercostal patches have a very high failure rate. In particular in this patient there would be infected ischaemic muscle from an injury which happened 10 days prior to the surgery.

Diversion of alimentary feeding via a gastrostomy and jejunostomy was appropriately performed. That there was almost an inevitable leak was recognised and a further thoracotomy was performed on day 23 and an oesophageal stent was inserted on day 25.

On day 31 there was a dramatic deterioration in the patient's conscious state which represents a further embolic stroke and then there was blood as well which suggests that the atrial repair had also broken down at this stage. Death was inevitable from this point on and in reality was inevitable from the time of presentation.

The fundamental problem was the damage to the oesophagus and left atrium sustained at the time of the radiofrequency ablation. This needed to be reviewed very carefully at the hospital where this was performed as to the strength of signal used, the duration of the signal and the experience of the person performing the procedure.

Comments

Regarding the treatment that was subjected to this audit the only real question is whether a different procedure other than the intercostal flap repair for the ruptured oesophagus would have made any difference. Probably a stent should have been inserted earlier but this really would not have made any difference to the eventual outcome. This really is an extremely unfortunate sequence of events and according to the first-line assessor this is the fourth time that this complication had been encountered.

GENERAL SURGERY - COLORECTAL

CASE 7: DELAY IN DIAGNOSIS OF COLONIC TUMOUR AND INAPPROPRIATE DRAINAGE DELAYING RESECTION.

Clinical details

A patient in their mid-70s was admitted following a mechanical fall. The patient developed large bowel obstruction secondary to colonic tumour, perforated and died despite surgery. The patient was admitted through the ED the day after a fall injuring the right wrist on a background of a week of right knee pain, diabetes, chronic renal impairment, AF (on warfarin) and heart failure. The patient was admitted under orthopaedics with medical input and allied health care was involved. Problems arose with tachy-bradycardia over 48 hours and cardiology was consulted. Daily reviews occurred.

On day three of admission, a pre-MET review was obtained due to tachycardia. The patient was documented to be eating breakfast at the time. There was no documentation of any abdominal pain. On day four of admission at 11:45am a MET was called. The patient was tachycardic and tachypnoeic with low oxygen saturation and complained of abdominal pain associated with tenderness on the right with "guarding and peritonism". Fluid resuscitation was commenced and a CT abdominal ordered. The General Surgery team were called and a CT abdominal showed a right sided retroperitoneal collection (report not in notes). A decision was made to place an image guided percutaneous drain which drained a small amount of faecal fluid.

The patient went to ICU post-drainage but deteriorated and a formal laparotomy and right hemicolectomy (ends left inside) was performed just before midnight (11 hours after the MET call). The patient returned to theatre the following day for a second look (all viable) and formation of ileostomy and mucous fistula. Over the following three days, the patient's condition deteriorated despite ICU care and the patient died.

In response to the first-line assessor's comments:

- Warning signs/symptoms do not appear to have been present before the day of deterioration.

- The initial admission and examination appears thorough. There was no 'systems review' but the patient clearly presented with a mechanical fall with bony injury and the admitting team can be forgiven for not asking about bowel habit.

Areas of concern

Deciding to place a percutaneous drain in an unwell patient who was clearly deteriorating with documented signs of peritonism. The patient should have gone straight to laparotomy but the outcome would have been the same. Missing an (apparently large) obstructing colon tumour on CT, would have directed the team away from the idea of a drain and towards laparotomy.

Areas of consideration

There were four consultant surgeons within 12 hour period making decisions on one patient. It is useful and sometimes beneficial to seek help / advice or a second opinion but two of the consultants had not seen the patient and were being guided by an (inaccurate) CT report. The grade of experience of the initial surgeon is unknown.

Record keeping

The initial ED clerking and documentation was thorough with regards to the fall. Medical history, medications and social history all documented. There was, however, no documented systems review but the patient didn't appear to have expressed any abdominal symptoms or bowel problems until the patient deteriorated. Note-making leading up to the patient's deterioration was good. Pre-MET and MET records were also very good. Unfortunately, the general surgical notes surrounding the patient's deterioration, CT results, presumed diagnosis and decision to drain and then perform laparotomy are non-existent. The review was based on the initial case review for this information. ICU notes are dated, timed, typed and very easy to read.

Areas of concern

- Surgical note making as above.

- Decision to place a drain in a deteriorating patient with signs of (localised) peritonitis rather than proceed straight to laparotomy. What was the working diagnosis? This delayed surgery by at least nine hours but would not have altered the outcome.

- Although there was no report in the notes, the obstructing colonic tumour (large) was apparently missed on the CT scan. This would have led the surgical team to laparotomy rather than trying conservative measures.

Areas for consideration

This was not documented in the notes but according to the initial report, four consultant surgeons were involved in the patient's management in a 12 hour period. The initial consultant who assessed the patient apparently was going to operate but discussed the case with two consultant colleagues (who did not see the patient) and was persuaded to drain instead. The fourth consultant performed the late night laparotomy.

It was unknown what discussions were had or the rationale behind the decision-making or even the working diagnosis. Discussing difficult or complex cases with colleagues or asking for a second opinion should not be discouraged but four senior opinions in such a short space of time was likely to cause confusion and indecision. One wondered if the initial consultant was junior and unsure of him/herself.

Comments

Improvements that could be made:

- Surgical note keeping

- Radiology quality control

- Avoid "too many cooks". If a second opinion was sought, review the patient (and imaging) together.

GENERAL SURGERY WITH CORONER INQUEST

CASE 8: DELAY IN DIAGNOSIS OF ANASTOMOTIC LEAK AFTER COLECTOMY

Clinical details

This cachectic 50 kg 80 year old patient appeared to have died as a result of a leak from ileo- colonic anastomosis nine days following extended right hemicolectomy (autopsy results were not available for review). There appears to have been a significant delay in the initial diagnosis as the patient had a positron emission tomography scan identifying the lesion five months previously although this is not the responsibility of the current treating team. The patient had appropriate preoperative anaesthetic assessment, intraoperative care and early postoperative care.

Following admission, the patient went on to have a colonoscopy which identified an obstructing lesions in the transverse colon confirmed to be adenocarcinoma. The patient had anaesthetic and dietician review prior to proceeding to an extended right hemicolectomy and ileocolic anastomosis.

The patient postoperative recovery was characterised by delayed return of gut function and fluid balance issues. The patient was initially commenced on fluids and light ward diet day one postoperative, opened bowels on day three postoperatively but had abdominal distension and nausea and on day four, vomited requiring NGT insertion. With ongoing ileus and vomiting on day five the patient was noted to have a tender abdomen, but passed wind and tolerating clear fluids by day seven. The patient had low urine out put on a number of occasions postoperatively requiring fluid boluses and medical registrar review. The patient was felt to be intravascularly deplete secondary to hypoalbuminemia. The patient did not manifest overt signs of sepsis during this time, remaining afebrile and with a relatively normal full blood examination. The patient was noted to have a tender calf and was found to have DVT despite prophylactic heparin which was treated with full anticoagulation.

On day eight following the operation, the patient became hypotensive with blood pressure dropping at its lowest to 82/50 mmHg associated with a tachycardia of 115 (irregular or new AF) and low urine output – 30 ml from 6.00pm to 10.00pm. During this time the patient was reviewed by the surgical covering Hospital Medical Officer (HMO) but a MET call does not appear to have been made. The HMO performed a fairly comprehensive and well-documented review of the patient and felt that the patient was fluid overloaded and therefore a decision was made to administer a small dose of IV furosemide 20 mg at 9.45pm. The patient demonstrated some response to the furosemide, but was anuric from 4.00am on day nine associated with blood pressure of 80/50. At 5.10am the patient's blood pressure dropped to 60/30 mmHg and a MET call was made. The patient later arrested and was unable to be resuscitated. Although the autopsy was not available for review, it was understandable that the patient had an anastomotic leak causing septic shock leading to death.

Second-line assessors report

This frail patient presented to hospital with conscious collapse secondary to anaemia from a transverse colon carcinoma. Of note was the fact that this tumour was evident on a PET scan obtained five months prior to admission although this result does not appear to have been pursued. On day eight with the episode of haemodynamic instability, the patient would appear to have met criteria for a MET call. If more senior staff had reviewed the patient at this stage a postoperative leak may have been suspected and more aggressive intervention considered such as High Dependency Unit/ Intensive Care Unit (HDU/ICU) admission, antibiotics, possibly CT scan and operative intervention.

Comments

This patient was at a higher risk for developing anastomotic leak than average due to advanced age and very poor nutritional state prior to surgery. The patient's delayed return of gut function might have prompted a CT scan around day five to six postoperatively but the patient did not demonstrate overt signs of sepsis at this stage. In retrospect the patient was clearly becoming septic on day eight postoperatively with hypotension, tachycardia and end organ hypoperfusion however it was not entirely surprising that the covering HMO, who was reviewing the patient for the first time, was unable to identify this. Review by a more senior member to the surgical team at this stage may have led to more aggressive intervention with a change in outcome. However, given the patient's underlying frailty, it was quite possible that the patient might not have survived a laparotomy and exteriorisation of the bowel which was what probably would have been required to control sepsis.

GENERAL SURGERY AND GYNAECOLOGY

CASE 9: UNRECOGNIZED ENTERIC INJURY AFTER VAGINAL PROLAPSE REPAIR

Clinical details
Gynaecological Review - Summary:

This case was of a 70 year old woman who underwent elective gynaecological repair for vaginal vault prolapse and enterocele. Her past significant surgical history included a previous total abdominal hysterectomy and sigmoid colon resection for diverticulosis. The surgical procedure involved an anterior vaginal wall repair with right sacrospinous colpopexy, posterior vaginal wall repair with right sacrospinous colpopexy and insertion of a suprapubic catheter.

On the third day postoperative, she had abdominal distension, intermittent hypotension, pallor and deteriorating renal function. CxR at that time revealed free gas under the diaphragm and subsequent CT scan seven days postsurgery revealed free peritoneal fluid, distended fluid filled loops of small bowel and pockets of free gas. Following general surgical review, a laparotomy seven days following the original gynaecological surgery occurred and the findings were consistent with established peritonitis. Despite appropriate surgical intervention and postoperative intensive care unit facilities, the patient continued to deteriorate and despite a second laparotomy, which revealed ischaemic bowel and peritonitis, the patient died soon after.

Adverse event

This patient, with her previous surgical history of both a total abdominal hysterectomy and sigmoid resection for diverticulitis, places her at risk of having loops of particularly the small bowel, adherent in the Pouch of Douglas via postsurgical scar tissue. In general, the operation of an anterior vaginal wall repair, posterior vaginal wall repair and a right sacrospinous colpopexy would not usually breach the peritoneal cavity. If the posterior vaginal wall repair included repair of an enterocele, with opening of the herniated peritoneal sac and ligation of the sac high up at its neck, then I agree that a peritoneal breach does occur. There is no evidence from the operative notes that opening of the herniated peritoneal sac of an enterocele took place. The consent form specifically documents vaginal repair only and there is no consent for either a sacrospinous colpopexy or repair of an enterocele.

Area of concern - the enteric leak

The enteric leak was not recognised until day seven postoperatively when a general surgical team assessed the patient. Abdominal distention was clinically recognisable on day three of her postoperative care. The CxR ordered at that time revealed free gas under the diaphragm and that a vaginal repair procedure does breach the peritoneal cavity. The finding of free gas under the diaphragm is consistent with a perforated intra-peritoneal viscus. It was possible that the perforation of the small bowel occurred with either the vaginal repair operation or the suprapubic catheter. A suprapubic catheter insertion is outdated. Current protocol of insertion of a urethral catheter would have been adequate and might be associated with minor complications such as a catheter-associated urinary tract infection. In this case, one would suspect the trocar of the suprapubic catheter to have perforated the bowel.

There may have been inappropriate reliance upon the reassurance by the gynaecological surgeon that the peritoneal cavity could have been breached by the vaginal surgery. If careful attention was paid to the medical team's notes on questioning the possibility of a perforated viscus, the outcome for this patient may have been very different.

With respect to specifically answering the General Surgery questions

Postoperative course deviated significantly from expected on day three postoperatively. There was significant delay by the Gynaecological team alone (not the Medical or Surgical team). It was of significant concern that the Medical Team considered the possibility of a perforated viscus and not the Gynaecological Team. Neither a postoperative ileus nor an intraperitoneal perforated viscus would be considered a usual outcome of vaginal repair surgery.

Even if the herniated peritoneal sac of an enterocele was entered at the vaginal repair surgery, the loops of small bowel are visible and can be pushed superiorly from the purse-string suture by a sponge on a holder until the suture is pulled tight, hence avoiding bowel damage.

There were no reviews by the surgical team that contributed to delays. With respect to a CT scan, the appropriate course of action following the CxR and AxR revealing free gas under the diaphragm would be for immediate referral to a Surgical Team and asking them whether they would want an urgent CT scan be performed to clarify the site of the injury.

General Surgery Review - Summary

The case was that of a 70 year old woman who underwent elective gynaecological repair for "vaginal vault prolapse/enterocoele". There was a past history of CABG and subsequent stenting, controlled hypertension, previous hysterectomy and sigmoid resection for diverticulosis. Pre-anaesthetic assessment was satisfactory. The notes indicate a routine operation involving anterior vaginal repair with right sacrospinous colpopexy, posterior vaginal repair with right sacrospinous colpopexy, and suprapubic catheterisation. Postoperative progress was apparently uneventful for the first two days apart from a failed trial of voiding and vomiting on day two. On day three there was deterioration and concern.

The patient had abdominal distension, intermittent hypotension, pallor and deteriorating renal function. On day four a medical referral was made because of poor renal function. Pallor, vomiting, intermittent hypotension and abdominal distension continued.

CxR showed free gas under the diaphragm. The gynaecologist advised that they had breached the peritoneal cavity during the procedure and the free gas was not an unexpected finding. Conservative care continued concentrating on management of renal failure. Patient remained unwell but not dramatically so. Abdominal distension and poor renal function continued. On day six a CT scan, done seeking clarification of 'hydronephrosis' indicated on a renal U/S, showed a small amount of free fluid, distended fluid filled loops of small bowel and pockets of free gas.

On day seven there was more obvious deterioration, she was febrile overnight (for the first time) with a sharp rise in C reactive protein (CRP) and white cell count (WCC) and very low albumin. A General surgical referral was made and she was seen by the surgical registrar at 10.00am and moved to HDU. She was seen by the surgeon at 1.00pm and immediate laparotomy advised. Surgery commenced about 2.30pm, finding established peritonitis, gross contamination by enteric contents and two perforations in the small bowel. These were oversewn, lavage performed and multiple drains placed. Postoperatively the patient was transferred, still intubated and requiring inotropic support, to a tertiary hospital with ICU facilities. No history has been provided from that hospital, but the reporting surgeon indicates a second laparotomy was done the following day finding continuing leakage and ischaemic bowel. The patient died later that day.

Case Notes

The hospital case notes provided are adequate and document events at the primary hospital with reasonable clarity. The operation notes for the vaginal repair procedure do not record the peritoneal breach. No case notes have been provided from the tertiary hospital.

Adverse event

It appears certain that the small bowel was perforated at the time of vaginal repair. Any surgeon should be aware that in a patient with a history of previous hysterectomy and sigmoid resection for diverticulitis of the small bowel is likely to be in close proximity to, and likely adherent to, the vaginal vault area and possibly more likely to be damaged.

Area of concern

The enteric leak was not recognised and general surgical referral was not made until day seven postoperatively. Had this been recognised and laparotomy done sooner, the patient may well have survived. There do not appear to have been any signs of the problem in the first two days. On day three however there was clear deterioration with abdominal distension, pallor, intermittent hypotension and deteriorating renal function. Not all the classical signs of peritonitis were present. There was no fever until the evening of day six. The patient reported little or no pain. Strong analgesics were not given. The abdomen is described as "very" distended, but soft and bowel sounds are repeatedly recorded as present. The patient was clearly not right from day three onwards but was not dramatically unwell until day seven. It is well recognised however that peritonitis, especially an initially sterile peritonitis, can be insidious and there were sufficient signs on day three that specific investigations to confirm or exclude the possibility should have been done.

A medical referral was made on day four because of the poor renal function. CxR showed free gas. The medical team specifically queried "? perforated viscus" in their notes after review of that x-ray but were reassured by the gynaecologist that the free gas was not unexpected. The medical management thereafter concentrated on the renal function and fluid balance. In retrospect the fluid management with fluid restriction and diuretics was not correct, but in the context of the misdiagnosis with which the physicians were presented it was not unreasonable. I do not believe the fluid management significantly affected the outcome and have not recorded that as an area of concern. A CT scan was not done until day six, and then it was done to clarify suspected hydronephrosis rather than seeking other abdominal pathology. The findings are not diagnostic but are suggestive of a perforated viscus. The alarm was finally raised on day seven when there was obvious deterioration, fever overnight, and the CRP and WCC were markedly raised. CRP and protein levels had not been monitored since day two; even simple monitoring of the inflammatory markers might have led to earlier recognition of the true problem.

Comments

The first-line assessor queried whether there were any surgical reviews that contributed to delay in diagnosis of the peritonitis. The notes clearly indicate the first referral to the general surgical team was at 10.00am on day seven. Thereafter that team responded in an appropriate and timely manner. Laparotomy, oversewing, lavage and drainage was done that afternoon. There was no contribution by them to the delay. Also queried is "when was a CT done or considered?" A CT was done on day six – at the suggestion of the radiologist after a renal U/S suggested hydronephrosis. Results described above were communicated verbally to the Research Medical Officer at 5.00pm who then contacted the medical registrar. No further action was taken.

There was no evidence of failed or delayed communication from nursing to medical staff or from junior to senior medical staff. General hospital procedures, protocols and records appear to have been adequate. The area of concern, failure to recognise, suspect or investigate for a visceral leak, lies with the gynaecological team.

NEUROSURGERY

CASE 10: DELAY IN DIAGNOSIS AND TRANSFER FOR TREATMENT

Clinical details

A 42 year old woman who was 26/40 pregnant was admitted mid-afternoon to hospital A, a large metro emergency department with headache and drowsiness. No CT brain was performed until early evening which showed a cerebral haemorrhage and obstructive hydrocephalus. Hospital A ED referred to her to neurosurgery at their usual neurosurgery centres. The neurological team reviewed the scans and recommended intubation and emergency surgery. However, they informed Hospital A that there were no ICU beds and should refer the patient elsewhere. At 08:30pm Hospital A ED referred to a large tertiary centre neurosurgery. Just before midnight, the patient arrived at hospital B, a large tertiary centre ICU. She was sedated and ventilated. Pupils were re-active. Neurosurgery was informed and immediate theatre transfer required.

Just after midnight the patient arrived in theatre. Her pupils had acutely dilated (unexplained delay from ICU to theatre despite requesting an urgent transfer) given Mannitol prior to craniotomy. Postoperatively her pupils became sluggishly reactive. Over coming days she showed no signs of neurological recovery and was diagnosed with brain death. She was electively supported in ICU to allow her foetus to mature.

Two weeks postoperatively necrotic brain material oozed through the wound which was revised. Two days later worsening instability necessitated caesarean delivery of the baby and organ procurement.

Comments

It was difficult to assess the patient's problem at hospital A as Hospital B did not have remote access to their images, however transferring the patient directly to Hospital B theatre, rather than hospital B ICU could have reduced some of the delay. This patient's care was compromised by delay in a time critical situation.

- Hospital A ED failed to scan her for more than three hours after presentation.

- Other tertiary hospitals neurosurgery teams had seen the scans and recognised the urgency but contributed to the transfer delay by declining admission due to bed pressure, this lead to significant delays in referring to the tertiary hospital - hospital B.

- Transfer to hospital B took five hours after diagnosis established.

At the first hospital this pregnant female presented with drowsiness with GCS 13 and headache. This patient was a higher triage than the nominated rating of category three which meant she is be seen within 30 minutes. Category four is to be seen within 10 minutes. This would have been a more appropriate triage category. Presumably this decision was made by a triage nurse.

There was a delay in getting a CT scan which should have been done urgently. It was noted that the Radiographer refused to do the scan initially and that the Radiologist insisted on consent to be obtained from a family member.

Eventually the CT scan was performed and showed a cerebellar haemorrhage not cerebral as is recorded in the case summary from the records of the reporting doctor in the page four of the surgical case form. The patient was first seen mid-afternoon and then no CT scan was performed until 6.15pm. This was an unacceptable delay. As she was pregnant the abdomen could be shielded because she needed the scan urgently with her presenting problem.

The mother's health comes before that of the foetus. Here there was too much obstruction and delay by the Radiographer and the Radiologist as well as all of the other delays in getting the scan which may have resulted from the staff in the ED. There seemed to be a rather inadequate neurological assessment from the notes. All it stated was that the patient was moving all four limbs spontaneously. This was not an adequate neurological assessment. The neurosurgical contact from Hospital A advised intubation which they did prior to transfer. This was a reasonable decision. The patient did not arrive at the second hospital until just before midnight so a further unacceptable delay has occurred in the system.

There was a further delay in the patient actually getting to theatre from the ICU. It was uncertain what this delay was due to. By the time the patient arrived in the theatre the patient's pupils had dilated and the patient had been given Mannitol which is appropriate.

Surgery was then performed but the patient did not recover. It was all of the delays which led to the poor outcome and eventual death. The problem here was that no one seemed to be the patient's advocate either at Hospital A or Hospital B or in the transfer system in moving the patient quickly from one hospital to another. Unfortunately, the system just moved at a slow pace without anyone being able to or succeeding in to speed it up.

One of the problems here was ringing multiple hospitals and finding that there are no neurosurgical beds. Where there is a neurosurgical emergency, the patient's either can be transferred to a neurosurgical centre and have the surgery whether there was an ICU bed or not. Ideally the patient should have gone through the adult retrieval system where a hospital could be allocated quickly if deemed an emergency. This did not appear to have been done in this case. Ringing around multiple hospitals slows the process. It is better to make these transfers through the adult retrieval system. Once the urgency of the problem is better understood, they would rapidly allocate a hospital and make sure that the transfer occurs promptly. This did not appear to occur in this case.

It was stated in Hospital B notes that the patient was 26 weeks pregnant not 13 weeks as recorded at Hospital A. She was hypertensive on examination at 11.50pm with a blood pressure of 70/30. This was a dangerously low blood pressure not only for the pregnancy but also for her brain function. It was not clear why she was so hypotensive. A cerebellar bleed of 4 x 2 x 2.5 cm with secondary hydrocephalus and a patient who has a depressed conscious state who had been intubated is a surgical emergency. Unfortunately, this patient deteriorated prior to surgery with the pupils becoming fixed and dilated bilaterally.

There was no sign-off identifying the Neurosurgery registrar as having seen the patient preoperatively. It stated that she needed emergency OT and that the OT was booked. The reason for the delay in reaching the operating room is not clear. It was stated that the theatre did not commence until just after midnight i.e. a one and a half hour delay between the patient arriving at Hospital B and reaching the OT. This is an excessive delay for a patient with acute cerebellar haemorrhage with hydrocephalus.

The first-line assessor posed the question as to whether an external ventricular drain (EVD) could have been placed at the bedside as a temporising measure. This could have been done but the delay in reaching theatre should have rendered this unnecessary. Also placing a drain may have delayed the surgery further. The problem with an EVD is that if copious cerebrospinal fluid (CSF) is drained to lower the intracranial pressure, this can result in upward coning and worsening of the situation. Also, when a patient develops fixed and dilated pupils secondary to a cerebellar haemorrhage, it may be due to the clot itself pressing on the brain stem in which case draining CSF from above does not really alter the degree of compression on the brain stem.

The appropriate treatment is to take the patient urgently to the operating room and evacuate the clot and place an EVD to decompress the hydrocephalus. It would be recommendable to place the EVD first to start draining some CSF to lower pressure as this is quicker to place than getting to the cerebellar haemorrhage and then to drain fluid off progressively as one decompressed the cerebellum and the clot to equalise the pressure on both sides of the tent. However, this was a personal choice and there was clearly more than one way to handle this situation surgically. This was not meant as a criticism of what surgery was done it was just the technique one could use. It probably would not have made much difference in this particular case as the patient had already coned by the time she was receiving the surgery.

The answer to the question about whether the neurosurgeon was present to assess the patient on arrival is that the Neurosurgery registrar appears to have seen the patient just before midnight after the Obstetrics and Gynaecology registrar and the ICU admission. There may have been some delay in booking the operating room as a result. It is not clear whether the registrar stayed with the patient to try and expedite their transfer to the OT from the notes but it would have expedited the transfer if they had stayed with the patient.

ORTHOPAEDIC SURGERY

CASE 11: NO THROMBOPROPHYLAXIS FOLLOWING KNEE REPLACEMENT AND FATAL PULMONARY EMBOLUS

Clinical details

A patient in their early eighties had an elective total knee replacement (TKR) complicated by a significant PE day three postoperatively. This resulted in a transfer to ICU in a state of cardiogenic shock which did not respond to active treatment and the patient died day four postoperatively. The major concern in this case was the lack of thromboprophylaxis prior to the pulmonary embolus.

Case detail

The documents provided were adequate to identify the issues involved in the case. A cemented TKR was performed with no intraoperative issues noted. A combination of local anaesthetic infiltration and a femoral nerve catheter were used for analgesia. The postoperative orders noted standard DVT prophylaxis and an order for enoxaparin 40 mg was written up but not given for the first two postoperative days. The reason given was that there was increased "wound ooze" in recovery requiring reinforcement of the dressings.

Adverse event

The patient had normal postoperative course until day two when it was noted the patient was febrile and had slightly lower oxygen saturation (88%) on room air. A MET call was called on day three when the patient became hypoxic and hypotensive. The patient was transferred to ICU where inotropes and vasopressors were given. A CT pulmonary angiogram showed bilateral segmental pulmonary emboli with occlusion of the right upper lobe, middle lobe and lingula. Enoxaparin was only given after the PE was diagnosed. Thrombolysis was also performed but the patient failed to improve significantly and continued in a state of cardiogenic shock as well as anuric renal failure. After discussion with the family, a decision was made to withdraw treatment.

Areas of concern

While chemical thromboprophylaxis was still somewhat of a controversial topic in Orthopaedic literature, the current National Health and Medical Research Centre guidelines for TKR is to recommend thromboprophylaxis for all patients undergoing total knee arthroplasty and this was clearly the protocol at this hospital. Enoxaparin was charted but not given on the basis that there was excessive "wound ooze" in recovery. This was only documented in the nursing notes and no mention was made in the medical notes, nor was there an identifier regarding who made the decision to withhold the enoxaparin.

The cause of the bleeding was operative and not related to enoxaparin (which had not been given at this point). It is debatable whether withholding this would have made much difference in reducing the bleeding from the wound. In any event, once the decision had been made, an alternative method for thromboprophylaxis such as a foot pump or intermittent pneumatic calf compression should have been started as an alternative. Enoxaparin should then have been restarted at the first opportunity.

Comments

While it has yet to be proven that chemical thromboprophylaxis can eliminate the risk of PE, the current standard of care is to use chemical or mechanical (or a combination of) thromboprophylaxis in joint replacements. Cessation of thromboprophylaxis is a decision that should be discussed at a consultant level. The hospital clearly had a protocol where a daily checklist regarding the use of chemical thromboprophylaxis was part of the nursing plan. The recommendation would be to include mechanical prophylaxis as an option to be activated in the event of cessation of chemical thromboprophylaxis.

PAEDIATRIC SURGERY

CASE 12: DELAY IN RECOGNITION OF GASTRIC PERFORATION AFTER LAPAROSCOPIC FUNDOPLICATION

Clinical details

A five year old child with global developmental delay, autonomic dysfunction, congenital hypothyroidism, past history of severe infantile spasm, chronic lung disease and diabetes insipidus underwent laparoscopic fundoplication with formation of feeding gastrostomy. The indication for fundoplication was not clear. From the case notes it appeared that the child had only one ICU admission in early 2013 and two hospital admissions in the previous year for aspiration pneumonia. The reason for the patient's aspiration episodes could have multitude of causes such as pharyngeal incoordination, pooling of saliva, abnormal oesophageal peristalsis leading to poor oesophageal clearance. In addition this child was on home oxygen for chronic lung disease with poor lung reserves.

On day one postoperative the CxR showed a complete white out on the left side requiring bilevel positive airway pressure. On day two postoperative the patient became febrile (38.2) with scrotal wall oedema and discolouration. The patient was started on Timentin and Gentamycin for collapse/ consolidation of the right and left lower lobes.

On day three postoperatively the child was tolerating 30 ml/hour gastrostomy feeds. In the early hours day four postoperative the child became unsettled, febrile and had a very distended abdomen leading to increasing oxygen requirement. At this stage the patient's feeds were ceased.

During the course of day four postoperative, the patient became increasingly unwell requiring intubation and ventilation with ionotrophic support to maintain blood pressure. Unfortunately the event was complicated by difficult intubation and cardiac arrest for 16 minutes requiring CPR and a left sided pneumothorax. The clinical picture was consistent with septic shock. The patient's abdomen was very distended with scanty bowel sounds and scrotal wall oedema/discolouration. The constellation of signs point towards an intra-abdominal source for the septic shock. The patient was thought to be too unwell to undergo any radiological investigations to rule out intraabdominal sepsis.

On day six /day seven postoperative the patient was haemodynamically stable, but still on weaning doses of inotropes. In addition the child was noted to have leakage of large volumes of yellowish-green fluid around the gastrostomy site. Despite a request from the surgical team for CT abdomen/pelvis, the patient had an abdominal U/S on day 12 postoperative, which showed infra- hepatic fluid collections. It was decided by the surgical team to manage this conservatively. On day 14 a postoperative U/S guided aspiration of the intra-abdominal collections (500 ml) revealed purulent fluid. On day 15 methylene blue instilled via the gastrostomy tube leaked out via the abdominal drain indicating a perforation in the stomach.

On day 17 postoperative the patient was taken for a laparotomy which revealed a perforation in the fundus of the stomach and complex pus collections in the abdomen. The patient continued to deteriorate, and a second laparotomy six days later showed a missed perforation on the posterior wall of the oesophagus.

By this stage the patient's septic cascade has escalated to an irreversible stage with disseminated intravascular coagulation and abdominal compartment syndrome. Emergency laparostomy in the intensive care unit was done to relieve the abdominal pressure. Withdrawal of care after extensive discussion with parents and all treating teams concerned was taken.

Comments

In the assessor's opinion a lesser invasive procedure such as gastrojejunal feeding tube via a percutaneous endoscopic gastrostomy would have been a better alternative given the patient's significant comorbidity. There was a significant delay in establishing the surgical complication clinically and radiologically. From day four postoperative onwards the patient's abdomen was the source of concern from the case notes. It was not clear why the physical signs were missed or the appreciation from the junior surgical team regarding the ongoing concern of the abdomen. Delay in getting any form of abdominal imaging to rule of intraabdominal sepsis was not clear and a bedside U/S scan of the abdomen could have given some clue. Only on the twelfth postoperative day was an abdominal U/S done. In any child deteriorating following an abdominal operation the first and foremost priority from the surgical team is to rule out any surgical complication.

This child with significant comorbidity was a difficult and challenging case in the event of deterioration. The initial bilateral basal lung consolidation had diverted the attention from the abdomen.

The lesson learned was to have a very low threshold to rule out a surgical complication in a child who unexpectedly deteriorates in the immediate postoperative period. Appropriate and timely investigations can lead to a better outcome.

VASCULAR

CASE 13: DELAY IN DIAGNOSIS AND TREATMENT OF A RETROPERITONEAL BLEED FOLLOWING ANGIOGRAPHY.

Clinical detail

A patient in their early eighties presented to the clinic with ischemic ulcers on the right medial malleolus which were failing to heal and complicated by cellulitis. The patient died during the admission from a retroperitoneal haemorrhage. Normally on warfarin because of a previous embolus, the patient's past history was of ischemic heart disease, Type II diabetes, hypertension and hypercholesterolemia. The patient was a non-smoker.

The patient's warfarin was ceased and was changed to Clexane 1mg/Kg BD in preparation for interventional radiological procedures to improve the circulation in the right leg to allow healing. This was accomplished by insertion of a superficial femoral artery stent. The ulcer was debrided three days later. Warfarin was recommenced six days after the angiogram as there was intermittent wound bleeding but the haemoglobin level was noted to have fallen by 2 g/dL over 24 hours. Four hours after this drop had been noted a MET call was made because of hypotension, right lower back pain and collapse. The MET recommended urgent CT and transfusion if ongoing bleeding was clinically suspected and recommended FFP and admission to HDU if the CT demonstrated bleeding. Only after another four hours did the surgical team book a CT abdomen and after another hour and a half the first unit of blood was commenced with a note that the patient was still waiting to have the CT scan (at 2100). The patient had an asystolic arrest 40 minutes later.

Comments

The patient had a number of risk factors for peripheral vascular disease being diabetic, hypertensive and with hypercholesterolemia with already known peripheral vascular disease and ischemic heart disease. An experienced clinician would assume that the patient would also have renovascular perfusion impairment. The patient's estimated glomerular filtration rate was in the low 60 to 80 range. Whilst some would accept this as being "normal" the laboratory of this hospital accepts that is low (their normal being greater than 90 ml/min) hence by that hospital's standards the patient had renal impairment. Despite this the patient was given a dose of Clexane 1mg per kg twice daily. That was just within acceptable levels for full anticoagulation of a fit and well patient with normal renal function but the patient appears to be elderly with known peripheral vascular disease with a high probability of significant renal disease and the only indication appeared to be for DVT/PE prevention. I normally would give half the dose given. The patient was given too much Clexane.

It was then noted when warfarin was recommenced several days later the patient's haemoglobin fell from 9.1 to 7.6 in a 24 hours period. This was during a time when the patient was going through a transition phase from Clexane to warfarin and was being doubly anticoagulated but yet the penny did not drop that this should be investigated promptly and aggressively. Four hours later on that day a MET call was put out after the patient was hypotensive and unresponsive on the ward and there is no evidence at that time that anyone thought that the patient might have intraabdominal or retroperitoneal haemorrhage and no urgency seems to have been placed on getting a CT of the abdomen looking for a source of blood loss. Four hours after the MET call on the evening ward round, noting the haemoglobin had fallen even further to 7.2 a CT abdomen was booked but again without any apparent urgency and it took a further hour and a half before the first unit of blood was commenced.

The second issue was that this patient had a significant fall in haemoglobin and was not noted, a period of hypotension in the afternoon did not ring alarm bells and the CT looking for the source of bleeding as well as blood replacement was not pursued with the necessary vigour. The patient's death was preventable. It was a combination of over anticoagulation in a patient with borderline renal impairment who at the time of reverting from Clexane to warfarin had a retroperitoneal bleed with ample warning signs which were not addressed. The hospital needs to look at whether a Registrar or a Senior Clinician was aware of the Clexane dose, whether a member of the surgical team was available to assess the patient when the MET call was made.

VASCULAR

CASE 14: EMBOLIC COMPLICATIONS OF FENESTRATED STENT GRAFT FOR ABDOMINAL AORTIC ANEURYSM

Clinical Detail

This was a case of a patient who had a complex endovascular repair of a symptomatic abdominal aortic aneurysm (AAA) with a reported short angled neck. Technically difficult repair with snorkel grafts to the renal arteries resulting in a number of complications with death occurring two days post initial procedure with multi-organ failure. Snorkel-covered grafts were placed to both renal arteries because of the short neck but access was lost prior to reinforcement of these. Completion angiogram was noted to be satisfactory however. This operation took four hours but because of an ischaemic right leg an iliofemoral thromboendarterectomy and patch was undertaken three hours later. The next day, because of the trash, a left femoral and tibial embolectomy was performed. This patient also had extensive trash to visceral organs and no renal arteries were visible on postoperative U/S. The patient went into liver failure and died two days after the initial operation.

Comments

The hospital case notes provided are adequate though a full description/report of the initial CT angiogram was lacking in detail. Death two days following the initial intervention appears due to atheroembolic trash involving multiple abdominal organs. There was a very short neck so complications would be expected to occur. The patient was initially assessed, ASA 4 (hypertension, Type II Diabetes, palpitations, asthma) was considered over a period of days following admission before the type of repair was decided and subsequent further corrective procedures performed.

Documentation of the patients suitability for repair of the symptomatic AAA and choice of a complex endovascular aneurysm repair EVAR rather than open repair was adequate; both techniques carrying significant risk of death or major complications. EVAR has largely replaced open repair for Infra-renal AAA in anatomically suitable patients. An early survival advantage is seen over open AAA repair but no late survival advantage has been noted.

Recent data suggest that fenestrated endovascular aneurysm repair (F-EVAR), and Snorkel endovascular aneurysm repair (Snorkel-EVAR) in complex patients have an associated peri-operative mortality of 2.5 to 5 per cent in suitably experienced units. There is a clear need for adherence to strict selection criteria, meticulous procedural planning and technical performance.

A number of technical failures (rupture, limb ischaemia, renal failure, mesenteric ischaemia) occurred in this patient and some were corrected at subsequent procedures but the atheroembolic trash to multiple organs at the first procedure was unable to be corrected and lead directly to the death of the patient.

In the era of transition to EVAR, F-EVAR, branched-fenestrated endovascular aneurysm repair, Snorkels, Periscopes and Hybrid procedures, gaining experience and expertise in these techniques will be difficult except for a small group of vascular surgeons and endovascular interventionists with multidisciplinary cooperation and higher volume centres.

LIST OF SHORTENED FORMS

AAA	Abdominal Aortic Aneurysm
AF	Atrial Fibrillation
APLS	Antiphospholipid Antibodies
ARDS	Acute Respiratory Distress Syndrome
ASA	American Society Of Anesthesiologists
AVR	Aortic Valve Replacement
AxR	Abdominal X-Ray
BD or b.d.	Twice Daily
BP	Blood Pressure
CABG	Coronary Artery Bypass Graft
CAD	Coronary Artery Disease
CAG	Coronary Artery Grafting
CCU	Critical Care Unit / Coronary Care Unit
CPR	Cardiopulmonary Resuscitation
CRP	C Reactive Protein
CSF	Cerebrospinal Fluid
CT	Computed Tomography
CxR	Chest X-Ray
DVT	Deep Venous Thrombosis
ECMO	Extracorporeal Membrane Oxygenation
ED	Emergency Department
EVAR	Endovascular Aneurysm Repair
EVD	External Ventricular Drain
FiO2	Fractional Inspired Oxygen
F-EVAR	Fenestrated Endovascular Aneurysm Repair
FFP	Fresh frozen plasma
FLA	First-Line Assessor
FXa	Factor Xa Inhibitor
GCS	Glasgow Coma Score
GTN	Glyceryl Trinitrate
HDU	High Dependency Unit
HMO	Hospital Medical Officer
ICU	Intensive Care Unit
INR	International Normalised Ratio
IV	Intravenous
LAD	Left Anterior Descending (Artery)
LV	Left Ventricle
MET	Medical Emergency Team
NGT	Nasogastric Tube
OT	Operating Theatre
PE	Pulmonary Embolus
RANZCOG	Royal Australian and New Zealand College of Obstetricians and Gynaecologists
TKR	Total Knee replacement
US, U/S	Ultrasound
VA ECMO	Veno-arterial Extracorporeal Membrane Oxygenation
VASM	Victorian Audit of Surgical Mortality
WCC	White Cell Count

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