SECTION 8

SPECIAL SITUATIONS

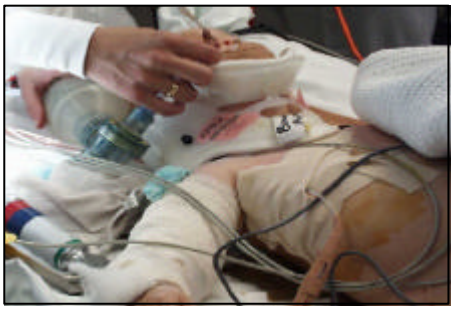
The principles of treating paediatric trauma victims are in many ways similar to adults, however, there are some specific aspects of the care of the paediatric population worth highlighting.

Preparation and anticipation are even more important. Drug doses are weight based as are many pieces of equipment used e.g. ETT. Weight can be estimated by age using the formula:

Wt in kilos = 2 times age (in years) + 9

Additionally, ETT diameter needed:

$$\frac{\text{(Age + 16)}}{4}$$



All Trauma Team Leaders should have a paediatric drug dose book (e.g. *DrugDoses* by Frank Shann) on their person to assist in accurate dosages.

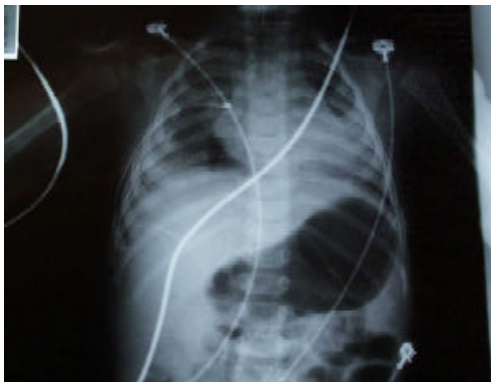
Paediatric trauma patients under 14 years of age come under the care of the Paediatric Surgeon on call. All those over 14 years of age come under the Trauma Surgeon on call.

The paediatric registrar is not part of the trauma team, however, during the day they are available in the hospital and may be useful for advice. There is a neonatal registrar on site 24 hours a day and could

be invaluable to assist as an adjunct in the neonatal subgroup - contact on pager number 49361.

Some general comments on examination of children:

a) The ED is a loud, cold, frightening place for a child. Keep noise to an absolute minimum and speak gently and quietly to the child explaining all steps ahead of time.
b) When examining, warm your hands, use distractions such as toys or songs “Bananas in Pyjamas” often works. Avoid multiple examinations.
c) Parents / carers are part of the resuscitation process and should be with the child whenever possible.
d) Keep the child warm. A higher body surface area to weight means heat loss is faster than in adults. Warm IV fluids.
e) Give analgesia early. Give it IV. Give it in adequate doses e.g. 0.1 to 0.15mg/kg morphine IV. Titrate to effect.
f) Remember that the child has a smaller physiological reserve and may suddenly decompensate. Therefore ANTICIPATE and plan ahead.
g) Get the ED social worker involved early to assist in family dynamics.



Liverpool Hospital is not equipped to look after children in the ICU. As a result children may need to be retrieved to a children's hospital. In an unstable patient they will have surgery here at Liverpool e.g. extradural drainage, then be transferred from the recovery bay. At other times e.g. "conservative" management of a splenic injury, the child will be transferred from the ED. In the ED the Trauma Team Leader usually coordinates this in consultation with the paediatric surgeon on call at Liverpool Hospital.

REGARDLESS OF DESTINATION, THE TRANSPORT PROCESS IS THE SAME

a) Give the NETS an early call so they are able to mobilise as efficiently as possible.
b) The NETS contact number is **1300 362 500**. Once contacted they will organise a conference call with you, the NETS consultant and the ICU consultant. They will discuss the case and follow a retrieval check list (following the A,B,C,D priorities) to ascertain if there is anything they would like addressed before transfer.
c) They organise the bed and retrieval team and will contact you with a hospital and estimated time of team arrival.
d) Photocopy all notes and ask radiology to scan the films.
e) Contact the paediatrician on call so they are aware of the transfer.
f) Until formal hand-over occurs with the retrieval team the care of the patient remains with the trauma team led by the Trauma Team Leader.

PREGNANCY

Injury during pregnancy evokes a certain amount of anxiety because of its infrequent occurrence and the complex implications. By definition, it constitutes a multi-trauma and throughout the resuscitation and assessment of the woman, it is important to remember that there are two patients. Of particular importance is that one of these patients must be resuscitated aggressively to save the other and very occasionally the baby has to be delivered to save the mother.

The aim of this chapter is to provide an overview of the current management and issues in relation to trauma in pregnancy.

Trauma in pregnancy is a relatively uncommon event, reported as occurring in 6-7% of traumas in the United States[1]. Data from around Australia currently provided by Nepean, Auckland, Royal North Shore, Westmead, John Hunter and Royal Perth Hospitals, suggest that trauma is relatively infrequent during pregnancy. Trauma in pregnancy can be divided into two categories – major and minor trauma. At Liverpool Hospital 5 serious injuries to pregnant women were seen between January 1996 and December 1997. This yields an incidence of significant trauma in pregnancy of approximately 0.1%.

Anatomical and physiological changes occur during pregnancy that can mask or mimic injury and physical signs can be misinterpreted. Occasionally trauma care givers have a fear of harming the baby or upsetting the patient and this can result in a passive “do nothing” approach that can have a potentially devastating effect on outcome. It is important that there is no delay in the correct diagnosis and prompt initiation of treatment. The physiological changes seen in pregnancy are shown in Table 1.

PHYSIOLOGICAL CHANGES ASSOCIATED WITH PREGNANCY

Table 1

Parameter	Non-pregnant	Pregnant
Cardiovascular		
Heart rate	70-80 bpm	↑ 10-15 bpm
Cardiac output	4.5 L/min	↑ to 6 L/min
Systolic blood pressure	110 mm Hg	↓ by 5-15 mm Hg
Haematology		
Blood volume	4000 mL	↑ by 30%-50%
Plasma	2400 mL	↑ to 3700 mL
RBC	1600 mL	↑ to 1900 mL
Haemoglobin	12-16 gm/dL	↓ to 10-14 gm/dL
Haematocrit	37%-48%	↓ to 32-42%
WBC	4500-10,000	5000-14,000
Respiratory		
Tidal volume	500 mL	↑ by 40% (700mL)
Residual volume	1200 mL	↑ by 40% (720mL)
Respiratory rate	12-20 breaths/min	Increased
PH	7.38-7.44	↑ 7.41 – 7.46

In addition, there are significant anatomical and functional changes which occur during pregnancy:

- delayed gastric emptying
- increased gastroesophageal reflux
- upward displacement of the peritoneal contents
- displacement of the urinary bladder, and
- widening of the symphysis pubis.

MATERNAL FOETAL UNIT

The foetus is usually well compensated for life through higher affinity of foetal haemoglobin for oxygen. At any given partial pressure of oxygen, foetal haemoglobin has a higher affinity for oxygen than maternal haemoglobin. Oxygen transport in the foetal placental unit is intimately tied to the maternal uterine blood flow. Because of the

passive uptake of oxygen, foetal oxygenation is not higher than that in the uterine vein.

MATERNAL ASSESSMENT

When confronted with an injured pregnant patient the mother should be attended to first, as rapid resuscitation of the mother optimises foetal outcome. Maternal assessment should follow guidelines laid out by the EMST / ATLS® approach to trauma, with a detailed primary and secondary assessment. In relation to primary assessment, there are some slight differences from the assessment of the non-pregnant patient. In particular, positioning of the pregnant patient is very important especially in the third trimester. A supine patient often has vena cava compression reducing venous return. It is important to tilt the pregnant patient to the left by approximately 35°. The patient should be tilted as an entire unit, maintaining stabilisation of the cervical spine (Figure 1).

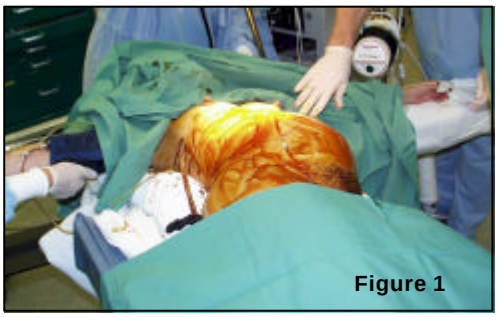


Figure 1

THE RISKS OF TRAUMA IN PREGNANCY

The risk to the pregnancy in "minor" or non-catastrophic trauma is still significant, with pre-term labour occurring in 8%, abruption in 1% and foetal death in 1%. For those with major trauma, mortality to the mother is approximately 9% depending on injury severity score[2]. The foetal death rate is 20% or greater and foetal injuries occur in isolation in 5%. The pattern of serious injuries in pregnancy is slightly different from that of non-pregnant women with injuries to the abdomen more common than injuries to the head and chest.

INVESTIGATIONS

How does one approach abdominal evaluation during pregnancy?

The best indication of maternal or placental injury comes from clinical observation. Clinical findings of placental abruption may include vaginal bleeding, abdominal cramps, uterine tenderness, amniotic fluid leakage, and maternal hypovolaemia out of proportion to visible bleeding. Remember that up to 2 litres of blood can accumulate in the uterus and this can be a cause of maternal shock. The uterus may clinically seem larger than normal for gestational age. Change in foetal heart rate may also indicate placental injury. Abdominal signs can be more difficult to interpret in a pregnant woman and for this reason, ultrasound of the abdomen to detect free fluid is useful (Figure 2). Diagnostic peritoneal lavage can be used and has an accuracy of 92%. CT scanning can be used, however it should be avoided if at all possible especially in the first and early second trimester because of potential radiation side effects. Ultrasound has the

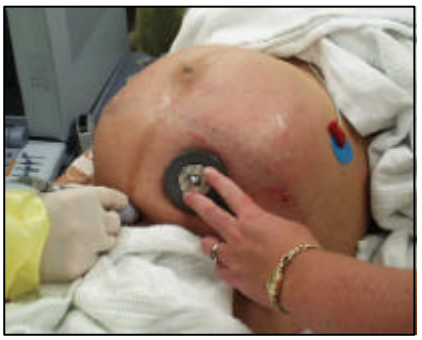
FIGURE 2

potential advantage of being able to detect significant foetal injuries, however it is not good in determining abruption or uterine rupture. It has an accuracy of only 50% in detecting abruption.

FOETAL MONITORING

Is it needed and how long should we use it for?

Any viable foetus of 24 weeks gestation or more requires monitoring after trauma. This includes patients with no obvious signs of abdominal injury. Pearlman has recommended a minimum of 4 hours of cardiotopographic (CTG) observation to detect intra-uterine pathology[3]. This should be extended to 24 hours if at any time during the first 4 hours there is more than one uterine contraction every 15 minutes, there is uterine tenderness and a non-reassuring foetal monitor strip, vaginal bleeding, rupture of the membranes or any serious maternal injury.



Over the last 10 years at Liverpool Hospital we have had 6 foetal deaths, of which 5 arrived in our resuscitation room with foetal heart sounds, or CTG evidence of viability. It is important that there is a joint multidisciplinary monitoring approach to the pregnant trauma patient. Rapid caesarean section facilities should be available. In the presence of placental abruption, when the foetus is alive on presentation, foetal

distress is present in over 60% of these cases and an immediate caesarean section is required. Resuscitation of the mother is absolutely vital and if maternal shock occurs, the foetal mortality approaches 80%.

Foetal monitoring should occur in all major and minor trauma patients, for a minimum of 4 hours in minor cases, and a minimum of 24 hours in major cases.

What about Peri-mortem Section?

Restoration of normal maternal and foetal circulation is the goal in trauma resuscitation. However, exclusive attention to the mother may prevent recovery of a potentially viable baby. Maternal revival after delivery of the foetus has been reported in peri-mortem circumstances, presumably due to relief of vena cava compression, however, this is rare. It has therefore been suggested that there is no such thing as a postmortem section only a perimortem section. If there is no response to advanced resuscitation within a few minutes, maternal CPR should be continued, (if necessary this can be performed through a thoracotomy without cross clamping the aorta) and an emergency room caesarean section performed.

In a review of 250 years of literature, Ritter has documented 120 successful perimortem caesarean sections[4]. Of these, 61 babies have survived perimortem caesarean section to discharge from 1900 to 1985. 70% were delivered in less than 5 minutes, 13% in 6-10 minutes, 12% in 11-15 minutes and 5% after 16 minutes. The incidence of neurological sequelae increased with longer delivery time. It is important to realise that there is a difference between survival rate from peri-mortem sectioning and discharge home, as less than half those who actually survive a perimortem section are discharged. Caesarean section should only be performed in the emergency department where the uterine size exceeds the umbilicus, where there is evidence of foetal life by clinical examination, either on doppler or ultrasound, and when the patient has not been receiving CPR for

more than 10 minutes.

It is important to remember other conditions that can occur in trauma in pregnancy:

- amniotic fluid embolism, which is rare but an important cause of disseminated intravascular coagulation and shock, and more commonly
- foetal maternal haemorrhage.

Foetal maternal haemorrhage (FMH) is the transplacental haemorrhage of foetal cells and is a unique complication of pregnancy. The reported instance of FMH is 8-30% compared to 2-8% for non-traumatic victims. Anterior placental location and uterine tenderness have been associated with an increased risk of foetal maternal haemorrhage. Complications of FMH include rhesus sensitisation in the mother, foetal anaemia, foetal paroxysmal tachycardia and foetal death. As little as 1ml of rhesus positive blood can sensitise 70% of rhesus negative women. Therefore, all rhesus negative mothers who present with a history of abdominal trauma should receive a prophylactic dose of Rh immune globulin. The Kleihauer-Betke test has been utilised to determine the presence of foetal maternal haemorrhage. It is not entirely accurate and is not necessary in Rh positive women.

CONCLUSION

- After injury during pregnancy, the key to a successful outcome for both the mother and child is prompt and adequate initial assessment and resuscitation of the mother.
- All patients with minor trauma should be admitted to hospital for at least 24 hours.
- Those with major trauma always require a multidisciplinary approach.
- Careful foetal monitoring is essential once foetal viability has been established.
- If maternal resuscitation fails, urgent perimortem caesarean section may be useful with short CPR times.

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Although there are no changes in protocol, the elderly trauma patient poses a number of important challenges. Even relatively fit older persons have a reduced physiological reserve compared to younger counterparts, and will tolerate primary injuries and secondary insults less well. The effects of ageing also induce more serious damage from apparently minor accidents so a high index of suspicion should be maintained for occult injuries. In the face of higher mortality and morbidity the principles of treatment do not alter, but great attention to detail must be paid by the team in the primary resuscitative phase, and even more so during the rest of the hospital stay. The aim of treatment for the patient must be a return to independent living where possible. Although the elderly have a higher than predicted mortality from trauma, aggressive management produces good results and a high proportion can return to their previous mode of living.[1,2]

RESUSCITATION

Trauma teams should be activated more readily for elderly patients with borderline mechanisms of injury such as same level falls.[3,4] Being elderly is a criterion for team activation in some centres.[5]

Airway / Breathing:

Reduced respiratory reserve may require that the patient be intubated and ventilated when a younger patient might not need it.

Circulation:

Pouring in 2L of crystalloid followed by blood intravenously may well push the elderly patient into heart failure. On the other hand withholding necessary fluids for fear of causing heart failure will also harm the patient. Therefore fluid administration and the response to it must be carefully watched.

Disability:
Some elderly patients will already have had strokes but do not assume this without definite confirmation from a carer. Weakness in any limb should be treated as part of the injury pattern initially. Remember that the motor component of the Glasgow Coma Scale is the best response obtained. If there is no response to pain on one side check the other.

Exposure / Environment:
Although the patient must be fully undressed to allow proper treatment, they should be kept covered whenever possible. The elderly are very susceptible to hypothermia.

CONCURRENT ILLNESS AND MEDICATIONS

The effect of concurrent illnesses and their treatment must not be forgotten. For example β-blockers may prevent patients mounting a tachycardia in response to blood loss, which will disguise the level of shock present. If the patient cannot give their past history and medications this must be swiftly obtained from relatives or carers. A search of belongings may yield useful information.

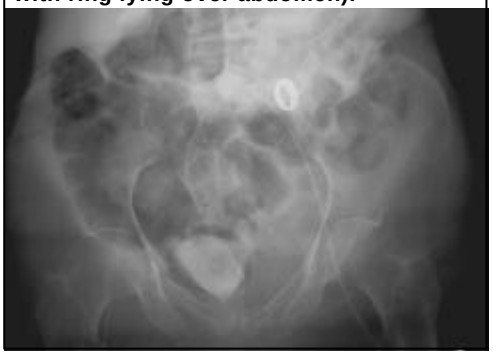
A patient taking warfarin who suffers a head injury must have a CT scan. This applies even if the injury seems trivial and the patient well with no history of loss of consciousness.

Many elderly people have reduced glucose tolerance even if they are not diagnosed as diabetics. All diabetics and those with reduced glucose tolerance who suffer traumatic injury must be assessed by the endocrine team during hospital admission.

INVESTIGATIONS

On the chest radiograph beware of bullae mimicking pneumothoraces. The cervical spine radiograph may be difficult to interpret due to degenerative changes; if unsure treat with care and get a second opinion from radiology and neurosurgery.

Pelvic x-ray of elderly patient with significant osteopaenia. (Note: patient has hand with ring lying over abdomen).



POST-RESUSCITATION

Elderly patients suffer more and faster from the effects of immobility. They have a higher risk of thrombosis and must start prophylactic treatment early. Spinal boards can produce pressure sores within 2 hours and must be removed as early as possible.

Pulmonary complications are also frequent. Patients with proven or suspected rib fractures should be placed on the rib fracture pathway and adequate analgesia ensured. This may well require an epidural and admission to the Intensive Care Unit. Without proper analgesia and physiotherapy, pneumonia is likely, which may necessitate a longer ICU stay later in the course of treatment. For each rib fracture in the elderly mortality increases by 19% and the risk of pneumonia by 27%.[7]

As well as physiotherapy a whole multidisciplinary team will be required for the patient. The Rehabilitation and Aged Care team will be required to manage and optimise any ongoing medical problems. Occupational

therapy will be needed to advise on the patient's readiness for discharge and his / her home's suitability. The attitude of the patient's family is vital to a successful outcome for the patient and they should be involved as early and as fully as possible. There may be a requirement

Elderly patients have a worse outcome from trauma, but survivors are likely to make a return to independent living. Optimal results can only be achieved by aggressive treatment, attention to detail and a multidisciplinary team approach.

for a short-term rehabilitation placement prior to a return home.

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