

Trauma in pregnancy at a major trauma centre in South Africa

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Background. Trauma in pregnancy poses a unique challenge to clinicians. Literature on this topic is limited in South Africa (SA).

Objectives. To review our institution's experience with the management of trauma in pregnancy in a developing-world setting.

Methods. This study was based at Grey's Hospital, Pietermaritzburg, SA. All pregnant patients who were admitted to our institution following trauma between December 2012 and December 2018 were identified from the Hybrid Electronic Medical Registry (HEMR).

Results. During the 6-year study period, 2 990 female patients were admitted by the Pietermaritzburg Metropolitan Trauma Service (PMTS), of whom 89 were pregnant. The mean age of these patients was 25.64 (range 17 - 43) years. The mechanism of injury was road traffic crash (RTC) in 39, stab wounds (SW) in 19, assault other than SW or gunshot wounds (GSW) in 19, GSW in 8, snake bite in 5, impalement in 1, dog bite in 1, hanging in 1, sexual assault in 1 and a single case of a patient being hit by a falling object. A subset of patients sustained >1 mechanism of injury. Thirty patients were managed operatively. The mean time of gestation was 19.16 (5 - 36) weeks. Three patients died, and there were 16 fetal deaths (including 3 lost after the mother's death). Forty-five fetuses were recorded as surviving at discharge, while 25 fetal outcomes were not specifically recorded. There were 2 threatened miscarriages and/or patients with vaginal bleeding, 1 positive pregnancy test with no recorded outcome and no premature births as a result of trauma.

Conclusions. Trauma in pregnancy is relatively uncommon and mostly due to a RTC or deliberately inflicted trauma. Fetal outcome is largely dependent on the severity of the maternal injury, with injuries requiring laparotomy leading to a high fetal mortality rate.

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Trauma in South Africa (SA) has been referred to as the 'malignant epidemic'^[1] and is a massive burden to society and the health system. During the last half century, a great deal has been written about the burden of trauma in SA. Nonetheless, there remain specific vulnerable groups who are relatively under-researched, including children, adolescents, women and the elderly. Trauma in pregnant patients is an example of double jeopardy for two vulnerable groups, i.e. women and children. Although the management of the mother takes priority over that of the unborn child, the physiological changes associated with pregnancy^[2] and the need to consider the unborn child as a patient in its own right make the management of pregnant trauma victims challenging. This topic generally warrants its own dedicated chapters in most standard textbooks and is especially emphasised in Advanced Trauma Life Support (ATLS) training.^[3] Our institution has previously reported on our early experience with the management of such patients.^[4] Since that time, our Hybrid Electronic Medical Registry (HEMR) has matured and allowed us to accrue a considerable data set. The HEMR has been fully functional for >6 years - this is an appropriate time to revisit and update our experience with this topic.

Methods

Clinical setting

The Pietermaritzburg Metropolitan Trauma Service (PMTS) at Grey's Hospital, Pietermaritzburg, SA, maintains a digital database, i.e. the HEMR, which captures data on all admissions to the service.

Management overview

All pregnant trauma patients are resuscitated using ATLS principles,

as established by the American College of Surgeons.^[3] Resuscitating the mother and treating her according to her injuries are prioritised. The fetus is of secondary concern. Although an obstetrical opinion is obtained early during the admission, it is predominantly to confirm the pregnancy state and to ascertain if the fetus is viable. In patients who sustain trauma while in an advanced state of pregnancy, and if the fetus is mature enough to survive, consideration is given to delivery, which makes management of the mother less complex. If the fetus is immature, an expectant approach is adopted. Managing the mother's injuries remains the priority.

The study

All pregnant patients who were admitted to the PMTS following trauma between December 2012 and December 2018 were identified from the HEMR. Basic demographic data were documented, as well as the mechanism and severity of injury.

Ethical approval

Ethical approval for the maintenance of our registry and for this study was received from the Biomedical Research Ethics Committee of the University of KwaZulu-Natal (ref. nos BCA 207/09 and BCA 221/13, respectively).

Results

During the 6-year study, the PMTS admitted 2 990 female patients, of whom 89 (3%) were pregnant. The mean age of these patients was 25.64 (range 17 - 43) years. The mechanism of injury was road traffic crash (RTC) in 39, stab wounds (SW) in 19, assault other than SW or

gunshot wounds (GSW) in 19, GSW in 8, snake bite in 5, impalement in 1, dog bite in 1, hanging in 1, sexual assault in 1 and a single case of a patient being hit by a falling object. A subset of patients sustained >1 mechanism of injury.

Investigations

Thirty-nine chest radiographs (CXR) were performed, as well as 21 radiographs of the cervical spine, 18 of the pelvis, 15 of the skull, 15 of the extremities and 6 of the abdomen. A focused assessment with sonography for trauma (FAST) scan was performed in 11 patients, ultrasound (US) scans of the abdomen and pelvis in 11 and 7 patients, respectively, duplex Doppler US scans in 2 patients, as well as an echocardiogram and a gynaecological US scan in 1 patient each. The following computed tomography (CT) scans were performed: 7 whole-body, 16 of the abdomen, 5 of the pelvis, 5 angiograms (CTA), 4 of the neck, 2 of the thorax, 1 maxillofacial and 1 of an extremity. One contrast swallow and 1 cystogram were also performed.

Physiology

The presenting physiology is summarised in Table 1. The median injury severity score (ISS) was 8 (range 1 - 75; interquartile range (IQR) 12.5).

Injuries

Injuries were as follows: head and neck ($n=38$), abdomen ($n=32$), extremities ($n=31$), chest ($n=19$), maxillofacial ($n=14$), pelvis ($n=13$) and other ($n=5$). The total number of injuries exceeds the total number of patients owing to some patients sustaining multiple injuries.

Management

Thirty patients were managed operatively, which included laparotomy ($n=14$), relaparotomy ($n=2$), thoracoscopy ($n=2$), sternotomy ($n=1$), wound debridement ($n=11$), open reduction internal fixation ($n=5$), external fixation ($n=2$), K-wires ($n=1$), vascular ligation ($n=1$), split skin graft ($n=2$), tracheostomy ($n=1$), burr-hole drainage of a subdural haematoma ($n=1$), intracranial pressure monitor insertion ($n=1$), emergency caesarean section ($n=1$) and uterine evacuation ($n=1$). Table 2 provides a more detailed breakdown of the required surgery and shows the injuries found at laparotomy. In 2 patients a bullet had traversed the gravid uterus; both these patients required a hysterectomy. The injured uterus with the arm of the dead fetus is clearly visible in Fig. 1.

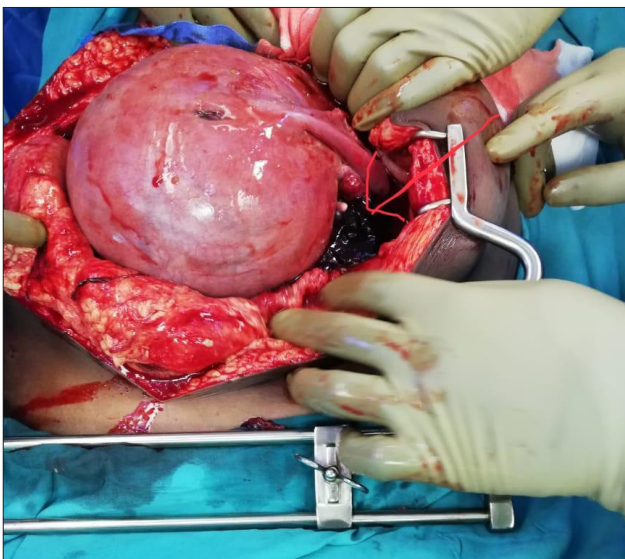


Fig. 1. A gunshot wound of a gravid uterus, with the arm of the dead fetus clearly visible.

Fetal and maternal outcome

The median time of gestation was 20 (5 - 36) weeks. Three mothers died and there were 16 fetal deaths (including 3 after the mothers' death). There were 2 threatened miscarriages, 1 ectopic pregnancy, 1 positive pregnancy test with no recorded outcome and no premature birth as a result of trauma. Of the 14 cases where a laparotomy was performed, there were 5 fetal deaths. Only 1 mother who required a laparotomy died. The lactate level, shock index (SI), injury severity score (ISS) and the need for being admitted to an intensive care unit

Table 1. Presenting physiology

| | |
|--|----------|
| Heart rate (bpm), median | 97 |
| Heart rate (bpm), range | 62 - 164 |
| Heart rate (bpm), IQR | 21.75 |
| Systolic blood pressure (mmHg), median | 111 |
| Systolic blood pressure (mmHg), range | 80 - 177 |
| Systolic blood pressure (mmHg), IQR | 23 |
| Lactate (mmol/L), mean | 2.76 |
| Lactate (mmol/L), range | 0 - 13.7 |
| Lactate (mmol/L), SD | 2.82 |

IQR = interquartile range; SD = standard deviation.

Table 2. Breakdown of procedures

| Procedure | <i>n</i> |
|-----------------------------|----------|
| Laparotomy ($n=14$) | |
| Liver packing | 1 |
| Renal exploration | 1 |
| Nephrectomy | 1 |
| Small-bowel repair | 3 |
| Large-bowel repair | 1 |
| Mesenteric injury repair | 1 |
| Hysterectomy | 2 |
| Wound debridement | 2 |
| Wound packaging | 1 |
| Salpingectomy | 1 |
| Splenectomy | 1 |
| Diaphragmatic repair | 1 |
| Relaparotomy ($n=2$) | |
| Anastomosis | 1 |
| Closure | 1 |
| Thoracoscopy ($n=2$) | |
| Adhesiolysis | 1 |
| Vascular repair | 1 |
| Sternotomy ($n=1$) | |
| Vascular ligation | 1 |
| Wound debridement | 11 |
| ORIF | 5 |
| External fixation | 2 |
| K-wires | 1 |
| Vascular ligation | 1 |
| Split skin graft | 2 |
| Tracheostomy | 1 |
| Burr-hole drainage of SDH | 1 |
| ICP monitor insertion | 1 |
| Emergency caesarean section | 1 |
| Uterine evacuation | 1 |

ORIF = open reduction internal fixation; SDH = subdural haematoma; ICP = intracranial pressure.

(ICU) were all significantly greater in cases of fetal death. Fetal deaths are compared with all cases where the fetus survived (Fig. 2 and Table 3). Outcome in blunt and penetrating mechanisms of injury has also been compared (Table 4).

Discussion

The overwhelming burden of trauma and violence in SA has aptly been labelled as the malignant epidemic.^[1] There is scant evidence to suggest that this epidemic is in any way being controlled or rolled back.

Within this overall burden, there are specific vulnerable groups who are at increased risk. One such group comprises women, who in many ways experience a degree of double jeopardy, as they are at risk of gender-based violence directed at them specifically and they are often pedestrians at risk of being injured in a pedestrian-vehicle collision. Gender-based violence remains a scourge in SA and is largely under-represented in the surgical literature on trauma that has emanated from SA over the last 50 years. Our study is typical in this regard, with 39 patients

being involved in vehicle-related trauma and 47 being victims of assault.

The principle underlying the treatment of a pregnant trauma patient is to prioritise treatment of the mother and to largely ignore the fetus.^[5] Only by successfully treating the mother can there be any realistic hope of a successful outcome for the fetus. Standard fluid-resuscitation strategies are needed, although a physiological tachycardia is often seen in pregnant women due to the increased blood volume.^[2,6-8] The gravid uterus may decrease venous return by compressing the vena cava.^[2,6] The gravid patient is at increased risk of gastric aspiration and has decreased respiratory reserve owing to the pressure of the gravid uterus on the diaphragm.^[2,7] We do not withhold appropriate imaging owing to concern for potential teratogenicity, as evidenced by the extensive use of CT scans in our series. Most authors agree that this risk is overstated after the first trimester and the mother's health must take priority over any theoretical risk to the fetus.^[2,6,7,9]

Once a mother has been assessed, stabilised and all her injuries documented and managed, a more detailed obstetrical assessment should be performed.^[10] The major obstetrical complication of blunt

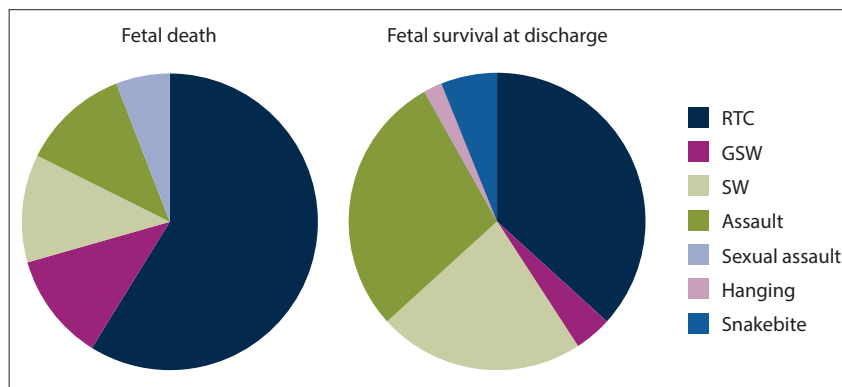


Fig. 2. Mechanism of injury by outcome. (RTC = road traffic crash; GSW = gunshot wound; SW = stab wound.)

Table 3. Comparison of fetal death v. fetal survival

| | Fetal death | Fetal survival at discharge | p-value |
|--|---------------|-----------------------------|----------|
| n (%) | 16 (26.23) | 45 (73.77) | - |
| Age (years), mean (SD) | 25.07 (4.83) | 25.51 (6.64) | 0.812 |
| Heart rate (bpm), median (IQR) | 99 (53.5) | 97 (22) | 0.352 |
| Respiration rate (breaths/min), median (IQR) | 18 (9.5) | 18 (4) | 0.631 |
| Systolic blood pressure (mmHg), median (IQR) | 110 (25.5) | 114 (27.5) | 0.110 |
| Lactate (mmol/L), mean (SD) | 4.307 (3.439) | 1.668 (1.414) | 0.004 |
| Shock index (SD) | 1.007 (0.306) | 0.842 (0.164) | 0.009 |
| ISS, median (IQR) | 24 (26.50) | 4.5 (9.25) | 0.0001 |
| Length of hospital stay (days), median (IQR) | 6 (8.00) | 4 (3.75) | 0.035 |
| Gestational age (weeks), mean (SD) | 20 (9.19) | 18.65 (7.03) | 0.617 |
| ICU, n (%) | 9 (56.25) | 3 (6.67) | 0.000018 |
| Maternal mortality, n (%) | 3 (18.75) | 0 | 0.003 |
| Road traffic crash, n* | 10 | - | - |
| Gunshot wound, n* | 2 | - | - |
| Stab wound, n* | 2 | - | - |
| Assault, n* | 2 | - | - |
| Sexual assault, n* | 1 | - | - |

SD = standard deviation; IQR = interquartile range; ISS = injury severity score; ICU = intensive care unit.
*Total of mechanism of injury is >16 due to multiple mechanisms in some patients.

Table 4. χ^2 calculation* for blunt v. penetrating mechanism

| | Blunt trauma | Penetrating trauma | Total |
|-------------------|--------------|--------------------|-----------------|
| Fetus died, n | 12 | 3 | 15 |
| Fetus survived, n | 30 | 10 | 40 |
| Total, n | 42 | 13 | 55 [†] |

* χ^2 0.151; p=0.697.
[†]N=55 is lower than the overall reported outcomes (n=61), as mechanisms that were not blunt or penetrating trauma were excluded, as well as patients who sustained blunt and penetrating trauma.

trauma is placental abruption,^[2,5,6,11] and fetal monitoring must be undertaken in pregnant trauma patients of >20 weeks' gestation.^[6] If the fetus is viable, fetal monitoring is indicated for at least 4 - 6 hours.^[2,6,9] If uterine contractions are noted or the mechanism of trauma is significant, monitoring should be continued for at least 24 hours.^[2,9] Trauma may result in maternal-fetal haemorrhage, which may result in sensitisation of the Rh-negative mother. The Kleihauer-Betke test can detect maternal-fetal haemorrhage. If it is confirmed, appropriate Rh prophylaxis should be administered to the mother.^[2,6,9] Late in pregnancy, delivering of the fetus may facilitate the management of the mother. Careful consideration must be given to expediting the delivery of the fetus – this discussion needs to be multidisciplinary and consider opinions from obstetricians, neonatologists and intensive care specialists.^[9] In our series, only 1 emergency caesarean section was performed.

The risk factors for fetal loss include the severity of the physiological insult, as evidenced by the increased ISS, serum lactate and SI in the cohort of patients who experienced fetal loss. The mechanism of trauma is not directly associated with fetal loss, although high-velocity blunt trauma and direct penetrating injury to the abdomen are associated with fetal death. The need for laparotomy is associated with a high rate of fetal loss.

Conclusions

Trauma in pregnancy is uncommon, but is associated with a high rate of fetal loss. Risk factors for fetal loss include the severity and the mechanism of trauma. The management of the mother must take priority over other considerations. Only in late pregnancy must consideration be given to delivering the fetus.

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1. Muckart DJJ. Trauma - the malignant epidemic. *S Afr Med J* 1991;79(2):93-95.
2. Petrone P, Marini CP. Trauma in pregnant patients. *Curr Probl Surg* 2015;52(8):330-351. <https://doi.org/10.1067/j.cpsurg.2015.07.001>
3. American College of Surgeons. *Advanced Trauma Life Support Student Course Manual*. 10th ed. Chicago: ACS, 2018.
4. Wall SL, Figueiredo F, Laing GL, Clarke DL. The spectrum and outcome of pregnant trauma patients in a metropolitan trauma service in South Africa. *Injury* 2014;45(8):1220-1223. <https://doi.org/10.1016/j.injury.2014.04.045>
5. Warner M, Salfinger S, Rao S, Magann E, Hall J. Management of trauma during pregnancy. *A N Z J Surg* 2004;74:125-128. <https://doi.org/10.1046/j.1445-1433.2003.02914.x>
6. Brown HL. Trauma in pregnancy. *Obstet Gynecol* 2009;114(1):147-160. <https://doi.org/10.1097/aog.0b013e3181ab6014>
7. Petrone P, Asensio JA. Trauma in pregnancy: Assessment and treatment. *Scand J Surg* 2006;95(1):4-10. <https://doi.org/10.1177/145749690609500102>
8. Awwad JT, Azar GB, Seoud MA, Mrouh AM, Karam KS. High-velocity penetrating wounds of the gravid uterus: Review of 16 years of civil war. *Int J Gynecol Obstet* 1994;82(2):259-264. [https://doi.org/10.1016/0020-7292\(94\)90497-9](https://doi.org/10.1016/0020-7292(94)90497-9)
9. Jain V, Chari R, Maslovitz S, et al. Guidelines for the management of a pregnant trauma patient. *J Obstet Gynaecol Can* 2015;37(6):553-571. [https://doi.org/10.1016/s1701-2163\(15\)30232-2](https://doi.org/10.1016/s1701-2163(15)30232-2)
10. Petrone P, Talving P, Browder T, et al. Abdominal injuries in pregnancy: A 155-month study at two level 1 trauma centers. *Injury* 2011;42(1):47-49. <https://doi.org/10.1016/j.injury.2010.06.026>
11. Battaloglu E, McDonnell D, Chu J, Lecky F, Porter K. Epidemiology and outcomes of pregnancy and obstetric complications in trauma in the United Kingdom. *Injury* 2016;47(1):184-187. <https://doi.org/10.1016/j.injury.2015.08.026>

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