South African Journal of Surgery. 2021;59(1):26a-26e
https://doi.org/10.17159/2078-5151/2021/v59n1a3200

South African Journal of Surgery
ISSN 038-2361

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A review of blunt pelvic injuries at a major trauma centre in South Africa

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Background: The collective five-year experience with the acute management of pelvic trauma at a busy South African trauma service is reviewed to compare the usefulness and applicability of current grading systems of pelvic trauma and to review the compliance with current guidelines regarding pelvic binder application during the acute phase of resuscitation.
Methods: A retrospective review was conducted over a 5-year period from December 2012 to December 2017 on all polytrauma patients who presented with a pelvic fracture. Mechanism of injury and presenting physiology and clinical course including pelvic binder application were documented. Pelvic fractures were graded according to the Young–Burgess and Tile systems.
Results: There was a cohort of 129 patients for analysis. Eighty-one were male and 48 female with a mean age was 33.6 ± 13.1 years. Motor vehicle-related collisions (MVCs) were the main mechanism of injury (50.33%) and pedestrian vehicle collisions (PVCs) were the second most common (37.98%). The most common associated injuries were abdominal injuries (41%), chest injury (37%), femur fractures (21%), tibia fractures (15%) and humerus fracture (14.7%). Thirty patients in this cohort (23%) underwent a laparotomy. They were mainly in the Tile B (70%) and lateral compression (63%) groups. Nine patients underwent pelvic pre-peritoneal packing. Thirty-five (27%) patients were admitted to ICU. Fifteen (12%) patients died. The Young–Burgess classification had a greater accuracy in predicting death than the Tile classification. Forty per cent of deaths occurred in ICU, 33% died secondary to a traumatic brain injury (TBI). Twenty per cent died in casualty and 6.6% in the operating room from ongoing haemorrhage. A pelvic binder was not applied in 66% of patients. In the 34% of patients who had a pelvic binder applied, it was applied post CT scan in 24.8%, in the pre-hospital setting in 7.2%, and on arrival in 2.4% of patients. In 73% of deaths, a binder was not applied, and of those deaths, 54% showed signs of haemodynamic instability
Conclusion: It would appear that our application of pelvic binders in patients with acute pelvic trauma is ad hoc. Appropriate selection of patients, who may benefit from a binder and it's timely application, has the potential to improve outcome in these patients.

Background

Acute pelvic trauma usually occurs secondary to major blunt force and is associated with significant mortality and morbidity.[1,2] Approximately 15% to 30% of patients with pelvic trauma will be haemodynamically unstable and this instability is often directly as a result of blood loss from the pelvic injury. This haemorrhage due to major pelvic disruption can rapidly be fatal but may be difficult to control as it has both a venous and an arterial source.[1-5] The main focus of the management of acute of pelvic trauma is to resuscitate the patient and to control the pelvic haemorrhage. Almost all algorithms for the acute management of pelvic trauma advise the use of a pelvic binder or compression device to realign the pelvic bones and to physically tamponade the bleeding.[6-11] Once this has been achieved, the next step depends on the clinical circumstances and the results of advanced imaging. Pre-peritoneal packing of the pelvis may be required, and interventional radiology may be used to embolise any overt source of pelvic bleeding.[11-18] Laparotomy may also be necessary depending on the associated injuries identified. Formal pelvic stabilisation devices may also be used in the acute situation. The recent introduction of retrograde endovascular balloon occlusion of the aorta (REBOA) has added a further modality to the above armamentarium.[19] Although clinical judgement and discernment are required in deciding on the appropriate strategy, the choice of strategy is highly dependent on local logistics and the availability of resources. This project aims to review the collective five-year experience with the acute management of pelvic trauma at a busy South African trauma service and to compare the usefulness and applicability of current scoring and grading systems of pelvic trauma.

Materials and methods

Clinical setting

The study was based at the Pietermaritzburg Metropolitan Trauma Service (PMTS), Pietermaritzburg, South

Africa. PMTS provides definitive trauma to the city of Pietermaritzburg, the capital of KwaZulu-Natal (KZN) province. PMTS is the largest academic trauma centre in western KZN and is the tertiary trauma referral centre covering a total catchment population of over three million people. Each year, over 4 000 trauma cases are admitted. PMTS maintains a formal regional trauma registry and all patients who present to our trauma centre are prospectively entered into the database; the information entered includes details regarding injury mechanism, operative intervention, patient progress and clinical outcomes. Although computed tomography (CT) scan is readily available, access to interventional radiology and endovascular techniques is very limited. Recently REBOA has been made available but our clinical experience with this modality is nascent.

The study

A retrospective review was conducted over the 5-year period from December 2012 to December 2017 on all polytrauma patients who presented with a pelvic fracture to PMTS. Basic demographic details including age and gender were reviewed. Specific information was sought from the pre-hospital emergency medical rescue service (EMRS) documentation in relation to the location of the incident, transport time and time of arrival at our trauma centre. Further clinical information reviewed included the body regions injured, operative interventions, need for intensive care unit (ICU) admission, morbidity and mortality. All pelvic radiographs were reviewed by the primary author (AA) and classified using the Tile and Young–Burgess classifications.[20,21]

Results

Outcome

A total of 325 patients were reviewed. All patients below the age of 18 years (61), all patients who had inadequate documentation (19), all patients who did not have a pelvic fracture on review of plain pelvic x-rays (40), and all patients whose imaging was done at base and not repeated on arrival at our centre (76) were excluded. This left a cohort of 129 patients for analysis. There were 81 male and 48 female patients, and the mean age was 33.6 ± 13.1 years. Motor vehicle-related collisions (MVCs) were the main mechanism of injury (50.33%) and pedestrian vehicle collisions (PVCs) were second most common (37.98%) (Table I).

Table I: Mechanism of injury for all 129 patients

Mechanism	Freq.	Per cent
Assault	1	0.78
Community assault	1	0.78
Fall from height	6	4.65
Fall from moving vehicle	3	2.33
Farming implement	1	0.78
Hit by a train	1	0.78
MVC	65	50.33
PVC	49	37.98
Tractor ran over abdomen	1	0.78
Truck reversed over pelvis	1	0.78
Total	**129**	**100.00**

Fracture classification

All the pelvic fractures were classified by the primary author according to both the Tile and Young–Burgess classifications. Table II categorises all the pelvic fractures according to the above two classification systems. Tile B and lateral compression (LC) pelvic fracture types tended to be more likely to be haemodynamically unstable (pH < 7.30, lactate > 3). Lactate levels were highest in Tile B group (mean = 4.63) and LC group (mean = 5.1). Patients were more acidic (pH < 7.30) in the Tile C group (42%) and LC group (74%). There was no significant difference with the shock index between groups. The study was underpowered as the Tile A, Tile C, anterior-posterior compression (APC) and vertical shear (VS) groups had small sample sizes. The most common associated injuries identified were abdominal injuries (41%), chest injury (37%), femur fractures (21%), tibia fractures (15%) and humerus fracture (14.7%) (Table II).

Table II: Cross tabulation of Young–Burgess classification and Tile classification systems

		Tile classification			
		Tile A	**Tile B**	**Tile C**	**Total**
Young–Burgess classification	LC	14	69	2	85
	APC	5	15	3	23
	VS	0	0	21	21
	Total	**19**	**84**	**26**	**129**

LC – lateral compression, APC – anterior-posterior compression, VS – vertical shear

Management

Thirty patients in this cohort (23%) underwent a laparotomy. They were mainly in the Tile B (70%) and LC (63%) groups ($p = 0.36$ to $p = 0.63$ respectively). Eleven out of 30 (36%) patients who underwent a laparotomy sustained a bladder injury, nine (30%) sustained a splenic injury, eight (26%) a liver injury and two a urethral injury (1.5%). Of the bladder injuries, three were extra-peritoneal, ten intra-peritoneal and one a combined intra- and extra-peritoneal injury. A total of nine (7%) patients were managed with pelvic peritoneal packing. There were seven in whom packing occurred at laparotomy and two in whom packing was done without recourse to a laparotomy. No patients underwent interventional embolisation for ongoing pelvic bleeding. REBOA was not used in any of these patients.

Clinical course

A total of 35 (27%) patients were admitted to the ICU. There was no significant difference between the Tile and Young–Burgess groups ($p = 0.77$ to $p = 0.81$) with regard to ICU admission. Fifteen (12%) patients died. The causes of death are summarised in Table III. Five deaths were due to traumatic brain injury (TBI), eight due to haemodynamic instability and two due to sepsis. The Young–Burgess classification had a greater accuracy in predicting death than the Tile classification ($p = 0.19$ to $p = 0.63$ respectively). Of

Table III: Causes of death			
Deaths	Binder applied (Y/N)	Binder indicated (Y/N)	Cause of death
1	No	Yes	Traumatic brain injury
2	No	No	Traumatic brain injury
3	No	No	Traumatic brain injury
4	No	Yes	Traumatic brain injury
5	No	Yes	Traumatic brain injury
8	No	No	Septic shock
11	No	No	Septic shock
6	No	Yes	Hypovolaemic shock
7	Yes	No	Hypovolaemic shock
14	No	Yes	Hypovolaemic shock
15	No	Yes	Hypovolaemic shock
12	Yes	No	Hypovolaemic shock
9	Yes	No	Intra-abdominal bleed, died on table, also massive head injury
10	No	Yes	Disseminated intravascular coagulation
13	Yes	No	Disseminated intravascular coagulation

note, 40% of deaths occurred in ICU, 33% died secondary to a TBI. Twenty per cent died in casualty and 6.6% (1) in the operating room from ongoing haemorrhage. The death in the operating room was a result of massive head injury as well as major intra-abdominal injuries (Table III).

Use of pelvic binder

A pelvic binder was not applied in 66% of patients. In the 34% of patients who had a pelvic binder applied, it was applied post CT scan in 24.8%, in the pre-hospital setting in 7.2%, and on arrival in 2.4% of patients. In 73% of deaths, a binder was not applied, and of those deaths, 54% showed signs of haemodynamic instability (Table IV).

Discussion

Fractures of the bony pelvis are still associated with a high mortality rate and the acute mortality is mostly due to uncontrolled pelvic haemorrhage.[1-6] The acute management strategies are intended to control haemorrhage and include resuscitation and urgent stabilisation of the fractured pelvis, followed either by imaging or urgent surgery. There are several broad strategies and options. The literature provides little definitive guidance on the place of all these modalities and it is difficult to produce a universal clinical algorithm as local logistical factors and prejudices impact greatly on the management approach.

The Advanced Trauma Life Support (ATLS) course of the American College of Surgeons advocates urgent application of a pelvic binder in an attempt to realign the disrupted pelvis and to temporise bleeding.[6] Our own compliance with this recommendation appears to be poor and a pelvic binder was not applied in 66% of patients. In the 34% of patients who had a pelvic binder applied, it was applied post CT scan in 24.8%, in the pre-hospital setting in 7.2%, and on arrival in 2.4% of patients. Of note, in 73% of deaths, a binder was not applied, and of those deaths, 54% showed signs of haemodynamic instability. Although our local policy is to follow the ATLS guidelines and apply pelvic binders routinely on all patients with a suspected pelvic fracture, it is apparent that this is not being done. Our centre is a tertiary level hospital which receives patients from numerous district and regional institutions by a plethora of different ambulance services. This makes it difficult to ensure conformity and consequently adherence to our pelvic binder application protocol appears to be heterogeneous. Ongoing educational and outreach efforts are required to change this.

Table IV: Use of pelvic binder		
Binder status	**Freq.**	**Per cent**
Pre-hospital	9	7.20
At arrival	3	2.40
Post scan	31	24.80
No binder	86	65.60
Total	**129**	**100.00**

A lack of consistency in the application of a pelvic binder is not unique to our setting. A major review of pelvic trauma in Great Britain identified 140 patients with major pelvic trauma.[10] Although this group had a higher rate of binder application (110/140), the authors felt that the binder was applied properly in less than half of patients (54; 49.1%). Of note, they found that 30/67 (44.8%) patients with a pelvic ring injury did not have a binder applied. Six (20%) of these patients had an unstable injury and the reported mortality rate in this subset was 9/67 (13%). A study from the United States also demonstrated poor compliance with pelvic binder application.[9] No binder was applied in 37% of patients with an unstable anterior-posterior compression or vertical shear injury. It would appear that the use of the pelvic binder is heterogeneous even in regions with more developed trauma systems.

In a ten year overview of pelvic trauma from Ontario, the authors reported a mortality rate of 11% at thirty days, whilst 6% of patients required angiography and 12.7% a laparotomy. Our own mortality rate was 12%, although we had a much higher rate of laparotomy (23%).[4] The reasons for our high rate of laparotomy are opaque and may be related to our delays in transfer to definitive care and our lack of access to interventional radiology. None of our patients underwent interventional radiology to embolise pelvic bleeding.[12-14] The force required to produce a pelvic fracture often results in intra-abdominal injuries. The reported incidence of such injuries varies from 11% to 20.3%. In the Canadian series, the incidence of solid visceral injury was 12%.[4] Our data is very much in keeping with these figures. The use of pre-peritoneal packing to tamponade pelvic bleeding was first proposed from the Scandinavian countries over a decade ago.[16-18] It has been widely adopted and we make use of this modality. It may be performed as a distinct procedure; however, if there is concern about an associated intra-abdominal injury, then it may be performed in conjunction with a laparotomy. We used this modality in nine patients. In seven, it was performed at laparotomy, and in two it was performed without recourse to a laparotomy. Not all unstable patients with a fractured pelvis undergo pelvic packing. If the source of haemodynamic instability is not the pelvic fracture but rather an associated injury, then pelvic packing may be eschewed. This requires clinical discernment.

The primary area for quality improvement revolves around the patients who died. In five of the 13 (38%), the cause of death was a TBI, and in two (15%), sepsis. The single patient who died in the operating room had a severe TBI as well as major intra-abdominal injuries and a pelvic fracture. However, in the remaining seven (65%) patients, pelvic haemorrhage was the cause of death. In half of this cohort, a pelvic binder was not applied. The nature of pelvic trauma means that there is a great deal of clinical vagary in the management of these severely injured patients. Whether angiography or REBOA would have impacted this outcome is unclear.[19]

Conclusion

Our outcomes for pelvic trauma appear to be similar to those reported in the literature. We have identified potential areas for quality improvement. It would appear that our compliance with current recommendation in the application of pelvic binders in patients with acute pelvic trauma is ad hoc and poorly thought through. This needs to be addressed with ongoing education and propagation of clinical algorithms.

Conflict of interest

The authors have no conflicts of interest for the generation of this work. VY Kong, DL Clarke, GL Laing and JL Bruce are current ATLS instructors.

Funding source

None.

Ethical approval

Ethics approval for the maintenance of this registry for both clinical care and research has been provided by the Biomedical Research Ethics Committee (BREC) of the University of KwaZulu Natal (UKZN). The ethics number is BCA 221/13.

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