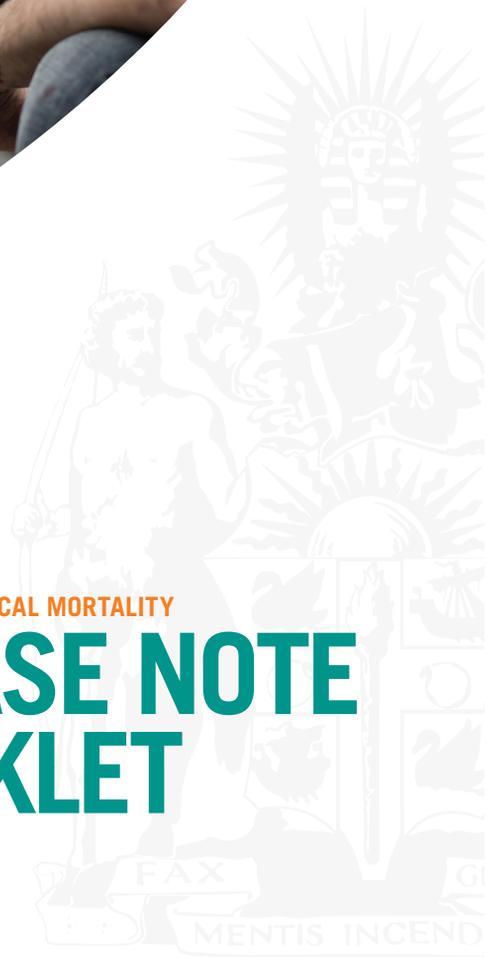




AUSTRALIAN AND NEW ZEALAND AUDIT OF SURGICAL MORTALITY

NATIONAL CASE NOTE REVIEW BOOKLET

VOLUME 11 / MAY 2017



The Royal Australian
and New Zealand
College of Obstetricians
and Gynaecologists
Excellence in Women's Health





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

Telephone: +61 8 8219 0900

Facsimile: +61 8 8219 0999

Email: gordon.guy@surgeons.org

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

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

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

Contents

Chairman’s Report.....	4
ANZASM Clinical Editor’s Report.....	5
Recommendations	6
Case Studies	7
Case Study 1: Assessments of patients with multi-trauma	7
Case Study 2: High speed: high mortality.....	9
Case Study 3: Multi-trauma delays in decision making.....	11
Case Study 4: Delayed recognition of jejunal perforation.....	13
Case Study 5: Pulmonary embolic death following trauma.....	15
Case Study 6: Trauma with delayed diagnosis of ileocaecal perforation.....	17
Case Study 7: Intracerebral embolus after fractured fibula due to paradoxical embolus without thromboprophylaxis.....	20
Case Study 8: DVT prophylaxis may not have been adequate.....	22
Case Study 9: Delay in treating an elderly multi-trauma patient.....	24
Case Study 10: A case of massive trauma.....	27
Case Study 11: Multi-trauma leading to late multiorgan failure.....	30
Case Study 12: Trauma following an unwitnessed fall	32
Case Study 13: Who cares for trauma?	34
Case Study 14: Necessity for astute clinical leadership from the responsible consultant.....	36
Case Study 15: Local level trauma procedures burden on clinical outcome.....	39
Case Study 16: A survivable head injury lost in a medical ward.....	41
Shortened Forms.....	43

Chairman's Report

In this, the eleventh Case Note Review Booklet from the Australian and New Zealand Audit of Surgical Mortality, cases relating to trauma have been highlighted. While trauma for most surgeons is not necessarily the major activity that fills their day, it may also represent one of the more lethal and dangerous types of patients that need to be managed. Often situations are under-estimated for their severity, and complications can be surprising.

The cases highlighted in the booklet again indicate the importance of communication, not only between patients and family but also between colleagues. Often trauma cases have multiple teams managing them and it is important that the groups understand who takes the lead, who is being consulted and with whom the consultation should be directed. Examples of poor communication are unfortunately present in a number of these cases presented. It is vital that clinicians provide high quality records of the cases they are managing. This is not a reflection on length but about relevance and ensuring that the instructions are understood and followed.

As all surgeons would know, trauma cases can rapidly deteriorate from a number of reasons, including haemorrhage and severe sepsis. This requires decisive decisions being made and close follow-up to ensure they are acted on. We are fortunate in Australia and New Zealand in having a relatively lower incidence of trauma than some of our colleagues overseas, however this leads to relatively less experience for many of us in the management of trauma and re-emphasises the need to understand the potential traps and dangers of such patients.

Many of the cases in this booklet could have been traumas that we may have been asked as individuals to manage. The lessons learnt and the obvious catastrophic outcomes for the patients are a salutary reminder that such cases warrant not only our close attention but probably a team with which we can consult and share the management.

Any feedback on the cases or the management would be welcomed.



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

ANZASM Clinical Editor's Report

The eleventh booklet includes cases from all states and territories and forms part of the feedback process that is seen as essential in the quality improvement processes of the audits of surgical mortality. A national booklet is produced to provide a wider readership for cases from various states. It also assists smaller states and territories that do not have enough cases to produce their own booklet and may have difficulty in adequately de-identifying cases. The larger states will continue to publish their own case note review booklets as well as contribute to the national booklet.

The cases in this booklet are focussed on patients who have suffered trauma of various types. Trauma is a part of almost all surgical work – in some specialties a major part, in some specialties a minor part.

Some of the cases described are ones in which senior surgical staff did not take appropriate leadership roles in the management of cases. Sometimes they were not able to do so as they had been inadequately informed about events.

Some of the cases demonstrate a lack of early diagnosis due to assistance not being sought from other specialities or a lack of communication between junior and senior staff. Some cases show poor documentation of events and clinical opinions. As one reviewer puts it “if it’s not written down it didn’t happen”.

Some of the cases have been edited to focus on a few points in a complex story or to reduce the length of the report. There is variability in the writing style as the text is, in general, written by assessors and treating surgeons and not by the editor.

There may be cases where readers may not entirely agree with the assessment and comments, but if we have stimulated you to think about the case we have succeeded in our aim. Correspondence and questions about specific cases are welcome, and while the ANZASM cannot provide identifying information, we may be able to explain the case in more detail than we have in this booklet.

As the ANZASM office is in the same building as the South Australian Audit of Surgical Mortality (SAASM) office, it seemed logical that the final clinical editing process would be done by the Clinical Director of SAASM on behalf of ANZASM. I must emphasise that I did not write this booklet. The real authors are the treating surgeons, the clinical directors, and the first- and second-line assessors of the various states and territories. To the assessors and the treating surgeons we all owe a debt of gratitude, as this publication would not be possible without them. Please learn from these cases.

Glenn McCulloch
Clinical Director, SAASM
Clinical Editor, National Case Note Review Booklet, ANZASM

Recommendations

- In complex cases there needs to be clear, demonstrable leadership in patient management. There should be regular team meetings involving all disciplines to ensure that the treatment plan is understood by all.
- Communication remains one of the most critical factors in the delivery of safe, high-quality patient care. Clear communication by the surgeon with patients and family is always a wise investment. Good communication between surgeon colleagues, other specialists, junior staff, nursing staff and allied health staff remains a cornerstone for quality care, especially when a transfer of care or inter-hospital transfer is required for the critically ill patient. In trauma cases this is an essential element of proper care.
- All clinicians should provide clear and relevant records. Some of the cases in this report had record keeping deficiencies.
- Trauma cases require rapid and decisive action – delay may mean death. Pelvic ring and multiple limb fractures can lead to massive blood loss.
- Severe trauma requires special skills and knowledge. Trauma surgeons should be used where available, or if not physically present should be consulted by phone. Proper deep vein thrombosis (DVT) prophylaxis is critical in the care of acute surgical patients. Proper care includes the correct dosage, the correct drug and timely commencement of treatment.
- Consultants should be actively involved in the care of their patients, including in the decision-making process. They have an obligation to make personal entries in the case record of the reasoning behind their decisions. They should also be willing to obtain other opinions if something is not right.

Case Studies

Case study 1: Assessments of patients with multi-trauma

CASE SUMMARY:

A middle-aged person was brought to the emergency department (ED) from the local hospital in which they had been received following a high-speed motorcycle accident. The patient was Glasgow Coma Scale (GCS) 5 and was hypotensive and bleeding from an open wound in the right lower thigh. Despite being treated with early management of severe trauma (EMST) principles and volumes of fluid and blood product, the poor response to resuscitation necessitated a transfer to theatre in an attempt to stop bleeding from any obvious intraperitoneal cause.

At laparotomy, a laceration of the liver was discovered and packed. There was no other obvious bleeding. However, there was a complex pelvic fracture that was set, and a fracture of the distal right femur.

The anaesthetic record in the operating theatre showed a progressive drop in blood pressure (BP) until cardiac arrest occurred. Large amounts of blood and blood products had been continually transfused but the patient's BP did not rise above the mid-80s.

There was at least one asystolic cardiac arrest during the resuscitation, and defibrillation resulted in ventricular fibrillation with poor cardiac output. Eventually death occurred due to blood loss.

The coroner ordered an external postmortem examination which included a computed tomography (CT) scan. This showed multiple fractures of the face and sinuses, fractures of the mandible and subarachnoid blood. Multiple fractures, scapular fractures, and fractures of the clavicles were also noted. The patient had a small pneumothorax on one side. Abdominal examination showed nothing more than what was found at surgery.

CLINICAL LESSONS:

This patient suffered a severe, high velocity motorcycle accident. Recovery was virtually impossible. In the haemodynamically unstable patient, multiple fractures such as these are life-threatening, and hypovolaemia can be the cause of death.

All multi-trauma patients must be assessed using EMST principles on admission. Multiple fractures need to be splinted early and pelvic fractures may be usefully treated by a pelvic binder of some description. Failure to control hypovolaemia may be assisted by the use of external fixation on pelvic and long bone fractures.

In this case, all attempts at resuscitation seemed to fail and unfortunately there will be times when continued blood loss is greater than the resuscitation given. There were no criticisms of the treatment. This case demonstrates that, even with the best of care, severe trauma – even that which in theory is recoverable – may have a fatal outcome.

Case study 2: High speed: high mortality

CASE SUMMARY:

This young patient was found unconscious with multiple injuries following an unwitnessed single-vehicle accident. The ambulance delivered the patient to the ED of a small hospital in the evening. The patient was in shock and injuries included: left arm glenohumeral disarticulation/partial amputation, grossly contaminated compound fractures of the left tibia and fibula and deep wounds to the right shoulder, right thigh and abdominal wall.

Resuscitation was continued with intravenous (IV) fluids and blood replacement. Bilateral chest drains were inserted. The response to the resuscitation was poor. A focussed abdominal sonography in trauma (FAST) assessment of the abdomen (for blood) was performed. It was found to be negative. Transfer from the ED to the operating theatre occurred within an hour of admission.

Surgery included left subclavian artery and vein ligation, an above-knee amputation, abdominal wound debridement, laparoscopy and subsequent laparotomy for splenectomy. A specialist general surgeon was involved. It was noted that an orthopaedic surgeon was not involved in either of the amputations.

A massive transfusion took place. The total transfused volumes of blood and products included 24 units of packed cells, fresh frozen plasma (FFP) and cryoprecipitate.

On transfer to the intensive care unit (ICU) the patient's BP was very low despite inotropes. Cardiac arrest occurred. Cardiopulmonary resuscitation (CPR) was commenced but this was stopped shortly thereafter and the patient was declared dead.

CLINICAL LESSONS:

Protocols are helpful when massive transfusion is required, both to record infused volume and proportionally replace factors, cells and volume. Poster-type documentation on the wall of the resuscitation area and operating room are practical in assisting with the sequence of transfusion products.

Laparoscopy in a multi-trauma patient who has failed to respond to resuscitation is not indicated. Suspicion of intra-abdominal pathology should lead to laparotomy. A strategy for surgery in a patient with such overwhelming injuries is always difficult. Several specialists may be necessary to provide the level of care the patient requires: "This patient arrived in shock with a coagulopathy – an international normalised ratio (INR) of 1.7, a APPT of 69 and a haemoglobin of 77 g/litre".

Communication between the surgical and anaesthetic teams is absolutely essential when treating a multi-trauma patient. Despite excellent work in this case, this patient was in dire circumstances on arrival at the hospital.

It is critical to cut-to-the-chase in these settings. A 'damage control approach' should be the initial management option. A glenohumeral dislocation or a scapular-distraction injury suggests, at best, avulsion of axillary artery and, at worst, avulsion of subclavian artery from the innominate artery on the right or the aortic arch on the left.

These injuries are rarely compatible with survival and certainly account for refractory responses to massive transfusion. In this setting it is clearly a waste of time, effort and resources to continue massive transfusion without defining the pathology, if necessary by a thoracotomy, sternotomy, or a combination of both.

Case study 3: Multi-trauma delays in decision making

CASE SUMMARY:

A middle-aged cyclist was admitted to a regional hospital after being hit by a car. Within 10 minutes of the accident the ambulance service was at the scene. The patient's GCS was 15. A pelvic binder was placed, but the BP was 90/55 mmHg with a heart rate of 100 beats per minute. The patient arrived at the hospital shortly thereafter and an initial assessment confirmed the significant pelvic ring injury with a FAST scan proving to be negative.

Some bleeding from an open proximal tibia fracture had been noted, and a tourniquet was placed on the thigh to control the bleeding from that site. The right hip was noted to be dislocated. Shortly after assessment, 2 units of blood were given via rapid infusion as well as FFP and platelets. The BP remained low.

The general surgery team was called nearly an hour after arrival in ED, just as the patient arrested. The patient was intubated and further resuscitation attempted when it was decided to take the patient to theatre. The patient left the ED for theatre 15 minutes after the decision was made, and laparotomy to investigate the source of blood loss commenced 20 minutes after arrival in the theatre. The surgery was carried out by the consultant.

Laparotomy showed that the liver and spleen were intact, and a small intestinal tear was repaired. There was no small bowel perforation. It was decided that most of the bleeding was coming from the pelvis. Operation notes confirm that the "pelvis and retroperitoneal" area was packed (though it was not clear which procedures, if any, were undertaken). The patient became coagulopathic and a case conference began with anaesthetics, general surgeons and orthopaedic surgeons. A decision was made that no acute orthopaedic intervention was necessary. Only the abdomen was addressed for damage control.

Referring the patient to a tertiary referral hospital was discussed but seemed impossible due to the poor status of the patient. The only further intervention was the placement of a Steinmann pin in the left distal femur to control the hip dislocation. Resuscitation and anaesthetic records confirmed 11 bags of blood were given in ED with 1 bag of platelets and 5 bags of FFP. In the operating theatre, another 38 units of packed cells, 29 bags of FFP and 4 units of platelets were counted.

Despite all efforts there was no response and active resuscitation was stopped. All drugs were ceased shortly after and the patient soon passed away. It seems from the notes and the anaesthetic protocol that the patient remained in theatre

the whole time and could not be adequately controlled or stabilised at any time.

CLINICAL LESSONS:

This multi-trauma patient suffered a significant pelvic injury involving one acetabulum with hip dislocation. Such significant injuries carry a high probability of death. Nevertheless, the following issues must be considered:

- This patient was already haemodynamically unstable at the accident scene. While information transfer to ED is essential, there was no evidence to suggest that this information was forwarded to the ED.
 - There was nothing in the medical records to indicate that pre-notification (trauma alert, trauma response or trauma attend) was passed on to the surgical teams to facilitate immediate surgical intervention.
 - While the patient arrived in daylight it took almost an hour to summon the surgical team. During this period the patient had received several units of blood and FFP.
 - The loss of 1 hour in the decision-making process made a critical difference to the outcome. It then took almost an hour to start the surgical procedure. The consultant was present for the laparotomy but does not seem to have been present for the decision-making.
- This was a case that would have challenged a tertiary referral hospital, even with a radiological intervention suite available immediately, to control the bleeding of this injury. In summary, immediate involvement of surgical teams in the decision-making process by activating a trauma alert is recommended.

Case study 4: Delayed recognition of jejunal perforation

CASE SUMMARY:

An elderly patient was involved in a low speed head-on motor vehicle accident. There were severe comorbidities including an implantable defibrillator, ischaemic heart disease requiring stenting and the use of clopidogrel.

On presentation to the ED the patient had a patent airway, but obvious rib and sternal fractures with a flail chest. The BP and pulse were stable and the GCS score was 15. Left upper quadrant tenderness was noted and the initial chest x-ray (CXR) showed severe lung contusion. In the setting of SaO₂ 85% and PaO₂ of 61.9, the patient was electively intubated and an indwelling catheter placed on the left side.

A FAST scan revealed free intra-abdominal fluid, which was apparently confirmed on CT (formal report not in the notes). The CT showed a splenic laceration and may have shown active extravasation. An electrocardiogram (ECG) raised the possibility of a myocardial event. The patient was reviewed by the consultant and admitted to the ICU for conservative management.

Within the ICU the patient became hypotensive and developed arrhythmias requiring inotropes and amiodarone. Cardiac enzymes suggested a myocardial event. Twenty-four hours after the accident the patient's abdomen remained soft but the patient continued to be hypotensive. An ECG showed an under-volumed but poorly functioning heart. Subsequent volume expansion was unsuccessful and the patient became oliguric. Thirty hours into the admission the patient was taken to theatre where a laparotomy was performed. Laparotomy findings were of a perforated jejunum with a small amount of bile-stained fluid and a contained splenic laceration. The perforation was oversewn and a splenectomy was performed by the consultant.

The patient returned to the ICU with further increasing inotropes. The patient was markedly acidotic and still anuric. A decision was made not to escalate treatment and the patient died 41 hours post-admission.

CLINICAL LESSONS:

The assessor did not conclude that a major adverse event had occurred in the management of this patient. It would appear from the notes that the patient suffered a myocardial event and primary pump failure rather than a septic death from delayed recognition of the perforation.

Small bowel perforation following blunt trauma is well-recognised but fortunately not common (less than 1%). The patient generally presents with peritonism or free air on imaging. It is, however, difficult to diagnose and published studies exist showing the inability of both CT and ultrasound to diagnose an immediate perforation post trauma. One factor in this is that a mesenteric haematoma may lead to subsequent ischaemic perforation causing a delayed rupture. This patient initially had no peritonism. Unfortunately the formal CT report was not within the notes, and the several authors of various notes have interpreted it differently.

The final decision for laparotomy would appear to have been in expectation of finding ongoing bleeding and not a cause for sepsis. It is doubtful that with this patient's comorbidities and injuries that any different outcome would have been observed, even if the patient had been taken to the theatre immediately. This case does raise two issues in regards to the missed injuries:

1. The accuracy of serial clinical exams in an intubated patient.
2. Understanding the limits of your investigations.

The answer to the first issue has been studied and the accuracy has been found to be low; therefore there must be a low threshold to re-image multi-trauma patients who are deteriorating.

The second issue looks at the fact that ultrasound and CT can both diagnose the presence of fluid, but cannot determine its content. It is possible that a diagnostic peritoneal lavage may have revealed the fluid content and led to an earlier diagnosis.

Case study 5: Pulmonary embolic death following trauma

CASE SUMMARY:

A middle-aged patient with no known significant comorbidities was admitted after a motorcycle accident with fractured left ribs 4–9 and a fractured left scapula. A CT of the head, neck, chest and abdomen was performed.

There was timely treatment in the ED and the surgical high dependency unit. No form of thromboembolic prophylaxis was given, and the patient's course was uncomplicated until the second day post-admission. Following physiotherapy, the patient suffered a cardiac arrest and underwent successful CPR. The patient was then transferred to ICU with subsequent support with adrenaline and noradrenaline.

A transthoracic ECG demonstrated thrombus in the inferior vena cava and right atrium. Tenecteplase was administered and further CPR was required. After a second dose of tenecteplase, a haemothorax was diagnosed by CXR. There was a 3-minute period of asystole. The patient was reviewed by a cardiothoracic consultant; a pigtail catheter was inserted and approximately 2 litres of fluids were drained. A total of 4 units of blood were administered. Further asystole culminated in death.

CLINICAL LESSONS:

Thromboembolic prophylaxis was not used, probably due to concerns relating to bleeding from the fractures. However, such patients are vulnerable to DVT (although it is most unusual to have this occur so soon after the injury), so some form of prophylaxis is advisable. Pneumatic compression stockings are an alternative, but do not affect the pelvic veins.

If the hospital had a cardiothoracic service, pulmonary embolectomy could have been considered on the basis that:

- the original pulmonary embolus (PE) caused cardiac arrest
- the patient demonstrated persisting hypoxia
- the patient demonstrated thrombus in the right atrium and inferior vena cava.

Admittedly, such surgery has a very high risk in this setting, but thrombolysis is even more unlikely to be successful in this situation. Regardless, such a course of action required a call to the cardiothoracic team at the time of diagnosis, rather than 3 hours later.

Essentially, this patient was unlucky to have had such an early DVT and PE. The likelihood of survival after a PE massive enough to cause arrest and persisting hypoxia is low because

of associated acute right ventricular failure. The situation was desperate. In hindsight, surgery may have been successful. Thrombolytics were unlikely to resolve this clinical situation. Within those parameters, management of the patient was acceptable.

Case study 6: Trauma with delayed diagnosis of ileocaecal perforation

CASE SUMMARY:

The patient was admitted to ED in the late afternoon an hour after crashing a motorcycle into a pole at approximately 80 km/h. A bystander provided assistance and brought the rider into the ED. Initial examination showed a GCS of 15, BP of 130 and a heart rate of 80. Respiratory function appears to have been satisfactory but there was evidence of guarding and tenderness in the right side of the abdomen. There were also injuries to the right hand.

The CT scans showed a subcapsular haematoma in segment five of the liver, a subcapsular haematoma of the spleen, a starburst fracture of the right kidney, and haematoma and stranding around the mesentery, distal ileum and ileocaecal valve. There was no evidence of any free gas.

The patient was admitted to the high dependency unit and treated conservatively (analgesia, fasting and IV fluids). Twelve hours after presentation there was increasing abdominal pain, tachycardia, bruising in the right flank and abdominal distension. Haemoglobin was noted to have fallen by 2 gm. The heart rate had increased to >120 and the respiratory rate had also increased.

A worsening haematoma in the flank was described and the question was raised of bowel perforation.

A repeat CT scan was performed. There was a dated, hand-written report in the notes but no formal report of this scan. Review of the notes made that day suggests the scan was performed because of the risk of bowel perforation and because a raised lipase suggested the possibility of pancreatic injury. The written report in the notes states that there was a hepatic laceration with intracapsular haematoma, normal pancreas and kidneys. No comment was made about the bowel.

By that evening, some 20 hours after presentation, the patient was still tachycardic but had become hypotensive. During that night their temperature was elevated (>39°C) and oxygen requirements were increasing. IV fluids were increased and a stat dose of metronidazole was given. Over the next 24 hours amoxicillin and metronidazole were given, but renal function deteriorated with decreasing urine output noted. An elevated creatine kinase >10,000 suggested the possibility of significant rhabdomyolysis. The patient continued to deteriorate with increased bruising and erythema over the right abdomen and extending down into the right thigh.

A further CT scan performed 3 days after admission showed an enlarging flank haematoma with gas within it. The CT report comments that there was a significant risk of bowel injury associated with these findings. The surgical registrar at this stage recorded a comment to continue with the current conservative management. This appears to have been discussed with the consultant and a CT-assisted aspiration of the flank requested. A small amount of offensive, anaerobic material was obtained and sent for microscopy and culture. The patient continued to deteriorate and later that afternoon required intubation. Timentin was commenced. Surgical review occurred because of the continued deterioration but, again, no intervention was thought appropriate.

Despite increasing inotropes there was further deterioration, requiring noradrenaline and adrenaline. Later that night a profound bradycardia required intensive resuscitation. The patient became profoundly acidotic (pH <7). It was at this stage that a pigtail catheter was inserted into the right flank to drain the right flank haematoma. The patient died approximately 20 minutes later.

CLINICAL LESSONS:

The initial management of this patient, with admission to high dependency for analgesia, observation and IV fluids, was quite reasonable and the injuries at

the time of admission, although serious, would appear to be survivable. The first CT scan raised the possibility of an ileocaecal injury and this risk was noted several times in the notes. Despite the patient's steady deterioration with increasing signs of sepsis and haematoma formation, and erythema in the right flank, the conservative management plan was maintained.

In light of the patient's steady deterioration, the risk of a significant small bowel injury and the increasing sepsis, laparotomy would seem to have been indicated. The last CT scan, showing a large flank haematoma with gas, suggested that there was a bowel injury. This finding should have prompted a laparotomy.

It was unclear from the notes as to why the treating surgical unit persisted with a conservative management plan in a patient with documented abdominal trauma and increasing sepsis. Even after the CT scan demonstrated gas in the retroperitoneal haematoma, a laparotomy may have salvaged this patient.

I wonder whether the failure to see intraperitoneal gas on the initial CT scans gave a false sense of security that there was no bowel perforation or injury. There may have been ischaemia of the terminal ileum and caecum secondary to mesenteric injury leading later to perforation, or a retroperitoneal perforation.

Insertion of the pigtail catheter by the ICU staff occurred during the resuscitation period and would appear to have been a futile attempt to drain the septic collection in the hope of buying more time.

This case reveals several issues:

- The clinical presentation, mechanism of injury with high energy blunt impact, and CT findings with retroperitoneal gas, suggest a retroperitoneal rupture of the duodenum, distal small bowel or caecum. The explanation that the gas represented an infected haematoma indicates a lack of knowledge and understanding of trauma surgery. Conservative treatment was not appropriate. A general surgeon would usually have performed a laparotomy on the basis of the third CT and clinical findings, or at least consulted a trauma surgeon at a major trauma centre.
- The patient should have been transferred to a major trauma centre on either the first or second day.
- The ICU registrar/consultant should not have inserted a pigtail catheter 'blind' without surgical or radiological advice. This procedure is outside the Scope of Practice of an ICU specialist.

REFERENCES:

- American College of Surgeons. Student Course Manual, 7th Ed, 2004. Abdominal Trauma. Chapter 5, In Advanced Trauma Life Support for Doctors (ATLS), p.133 Mechanism of injury and p.139 Special problems – duodenum.
- Daly KP et al. Traumatic Retroperitoneal Injuries: Review of Multidetector CT findings. *RadioGraphics* 2008;28:1571–90.
- Duruisseau O et al, Posttraumatic retroperitoneal rupture of the right colon simulating a retroperitoneal hematoma, *J Trauma* 199;42:741–2.

Case study 7: Intracerebral embolus after fractured fibula due to paradoxical embolus without thromboprophylaxis

CASE SUMMARY:

A 35-year-old patient with no significant comorbidities tripped and broke their fibula while overseas. The patient was placed in a back slab and flown back to Australia. An operation with open reduction, internal fixation and bone graft was performed in a private hospital 16 days after the event. There was intraoperative instability due to a possible PE (BP down to 40-50 mm Hg). The patient was taken to the post-anaesthesia care unit and was fine on waking; however, after 15 minutes became hemiplegic. The diagnosis was a right cerebral infarct from a paradoxical embolus, though the patient was not known to have a patent foramen ovale prior to this.

The patient was transferred to a public institution for attempted middle cerebral artery clot retrieval. The procedure was complicated by an iatrogenic external iliac artery injury (the femoral artery “shredded” from ProGlide closure device) that required emergency vascular repair with a vein patch. It was noted that there had been a high puncture with passage of the sheath through the inguinal

ligament. The postoperative course was characterised by poor neurological function and eventual brain death. Organ donation was performed.

CLINICAL LESSONS:

Limited notes were supplied for the initial open reduction and internal fixation. Intraoperative anaesthetic notes show that no heparin was given although a tourniquet was used. No notes were available regarding the preoperative use of heparin or similar. The surgeon’s operation note does not specify any postoperative orders for DVT prophylaxis. There were no inpatient or postoperative notes from the surgeon. Therefore, no comment can be made about the first-line assessor’s question about whether DVT was considered after a long haul flight and use of a back slab.

The outcome was very unfortunate. The glaring omission was the lack of confirmation of DVT prophylaxis administration. The lack of use of preoperative heparin was uncertain; or, as it was not charted on the drug chart it is unlikely that it was given.

The usefulness of ultrasound for vascular punctures should be highlighted, particularly in the prevention of inadvertent malpuncture. It was not recorded whether or not this was used. The passage of a sheath through

the inguinal ligament is usually detectable and should be recognised due to the increased resistance.

There was no record of whether DVT prophylaxis was given while the patient awaited surgery. This case highlights the importance of DVT prophylaxis in patients having delayed surgery after trauma, even in young patients with mild to moderate injuries.

Case study 8: DVT prophylaxis may not have been adequate

CASE SUMMARY:

A very elderly patient who was living alone and medically well, presented with a closed fracture of the left patella and right zygoma, and a forehead laceration, following a 4 metre fall. After initial assessment at a regional hospital the patient was transferred to a metropolitan teaching hospital on the same day. The patient was assessed at the teaching hospital shortly after dawn on the following day and underwent expedited surgery 6 hours later. A modified tension band technique was used for internal fixation of the patella fracture.

The postoperative recovery was uncomplicated and the patient transferred to another metropolitan hospital for rehabilitation 2 days later. Heparin 5000 units b.d. was commenced in the evening of the day the patient was transferred for rehabilitation. The patient was to be immobilised in a hinged knee brace for 6 weeks, with the range of motion progressively increased. The patient was allowed to full weight bear despite the immobilisation of the knee, and it is reasonable to assume that the patient was not confined to bed while in the rehabilitation ward.

The patient made an uncomplicated recovery over the next 2.5 weeks. However, on the day of discharge the patient underwent a sudden deterioration and resuscitation was unsuccessful. The coroner's postmortem revealed the cause of death as bilateral PE.

CLINICAL LESSONS:

There are two issues to consider, the first relating to the timing of heparin administration and the second to the anticoagulant administered. This patient had multiple risk factors for thromboembolism, including significant trauma and the immobilisation of the knee in a brace with locked extension. The patient was also elderly. The incidence of venous thromboembolism rises with each decade for patients over the age of 40.

The patient missed 1 to 1.5 days of chemoprophylaxis. In a trauma situation it would be reasonable to withhold heparin prior to surgery, and for a period of time after the procedure, to allow haemostasis to be achieved. However, heparin was not started until the patient reached the rehabilitation ward. There is no evidence of chemoprophylaxis being considered or an alternative measure used, with the exception of thromboembolism deterrent stockings. Of great concern is that even in hindsight the consultant believed that the use of the stockings alone was adequate prophylaxis.

The second issue was the use of unfractionated heparin rather than low molecular weight heparin (LMWH). While the evidence for using chemoprophylaxis is based on decreasing DVT rates, not PE rates, there is substantial evidence that LMWH is more effective in preventing DVT in hip replacement and hip fracture patients. However, there is a lack of reliable data in relation to the use of LMWH for lower limb trauma or immobilisation. There is also no evidence that LMWH decreases the rate of either PE or fatal PE.

Not all thromboembolic disease is preventable and it is unlikely that starting prophylaxis 1 day earlier would have affected the outcome. One key area for reflection is whether the delay in starting chemoprophylaxis was a deliberate decision or an omission. Either way, steps should be taken to prevent similar errors occurring in the future. In a similar situation, in which the patient remained under the care of the treating surgeon, this outcome could be difficult to defend.

Case study 9: Delay in treating an elderly multi-trauma patient

CASE SUMMARY:

A 70-year-old pedestrian was struck by a motorcycle travelling at moderate speed. The patient sustained multiple injuries to the head, thorax, abdomen and pelvis. As the patient was attending a sports event, the medical support services attended promptly. An ambulance was dispatched and the patient transferred to a nearby private facility for resuscitation and a CT scan. Following this, the patient was transferred to a major tertiary institution and a trauma call made.

On presentation to hospital the patient was significantly tachycardic, tachypnoeic and quickly became hypotensive. The patient underwent initial resuscitation. The report from the external hospital CT scan demonstrated extensive facial fractures, left frontotemporal cerebral contusion, a left haemopneumothorax, flail left chest, a left lung contusion, a potential aortic thoracic dissection and significant left-sided subcutaneous emphysema. A left-sided inserted central catheter (ICC) was placed and resuscitation continued with fluid support. The patient remained shocked throughout.

It was not evident from the notes supplied as to what time the ICC was inserted in the left haemothorax. The first entry, 3 hours after presentation, indicated 1 litre of drainage. One hour later this had increased to 2 litres. The note by the house officer (HO) at this time commented that the patient was on noradrenaline and required a continuous blood transfusion. It is further noted that the HO discussed this with the on-call general surgery consultant. The surgeon was uncomfortable performing a thoracotomy and indicated that the on-call thoracic surgeon should be consulted. The HO advised the resuscitation team that they should advise if any further surgical input was required.

By this time the patient had received over 12 litres of resuscitation fluid. Although it is not clear from the notes, it would appear that someone attempted to contact the thoracic surgeon only to find that no one was on call or available. It would then appear that another member of the general surgical staff was approached. It is not clear who made this approach, but the services of a private cardiothoracic surgeon were obtained. The patient was transferred to ICU for further resuscitation. The patient was volume-responsive on a noradrenaline infusion and continued fluid resuscitation. At the time of surgery, 6 hours following

presentation, the patient had lost 4600 mL into the left chest drain. A left-sided thoracotomy was performed. Multiple intercostal artery injuries were discovered associated with a flail segment. The descending aorta was normal diameter. The patient was now cold and acidotic. Blood was evacuated and packs placed into the left haemothorax.

The patient was otherwise stable during the procedure. During the evening in ICU, inotrope requirements continued to rise although blood loss appeared to be stable. A ceiling was placed on the inotrope use and decisions were made with the family to palliate the patient. Total blood use included 30 units of packed red blood cells, 4 units of platelets, 20 units of FFP, 20 units of cryoprecipitate and Factor 7.

The patient's death was reported to the coroner who ordered a coronial autopsy, and the injuries as described above were confirmed. The patient was found to have had a degree of cardiomyopathy, most likely due to hypertension and coronary artery disease. The cause of death was accepted as cardiogenic shock as a consequence of massive blood loss and multiple transfusions.

CLINICAL LESSONS:

The concerns raised in the first-line and surgeon's own assessments relate to the timing of thoracotomy. This elderly patient with multiple severe injuries and persistent shock had a 6 to 7 hour delay to theatre. The patient was well resuscitated and managed on arrival to this tertiary hospital ED, and the management once a surgeon attended and became involved was timely and appropriate.

The primary issue of concern relates to the documented unwillingness of the on-call general surgeon to become involved in this case. It would also appear that although this patient had very significant injuries, neither a consultant nor senior grade registrar or Fellow attended the hospital to assess the patient until help was sought elsewhere. Due to the junior grade of the surgical doctor who assessed this man, it was not clear whether the gravity of the situation was relayed to the on-call surgeon or whether it was fully appreciated. That another general surgeon, who was not on-call, had to become involved to facilitate surgical management raises concerns about trauma rostering at this institution. The triggers for thoracotomy were clear many hours prior to this patient reaching theatre. This may have been rapidly appreciated by a consultant surgeon assessing the patient, resulting in the patient being taken to surgery much earlier.

While age and the presence of significant traumatic injuries may have ultimately led to death with or without intervention, the delay of several hours may have compromised the final outcome.

Case Study 10: A case of massive trauma

CASE SUMMARY:

This young man was involved in a serious motorcycle crash following a visit to a local bar. His body was found 40 metres from the point of impact, the left arm totally amputated. Despite this he survived to arrive in hospital where a heroic attempt was made to save his life.

After arrival in hospital the patient spent approximately 1 hour in ED where he was very unstable. He required several units of blood, was intubated, had a chest drain and had two tourniquets applied. The obvious injuries were to the left arm (amputation) and left leg (partial amputation). He also had an injury to his abdominal wall. The patient's operation was slightly delayed, before being taken to theatre.

In theatre, simultaneous control of bleeding from the left arm and left leg was undertaken (summary amputation). When he failed to stabilise, laparoscopy revealed blood and a splenectomy was undertaken. The surgeons appeared to have made good and clear decisions. He was then transferred to ICU where he soon died. Contributing factors included hypothermia, acidosis, massive transfusion and coagulopathy.

CLINICAL LESSONS:

The need for very urgent damage control surgery to preserve life in these settings is obvious and well known. Any delays at the scene and in ED contribute to the accumulation of "physiological debt", which may not be recoverable. There are a number of areas of concern. In spite of these, the severity of the trauma, combined with the time spent undiscovered on the roadside, may have contributed to a shock state that was irreversible, despite the resuscitation and surgical interventions that were undertaken.

This patient had such major injuries that attendance at a level one trauma centre would have involved simultaneous multiple team management. In a regional centre such resources are simply not available. The concerns identified are:

1. This patient had a very large volume resuscitation and massive transfusion. Concern was expressed by the surgical team about the availability of platelets. However, the blood tests from ICU show general coagulopathy with an activated partial thromboplastin time of greater than 200 and an INR of 2.5. This indicates there were deficient coagulation factors. Haemoglobin and platelet counts corresponding to this blood

test were not available. Where massive transfusion occurs, protocols are helpful both to record infused volumes and to proportionally replace factors, cells and volume. Poster-type documentation on the wall of the resuscitation area and operating room may be practical and helpful to assist with the sequence of blood and products transfused. In this circumstance of massive blood loss, regular blood tests are also essential. This would be difficult to arrange at a smaller centre. Hourly progress bloods can sometimes guide the resuscitation and also put ongoing losses into context.

2. Laparoscopy in a multi-trauma patient who has failed to respond to resuscitation and amputation of two limbs is not indicated. Suspicion that the abdomen has bleeding organs should entail a laparotomy rather than further compromise venous return by insufflating gas into the abdominal cavity. A laparotomy, rather than laparoscopy, is indicated as a last ditch effort to save a shocked patient's life.
3. The strategy of surgery in a patient with such overwhelming injuries is difficult. A single surgeon will find it overwhelming because their attention will be

on the individual problems rather than the patient as a whole. Several specialists are necessary in this circumstance to provide the level of care the patient requires. This patient arrived in shock with a coagulopathy INR 1.7, APPT 69 and haemoglobin 77. He may not have bled into the abdominal cavity, so the FAST scan may have clouded the perception of the treating team as to whether abdominal injury was present or not. As the surgeon and others have commented, a damage control approach should be the initial management option. If the bleeding is more proximal in the shoulder or subclavian vessels, then clearly this will take precedence in terms of treatment. Subclavian artery and veins were ligated in the management of the arm or shoulder injury.

4. Communication has been pointed out as a problem between the surgical and anaesthetic teams. In the multi-injured patient, it is absolutely essential for the surgeon to be in touch with what the BP is doing and the patient's response to resuscitation. Despite everyone's excellent work, this patient was in dire circumstances on arrival at the hospital and his life could not be preserved. The admission bloods indicate an acidosis was firmly established

with coagulopathy at 1930. Blood gases at 2114 demonstrated a pH of 6.92 corrected and a base excess of -19.4, suggesting the outcome of any further intervention would not result in the survival of this patient.

It is important to take lessons from cases - the development of a massive transfusion protocol at a smaller centre is an essential part of good patient care. Coordinating all of those factors together is essential. Time passes very rapidly when faced with overwhelming circumstances such as this. The differences between the recorded times on the EDs forms and that perceived by the surgeons demonstrates this point.

Imaging is important in our day to day activities and the CT scan can provide a lot of information with regards to trauma. However, scans can be deceptive early after the trauma when little bleeding has occurred, and this is even more of a problem when ultrasound is used in less than ideal circumstances. Significance is very much operator dependent, and in the difficult circumstances of resuscitation of a severely injured patient, without CT scanning, a laparotomy would be an important adjunct to their overall management.

Case Study 11: Multi-trauma leading to late multiorgan failure

CASE SUMMARY:

This 60-year-old active patient was involved in a motor vehicle accident (approximately 100kph) while on a motorised scooter. A GCS of 15 was recorded at the scene. Injuries included minor pulmonary contusions and fractures to the pelvis (sacrum and pubic rami), left metatarsals, left humerus and right fibula, with abrasions to scalp and face.

There was initial difficulty with pain control and sedation was required after exclusion of cerebral abnormality. On day 4 there was an open reduction and internal fixation of the humerus. The patient had reduced GCS preoperatively. Postoperative initial management was required in ICU. A percutaneous inserted central catheter (PICC) line was inserted (right arm). Difficulty was noted with positioning and flushing of PICC line. Six days postoperatively, the patient experienced an episode of chest pain; myocardial infarction was excluded and PE was felt to be unlikely (patient on chemical DVT prophylaxis).

Twelve days postoperatively the patient developed chest pain. Ultrasound confirmed right arm DVT and multiple PEs, and clexane was given. Abnormal liver function tests

were also noted. The patient was given nonsteroidal anti-inflammatory drugs (NSAIDs) for pain relief, and 15 days postoperatively the INR was 2.2 (presumed auto-anticoagulation). The patient suffered a cardiac arrest and was resuscitated. The cause of the arrest was a bleeding duodenal ulcer, which was treated. The patient was admitted to ICU with multiorgan failure and sepsis (kidney, liver and central nervous system). Three days after ICU admission pus was drained from the humeral operation site. A surgical wound washout was completed in theatre; however, the patient went on to have further gastrointestinal (GI) bleeds requiring embolisation and oversewing of the ulcer. Multiorgan failure worsened and the patient eventually succumbed at 34 days following the multi-trauma.

CLINICAL LESSONS:

This was a very complicated and difficult case. The fact that the PICC line patency was unpredictable may have been the precipitator for, or an indicator of, the upper limb DVT. Changing this line early may have reduced the later propagation of clot.

The DVT and PEs became apparent later (after investigation following the second episode of chest pain) at which point treatment dose anticoagulation was started in the presence of abnormal liver function tests. A clotting check was not

documented until 48 hours later, just prior to the GI bleed and subsequent arrest. A clotting check at the time of consideration of anticoagulation and cessation of NSAIDs may have reduced the risk of GI bleed.

The surgical site wound had been oozing following surgery. The development of other complications were a distraction, and led to the initial belief that the sepsis was due to the PICC line. Incorrect ICU notes indicating that the patient had had all fractures managed conservatively were repeatedly 'copied and pasted' over 5 days. The pus that drained from the left arm alerted ICU medical staff to the prior surgery and source of sepsis. Early wound ooze is associated with later infection and can indicate a need for early treatment. The use of the 'copy and paste' in electronic records can lead to the reproduction of errors.

Initial difficulties with a family member delayed a full discussion about the patient's very poor prognosis and the option of limiting treatment. This may have prolonged the ICU stay. Early involvement of the patient liaison service may have helped with the distressed family member and led to earlier end-of-life decision-making.

This difficult case highlights how an early recovery can later become complicated. The main issues that arose were:

1. The apparent lack of awareness at an early stage that there was a DVT risk with the use of a PICC line.
2. The use of full anticoagulation in a patient on NSAIDs in whom there appeared to be auto-anticoagulation. This probably increased the risk of GI bleeding.

Case Study 12: Trauma following an unwitnessed fall

CASE SUMMARY:

An elderly patient was admitted to hospital with a fractured right subtrochanteric neck of femur. The patient had previously been admitted to another hospital for assessment of increasing confusion, agitation and aggression.

The patient sustained an unwitnessed fall the day prior to the admission and underwent surgery the following day, where a right cephalomedullary femoral nail was inserted with additional cable fixation. The patient suffered a relatively rapid decline post-surgery and passed away approximately 30 hours after the procedure. In the period from surgery to death, the patient was seen several times by junior medical staff with concerns regarding the patient's condition, in particular, the urine output, low haemoglobin and respiratory function.

CLINICAL LESSONS:

This case reveals several issues:

- It is unclear from the available information as to whether the consultant orthopaedic surgeon was present at the time of surgery. The procedure took 2.5 hours anaesthetic time, although the surgical time listed in the

notes was approximately an hour. Given the difficulty of fixation of subtrochanteric femoral fractures, it is recommended that these surgeries are performed under the direct supervision of a consultant orthopaedic surgeon or a senior registrar with experience in fixation of these fractures. It is unclear from the case notes whether this occurred.

- It appears that the supervision of the junior medical staff was minimal. In the period from the surgery to the patient's eventual death, the patient was reviewed by the surgical intern five times. The medical registrar was spoken to on each of these occasions but did not attend the patient. The patient had two further medical emergency team (MET) calls during this period of time; it is unclear who attended the patient at these times. There were ongoing issues regarding the patient's fluid balance in particular, and this does not appear to have been addressed by a senior doctor (or at least this was not documented clearly in the patient record). It is my opinion, from the notes available, that the junior medical staff were lacking in clinical support in managing a difficult and complex postoperative patient.

- There was a lack of documentation regarding the patient's not for resuscitation status. There appears to be no formal documentation in the case notes, apart from one entry in the admission note stating "not for resuscitation (NFR), For MET call". It would be best practice for these potential end-of-life decisions to be well documented on an independent form to allow timely, reasonable and rational decisions to be made at times of patient difficulty.

Case Study 13: Who cares for trauma?

CASE SUMMARY:

An elderly patient was involved in a low speed motor vehicle accident. Following treatment by paramedics, the patient was transferred to the ED of hospital A at 1730 the same day. A provisional diagnosis of facial fractures was made and appropriate investigations were carried out. The patient was reviewed by the maxillofacial registrar at 2330, and was admitted to ICU for observation overnight and planned for theatre the following day.

The operation (an open reduction internal fixation of facial fractures) was uneventful and he was returned to the ICU. The patient was transferred to the ward at 1600 the following day. Nursing staff sought the night resident's review of the patient due to confusion/agitation. The patient was reviewed but settled without intervention.

The patient was readmitted to ICU the next day following an apparent cardiorespiratory arrest on the ward following administration of diazepam for agitation. While in ICU, application of restraints was required due to persistent agitation and the patient continued to show episodes of agitation throughout the ICU stay.

The patient was again discharged to the ward 2 days later. Almost immediately a MET call was made due to deteriorating oxygen saturation. This improved with deep breathing. Later the same day a further review was performed by the HO for the same reason, at the request of nursing staff. The following day nurses again requested review due to delirium/agitation. No treatment change was made but a neurological/neuropsychological review was suggested. There is no record of enquiry into the possibility of alcohol abuse.

The patient remained on the ward until the 10th postoperative day when found on the floor in cardiac arrest. The patient failed to respond to resuscitation and was pronounced dead.

CLINICAL LESSONS:

The first area of concern relates to a perceived failure to consult early with a general or geriatric medical team to assist with or take over management. Once this patient had returned to the ward on the first occasion postoperatively, there was ample reason to at least involve a medical team. Certainly, after the second ICU admission, it was clear that the facial fractures were becoming a secondary problem and management in a medical ward would have been appropriate.

The content of the medical record is the second area of concern. Documentation by the ICU/ surgical teams is suboptimal, with medical entries primarily at the request of nursing staff. There was no documentation relating to the apparent arrest that resulted in readmission to the ICU. There is a record of a neuropsychiatric consultation being suggested but no results were found in the notes. The absence of such important documentation in a patient who subsequently dies leaves us with unanswerable questions as to what, if anything, was being done – and if something was being done, whether or not it was appropriate.

Thirdly, no overall management plan was documented, and thus medical care appeared reactive rather than proactive. Perhaps, with some direction from senior staff who were conspicuously absent (from the notes), a more formal plan could have instituted. This leads in to the question of who, or which team, was responsible for this patient. The initial impression was that this patient was admitted under the oral and maxillofacial surgical team - they certainly carried out the surgery. However, they appear nowhere in the postoperative period during this patient's stay on the ward. It would seem that postoperative care was left to nursing and junior general

surgical residents. This may not be the case, but the notes again lack information and thus fail to demonstrate any senior involvement.

In conclusion, this case provides three lessons:

- Teams should have no fear in consulting widely when unclear of the path a patient is taking. Fresh eyes with a different background can be very helpful.
- The medical notes were poor and incomplete at best. When problems arise it is difficult to know what colleagues were thinking or doing without clear documentation. The maxim “if it's not written down it didn't happen” is highly relevant here.
- There must be clarity of responsibility. Those who are ultimately responsible, that is, the admitting consultant(s), should take a leading role in patient management. While they don't need to be involved in the day to day minutia, they do need to provide direction and oversight.

Case Study 14: Necessity for astute clinical leadership from the responsible consultant

CASE SUMMARY:

A patient in their late 40s was brought in by ambulance at 0130 to a tertiary level trauma centre. The patient had a history of hypertension, gastro-oesophageal reflux disease, gout in the knees and a recent diagnosis of depression. The patient was on simvastatin and pantoprazole. The patient presented after an 8 metre fall from a second floor apartment.

At the scene the patient's GCS was 9. On arrival to the ED this had decreased to GCS 3, pupils 3-4 mm bilaterally and no discernible cardiac output. Rapid sequence intubation was initiated by the anaesthetic Fellow and the airway secured with CPR throughout induction. IV cannula access was obtained with two 14G cannulae placed. Adrenaline was administered with return of spontaneous circulation (ROSC) approximately 10 minutes after CPR commenced. The patient received IV fluid bolus in the form of crystalloid. Limited bedside ultrasound indicated no tamponade or effusion and consequently, prior to ROSC, no coordinated cardiac

contractions. Post-ROSC, limited ultrasound was again conducted and indicated good contractility, no tamponade or effusion. The FAST scan was negative. The trauma code was attended by the anaesthetic Fellow, ED trauma team, intensive care consultant and junior general surgery registrar (first year), and later a cardiothoracic registrar and consultant.

CXR indicated whiteout of right chest and fractured second rib. Subcutaneous emphysema was present on the left chest. A finger thoracotomy was performed to the right chest with approximately 1.3 litres of blood gushing out, which then slowed to minimal drainage, and an intercostal catheter was placed with minimal drainage. Prior to transfer to CT the patient was treated using a massive transfusion protocol that consisted of:

- right femoral vein sheath
- arterial line
- concurrent to monitoring and access placement: administration of 5 units of packed red blood cells (O negative), 4 units of FFP, and one gram of tranexamic acid and an adrenaline infusion to support labile BP.

While in CT the patient was consistently unstable, with SaO₂ dropping steadily to 81% on 100%

FiO₂ with no evidence of increased airway pressure or obstruction or changes to end tidal CO₂. A finger thoracostomy was conducted in CT to the left chest with large pneumothorax noted, nil blood and failure to reinflate despite an open chest with positive pressure ventilation. An ICC was placed in the left chest with minimal output. The patient then stabilised with PaCO₂ of 42 mm Hg and PaO₂ of 102 mm Hg.

A CT full body revealed no apparent internal injuries to brain, skull, spine or abdomen (except a likely paralytic ileus). It did reveal fractured superior and inferior left pubic rami, and fractured left acetabulum (undisplaced). A CT chest revealed left-sided flail ribs 2-7, with pneumothorax, and right side haemothorax with flail ribs 2-4 and bilateral pulmonary contusions. The patient was reviewed by a cardiothoracic registrar and consultant and was deemed not for operation. The patient was transferred to ICU at 0345 without having received review by a senior general surgery registrar or consultant, or a trauma service clinician. The responsible trauma consultant was not informed of the patient's admission.

At 0505 the ICU consultant contacted the on-call trauma consultant and on-call cardiothoracic surgeon after

a sudden onset of hypotension and tachycardia that occurred post coughing while being suctioned. The patient consequently lost over 1 litre of profuse frank blood from the right intercostal catheter. The total blood lost between the coughing incident and transport to theatre was 2.5 litres in 35 minutes. The patient was taken to the operating theatre by both the consultant cardiothoracic surgeon and trauma surgeon for an emergency fourth intercostal space clamshell thoracotomy. The patient was found to have avulsed the azygo-caval junction laceration and ligation was required. Intraoperatively, the patient had a 5.7 litre blood loss, and required 20 units of blood, 1 unit of FFP, 10 units of cryoprecipitate, and 2 units of platelets.

The patient had extensive periods of haemodynamic instability despite multiple massive transfusion protocols and inotropic management. The development of coagulopathic state in combination with acute respiratory distress syndrome resulted in continued cerebral deterioration on CT scan (diffuse cerebral oedema and tonsillar herniation). It was indicated that the patient had prolonged hypoxic ischaemic insult due to multiple hypovolemic arrests and demonstrated clinical brain death. The patient died 50 hours after admission.

COMMENTS:

The concerns arising in both the surgical case form and the first-line assessment relate to the apparent lack of involvement that the on-call trauma surgeon had in this case. It is well documented that the trauma surgeon was not contacted by the junior registrar in this case, due to the availability and perceived assumed responsibility by the cardiothoracic consultant reviewing the patient at the same time. The SET trainee should have made their admitting consultant aware of the patient. However, this was a clear instance of a communication breakdown that would likely have been preventable had there been a clear and consistent mechanism for contact in this institution's trauma protocol. Additionally, this is a timely reminder to consultants of the need to ensure clarity when reviewing cases of such complexity and urgency, as well as ensure that SET trainees are adequately supported in such scenarios.

The trauma consultant indicated that had they known of the patient's admission, the presentation would have necessitated a category one operative intervention, despite the evident unwillingness of the cardiothoracic surgeon to take the patient straight to theatre after the initial 2.5 litre blood loss. There is clear

evidence in this case that the facility's trauma rostering and management of trauma codes requires review. In particular, the timeframe within which the responsible consultant should be contacted and become involved in a patient's care. It also raised distinct questions regarding clinical leadership in the trauma environment, and the need for effective communication both verbal and written.

It is apparent that the accountability or the perception of accountability by the responsible clinician was lacking. The patient's injuries were extensive – mortality may have been avoided with early operative intervention.

Case Study 15: Local level trauma procedures burden on clinical outcome

CASE SUMMARY:

A 30-year-old man was brought in by ambulance after a high speed (160 km/h) motorbike accident, having slammed into a parked car and landed more than 100 metres away. On arrival at the trauma centre (1800) his GCS was 14 and he was complaining of thoracic and cervical back pain, and an inability to feel his lower extremities. Primary and secondary survey indicated a small external occipital head injury, a clear chest ultrasound and a self-maintained airway. The patient's medical history was that he was previously fit and well, with a clinical history of substance abuse.

There was obvious lower limb deformities, namely bilateral open fracture dislocations of the ankles and degloving injuries to the lower limbs. He was able to move his upper limbs without complaint. A pelvic splint was applied with an obvious thoracic spine deformity noted on the log roll. Pelvic x-ray indicated severe and multiple pelvic fractures and an "open book" sign. The patient was initially planned for PanScan but he became grossly hemodynamically unstable with an unstable compromised airway threatening a loss of consciousness.

He required rapid sequence intubation and became grossly bradycardic shortly after, requiring CPR. Repeat ultrasound showed lung sliding but no free abdominal fluid.

A massive transfusion protocol was activated but he remained unstable, likely due to pelvic bleeding. A decision was made for a category one operative intervention in the form of damage control laparotomy and external fixation – this was due to a 60 minute delay in CT angiogram/and angiography suite. The patient underwent a laparotomy and external fixation without incident but was continuously unstable. CT angiogram found constant extravasation of the left internal iliac artery. While moving to the angiogram table the patient had a pulseless electrical activity arrest. There was no regain of cardiac output for a period of 27 minutes despite all advanced life support efforts. Death occurred approximately 3 hours and 20 minutes following his arrival to the facility.

COMMENTS:

Although the surgical team acted appropriately, the lack of timely angiography may have contributed to the death of this patient. It is clear that for a major trauma institution that there were insufficient protocols and procedures to enable responsive activation of a trauma code and the required treatment areas i.e. operating theatre, and radiology.

There was a lack of defined protocol for angiographic management of cases such as this. Such a protocol often eliminates the need for preliminary CT angiogram. It is recommended that a local level protocol for the management of severe pelvic bleeding be developed and instituted, as advocated in Osbourne et al. (2009). A comparison of the management protocols of pelvic packing versus pelvic angiography is also provided in the article – see <http://www.sciencedirect.com/science/article/pii/S0020138308004245> or M.D. Gilliland, R.E. Ward, R.M. Barton, et al. Factors affecting mortality in pelvic fractures. *J Trauma*, 22 (1982), pp. 691–693. [SD-008].

Case study 16: A survivable head injury lost in a medical ward

CASE SUMMARY:

This man in his 70s fell and sustained a closed head injury with a short period of unconsciousness. He had a headache but was alert and orientated. He was admitted to a major metropolitan hospital 3 days after the trauma and a CT scan showed a subdural haematoma, 3-4 mm thick over the frontoparietal area. The following day (day 4 post-trauma) his condition had improved and a repeat CT scan did not indicate any progression of the haematoma. He was discharged home with appropriate advice and a request that he see his GP in 2 weeks.

On day 5 post-trauma his condition deteriorated and he was taken to the same hospital by ambulance. He was noted to be confused and very drowsy. Repeat CT of the head revealed a 6 mm right-sided subdural hematoma with mild mass effect. There was an entry in the file dated on day 6 indicating that the neurosurgical registrar had seen the CT and there was no indication for surgery.

There was an entry for day 10 post-trauma (retrospective) noting increased headache, and the MO was asked to review analgesia needs. He had been having up to

20 mg of Endone daily, but it was not clear what he received on the day and night of his deterioration. There was no record of the neurosurgical registrar reviewing the patient. In the early hours of day 11 he became unrousable with fixed pupils.

At surgery a large acute subdural hematoma was evacuated. Postoperatively he remained in poor neurological state. He was managed conservatively following discussion with the family and he died on day 14 post-trauma.

CLINICAL LESSONS:

At the time of surgery both pupils were fixed and his neurological state was poor. In these circumstances the mortality rate is in excess of 90%, so the outcome was not unexpected. In the operative note it is reported that a large acute subdural hematoma was evacuated and bleeding was from cortical arteries. Bleeding from cortical arteries is responsible for 20% of acute subdurals. It is not clear whether the surgeon thought the findings represented expansion of the original clot or new bleeding. We know that 30% of acute subdural hematomas treated conservatively will need surgery at some point. The literature suggest that the bigger clots (greater than 10 mms in thickness) and those with midline shift are likely to require surgery. This man's admission CT revealed

mild midline shift. Other writers on the subject emphasise that the total volume of the clot rather than the thickness may be more important.

Following admission he had one CT scan and possibly a further scan the next day, but it appears that he didn't have any further scans while in the care of the medical unit. He was possibly seen by the neurosurgical registrar on day 6 but not thereafter. There is a report of increasing headache on the evening of day 10, but it is not clear whether he was reviewed and whether he was given stronger analgesia. The patient should have been reviewed and the neurosurgical registrar alerted. A CT scan should have been performed.

If a patient with an acute subdural hematoma is sick enough to be in hospital in a general medical ward then they must be seen regularly by the neurosurgical registrar. They must also be scanned as a matter of urgency if there is any change in their condition. I would not expect a medical resident to have knowledge of the risks associated with conservative management of acute subdural hematoma.

Shortened Forms

ANZASM	Australian and New Zealand Audit of Surgical Mortality	HO	house officer
BP	blood pressure	ICC	inserted central catheter
CPR	cardiopulmonary resuscitation	ICU	intensive care unit
CXR	chest x-ray	INR	international normalised ratio
CT	computed tomography	IV	intravenous
DVT	deep vein thrombosis	LMWH	low molecular weight heparin
ECG	electrocardiogram	MET	medical emergency team
ED	emergency department	NSAIDs	nonsteroidal anti-inflammatory drugs
EMST	early management of severe trauma	PE	pulmonary embolism
FAST	focussed abdominal sonography in trauma	PICC	percutaneous inserted central catheter
FFP	fresh frozen plasma	ROSC	return of spontaneous circulation
GCS	Glasgow Coma Scale	SAASM	South Australian Audit of Surgical Mortality (SAASM)
GI	gastrointestinal		

Contact details

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

Telephone: +61 8 8219 0900

Facsimile: +61 8 8219 0999

Email: gordon.guy@surgeons.org

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

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

Telephone: +61 8 8219 0900

Facsimile: +61 8 8219 0999

Email: gordon.guy@surgeons.org



**The Royal Australian
and New Zealand
College of Obstetricians
and Gynaecologists**
Excellence in Women's Health

