

Abdominal trauma in urban Papua New Guinea

PONIFASIO PONIFASIO¹, H. OKTI POKI¹ AND DAVID A.K. WATTERS^{1,2}

Division of Surgery, Department of Clinical Sciences, University of Papua New Guinea,
Port Moresby

SUMMARY

Background. Trauma is the commonest cause of surgical admission in Papua New Guinea, accounting for around 30% of cases in Port Moresby and over 40% in the highlands. The abdomen is traumatized in about 10-15% of trauma cases. In malarial endemic areas the enlarged spleen is particularly prone to rupture although earlier studies showed that this injury can often be managed conservatively. **Aim.** To determine the pattern and outcome of abdominal injury in the two largest cities, Port Moresby and Lae, in the 1990s. **Methods.** A retrospective study of 213 adult admissions for abdominal trauma in Port Moresby and a prospective study of 98 adult abdominal trauma patients in Lae. In both centres malaria is endemic. Statistical analysis where appropriate was made using the χ^2 test. **Results.** Abdominal trauma was more likely to affect men outside the home and women in the home. Assault was responsible for 72% of cases of abdominal trauma. Women were assaulted by their husbands in two-thirds of cases. The spleen was the most likely organ to be injured, particularly in blunt trauma. Road traffic accidents caused only 10% of admissions with abdominal trauma. Most patients were admitted with a single injury. Splenic injury was managed nonoperatively in over 60% of cases. The negative laparotomy rate was 7% in Port Moresby and 20% in Lae, but negative laparotomy did not cause any deaths or extra morbidity. 17 patients (5.5%) died, the highest case fatality rate being 29% in a group of 31 patients with an injury severity score of 25 or greater. **Conclusion.** The pattern of abdominal trauma reflects the culture of Papua New Guinea and the different spectrum of risks to men and women. Once patients reach hospital they tend to do reasonably well although there is room for improvement, particularly with early assessment of the extent of the injury. The enlarged spleen is prone to injury and in those cases requiring laparotomy it is difficult to conserve. Many cases of ruptured spleen can be treated nonoperatively.

Introduction

Trauma is the commonest cause of surgical admission in Papua New Guinea (PNG), accounting for around 30% of cases in Port Moresby (1) and over 40% in the highlands (2). The abdomen is traumatized in about 10-15% of trauma admissions in PNG (1,2). The enlarged spleen is particularly prone to rupture with the result that many patients are admitted with ruptured spleen due to blunt trauma (3,4). In the highlands traditional weapons are commonly used in clan and other disputes with

the result that abdominal injuries due to arrow wounds are frequently encountered (5).

This study was undertaken to determine the pattern and outcome of abdominal injury in two urban centres, Port Moresby and Lae.

Methods

A 2.5-year retrospective audit was conducted between 1 February 1992 and 30 June 1994 in Port Moresby. 213 cases were identified from the Port Moresby surgical audit

¹ Division of Surgery, Department of Clinical Sciences, Faculty of Medicine, University of Papua New Guinea, PO Box 5623, Boroko, NCD 111, Papua New Guinea

² Present address: Department of Surgery, The Geelong Hospital, PO Box 281, Geelong, Victoria 3220, Australia

which was commenced in February 1992 and all case notes were also examined. Injury severity and revised trauma scores were calculated. All cases of abdominal trauma over the age of 13 years were included. The only cases excluded were those who had been initially managed and operated on outside of Port Moresby.

A prospective study of all patients with abdominal trauma admitted to Angau Memorial Hospital in Lae used data collected from mid-January 1996 to 24 December 1996. There were 98 adult patients with abdominal trauma. 5 paediatric cases were excluded from the study. Those patients that were stable enough to undergo ultrasound scanning (USS) were scanned as soon as possible by the radiologist as part of the initial assessment. All data were collected and recorded in a specifically designed protocol. Each patient was managed according to the presentation diagnostic findings and progress of the case. After discharge from the ward, each patient was seen at the review clinic at one week, one month and three months.

CT scanning was not available to assess abdominal trauma during the period of study. Ultrasound was available on a selective basis during the working day but not as a 24-hour service. Injury severity was graded using the revised trauma score (RTS) and the injury severity score (ISS). All data were analyzed using standard statistical methods and statistical significance was calculated using the χ^2 test.

The injury severity score is an anatomical score based on the severity of injury at the three most injured sites (abbreviated injury scale). The score at each site ranges from 1 to 6 where 1 is mild and 6 is unsurvivable. Each score at each site is squared and the squares are summated to calculate the injury severity score. An ISS >16 is regarded as a severe injury (6).

The revised trauma score is a measure of the physiological derangement at the time of admission. It is calculated from the systolic blood pressure, the respiratory rate and the Glasgow Coma Scale. Highest is best and the top score of 7.84 is calculated for fully conscious patients without hypotension or respiratory distress (7-9).

Results

Age and sex

There were 311 patients admitted with abdominal trauma, 214 males and 97 females. The ages ranged from 13 to 56 years with a mean of 27 years. In 4 patients the age was not known and no estimate had been recorded.

Cause of trauma

Table 1 shows the causes of trauma in both centres. Assault was responsible for 72% of injuries and motor vehicle accidents for 10%.

TABLE 1

CAUSES OF ABDOMINAL TRAUMA IN PORT MORESBY AND LAE

Cause	Port Moresby	Lae	Total	%
Assault	161	64	225	72
Accident	18	14	32	10
Motor vehicle	18	12	30	10
Sports	12	8	20	6
Self-inflicted	4	0	4	1
Total	213	98	311	

Violence

Violence was the cause of abdominal trauma in 229 (74%). 85% of women suffered abdominal trauma as a result of violence compared with 75% of men ($\chi^2 = 7.1$, $p < 0.01$). However, women were much more likely than men to be injured in the home than out of it (Table 2, $\chi^2 = 99.7$, $p < 0.001$). 86% of assaults on women occurred at home compared with 19% of assaults on men.

Violence outside the home was responsible in 132 cases. In 62 cases it was a fight between people who were socializing together and in 45 cases criminals (raskols) were responsible. In 9 cases security guards caused the injury, in 4 missiles were thrown and in 11 the cause was stated to be 'unknown' by the victim. Only 11 women were injured outside

TABLE 2

PLACE OF VIOLENCE FOR MEN AND WOMEN IN
PORT MORESBY AND LAE

Sex	Domestic	Nondomestic	Total
Men	27	121	148
Women	70	11	81
Total	97	132	229

the home. Of the 97 victims of domestic violence, 70 (72%) were women. Husbands were responsible in 64 (66%), wives in 9, relatives in 16, in-laws in 8.

Blunt versus penetrating trauma

Blunt trauma caused 199 injuries and penetrating 112. Women suffered proportionately more blunt trauma than men ($\chi^2 = 17.63$, $p < 0.001$). Penetrating trauma was more common in Port Moresby (44%) than Lae (19%). In Port Moresby the causes of penetrating trauma in 93 cases were stab wounds in 67, gunshot in 14, spears in 5, and 1 case each of axe, arrow, bomb and grenade wounds. In 3 cases the cause of penetrating trauma was not specified. Gunshot injuries were due to raskols or unknown assailants in every case except for one domestic incident.

Organ injured and management

The spleen, which was injured in 47% of cases, was the most commonly injured organ in abdominal trauma (Table 3).

In Lae clinical assessment of splenic trauma was compared with ultrasound scanning. Out of 60 cases of ruptured spleen, USS was performed in 53 cases. In only one case was the clinical and ultrasound diagnosis different. In 7 cases ultrasound was not performed because the patient was unstable and was taken straight to theatre. Only 15 of the 60 splenic injuries were operated on in Lae, splenectomy being performed on every occasion because of the difficulty in conserving an enlarged spleen.

A conservative approach to the management of blunt injuries was also used in Port Moresby but in the years of the study (1992-1994)

ultrasound was not routinely performed. In Port Moresby only 25 of 59 blunt injuries (42%) required a laparotomy. Two of these had been misdiagnosed as an ectopic pregnancy and two had other injuries (colon and kidney). One had had a ruptured spleen for some days before admission, gave no history of trauma, and was operated on for painful abdominal distension and ileus. 11 splenic injuries were due to penetrating trauma and required laparotomy. In only 2 penetrating injuries was the spleen the only organ injured. In the others there were multiple injuries including 4 diaphragmatic perforations, 1 stomach laceration, 2 small bowel injuries and 1 colonic injury. In Port Moresby 115 laparotomies were performed, 8 (7%) of which were negative for exploration of a penetrating wound.

The lower incidence of penetrating trauma in Lae meant that only 30 operations were

TABLE 3

ORGANS INJURED IN ABDOMINAL TRAUMA

Organ injured	Port Moresby	Lae	Total
Spleen	87	60	147
Liver	20	3	23
Kidney	11	5	16
Small intestine	30	2	32
Colon	22	2	24
Omentum	16		16
Pancreas and duodenum	5		5
Stomach	8		8
Mesentery	7		7
Wound only or negative	12	9	21
Bruised abdomen/soft tissues	13	13	26
Gall bladder	2		2
Bladder	2	1	3
Diaphragm	6	2	8
Unknown /other	22		22

In some cases there were multiple organ injuries so the numbers of organs injured do not add up to the number of patients

performed for abdominal trauma – 15 splenectomies (25% of all splenic injuries), 2 nephrectomies, 4 bowel injuries, 2 diaphragm repairs and 1 bladder repair. There were 6 negative laparotomies (20% of all explorations) performed for penetrating abdominal wounds with no organ involvement. One also had a thoracotomy, but he died on the table and the details of this case will be described below. In neither centre did a negative laparotomy cause death or any extra morbidity beyond recovery from the laparotomy itself.

Outcome and severity of injury

17 patients died, 11 in Port Moresby and 6 in Lae, an overall case fatality rate of 5.5%. The injury severity scores are shown in Table 4. The majority of patients had single injuries as is evident from 90% of patients having an ISS of less than 25. 4 deaths in Port Moresby had a revised trauma score of greater than 7 (maximum is 7.84) and 2 were between 6 and 7 on admission. In Lae 2 patients died with an RTS of over 7 and 1 between 6 and 7.

TABLE 4

SEVERITY OF INJURY AND MORTALITY OF ADMISSIONS DUE TO ABDOMINAL TRAUMA

ISS	Lived	Died	Case fatality rate (%)
1-8	66	1	1.5
9-15	95	4	4.0
16-24	111	3	2.6
≥25	22	9	29.0
Total	294	17	5.5

ISS = Injury severity score

Causes of death

It is often difficult to obtain post-mortem examinations in Papua New Guinea, even for trauma cases. However, the cause of death was unknown in only one case. In Port Moresby 11 patients died. None died of haemorrhagic shock in the resuscitative phase. All had an ISS of 16 or more. The causes of death were faecal peritonitis (5 cases) – in 2 cases

appropriate surgery although undertaken was delayed – renal failure (3 cases), shock with disseminated intravascular coagulation (2 cases) and 1 was unknown. In Lae there were 6 deaths, 3 of whom died postoperatively, 1 died during conservative management and 2 died during the resuscitation period – one suffered a penetrating knife injury to the left lower chest piercing the diaphragm and spleen and the other had a splenic rupture with severe blood loss. Among the postoperative deaths, one died due to hypovolaemic shock from a knife wound to the right lower chest. A thoracotomy done an hour after he was brought to the hospital revealed an intercostal artery that was severed and piercing of the diaphragm. The patient succumbed despite control of the bleeding vessel due to being exsanguinated on arrival. The other two died several hours after splenectomy because they had been severely shocked and were given inadequate postoperative ventilation. One death from the conservative management of a splenic injury was a female who was treated for ruptured spleen and who was stable for about 14 days. A progress ultrasound scan showed a large haematoma still present in the lower part of the spleen so splenectomy was planned for the surgical list on the next day. Tragically she collapsed and died in the bathroom the night before operation.

Discussion

The pattern of abdominal trauma in Papua New Guinea is somewhat different from that in developed countries. The incidence of laparotomy for abdominal trauma has increased in the last 30 years. The proportion of trauma out of all abdominal procedures has also risen from 13% to 26% in the period from 1968 to 1998 (10,11).

Papua New Guinea has a very high road accident fatality rate in the order of 70 per 10,000 registered vehicles (12). Although the number of road accidents increased by 400% between 1968 and 1978 it has since then levelled off (13,14). Previous studies based on autopsy showed that motor vehicle accidents are responsible for 56% of all trauma deaths with abdominal injuries being the third most common cause of death from trauma after head and chest injuries (15). There were 63 deaths

due to abdominal trauma out of 305 deaths over 5 years. 45 of the deaths involved the liver, 21 of which also had a second intra-abdominal injury (15). A much smaller proportion (10%) of admissions (as opposed to deaths) with abdominal trauma are due to motor vehicle accidents than are due to assault (72%). Road accidents are responsible for 30% of all trauma admissions in Port Moresby but musculoskeletal trauma accounts for the highest proportion of this (1). Similar findings have been previously reported from Mendi in the Southern Highlands where only 4 of 60 abdominal injuries were due to motor vehicle accidents, which were responsible for 14% of all trauma admissions (2). Falling out of the back of an open utility is a particular type of accident which is common in PNG (16). Although seat belts have become compulsory in PNG the rule is rarely enforced (17,18) and there is also no breathalyser available to curb the effects of alcohol despite high levels of drinking and driving (19).

Penetrating injuries to the abdomen are most commonly due to stab wounds in Port Moresby and Lae. Stab wounds tend to be low velocity and often single so that damage is limited to the track of the stab and the mortality for those who reach hospital is low. However, the incidence of gunshot injuries is unfortunately rising (2,20). There were only 6 coroner deaths from gunshot wounds in the 5 years 1976-1980 (11) but 14 gunshot deaths in hospital admissions in a study of surgical mortality 1996-1998 (21). Arrow wounds are still common in some areas of the highlands (5) but the current study shows that they are rare in PNG's two biggest cities.

Assault is the major cause of trauma in Papua New Guinea. This study has found that women are more likely to be assaulted in the home by their husband or another family member whereas men are more likely to be injured outside the home. Other studies have found this to be true for all types of trauma not just abdominal trauma (1,2). Violence against women is common in PNG and even women themselves often accept this (22). Despite the Law Reform Commission reports of the 1980s (23-25) there has been little incentive to tackle this problem politically despite increasing evidence that women face the most danger

from their own spouses. It is to be hoped that education will gradually reduce this worldwide problem which is particularly rife in PNG. In the highlands trauma to women is often caused by other women, the so-called 'second wife syndrome'. Polygamy is still legal in PNG although there have been many calls to discontinue it. There is unlikely to be a reduction in violence against women without a concerted effort by many sections of PNG society. Alcohol consumption by the victims (and presumably the perpetrators) of violence is another factor as autopsy studies in Port Moresby twenty years ago showed a blood alcohol level over 80mg/100ml in a fifth of the victims of assault (15).

The spleen is the most common organ to be injured in abdominal trauma. Chronic malaria and other tropical infections result in splenomegaly and thus an increased susceptibility to rupture. In one case from Lae in this series the spleen was so large that minimal trauma from driving over a pothole in a minibus with poor suspension led to its rupture. The two cases who were misdiagnosed as ectopic pregnancy and the one case who presented with abdominal distension and did not give a history of trauma until later are reminders that in the tropics the ruptured spleen can masquerade in a number of different ways.

Once rupture occurs up to two-thirds of cases are able to be managed conservatively following the recommendations from previous studies on splenic injury in this country (3,4). When laparotomy becomes necessary it is not easy to conserve an enlarged spleen at operation and the majority of splenic injuries needing laparotomy end up with a splenectomy. In those patients who have their spleens conserved there is a risk of developing a splenic cyst. However, when such a cyst develops it can usually be excised without removing the spleen (Figure 1). Following splenectomy it is important not only to give prophylaxis against the pneumococcus and *Haemophilus influenzae* type b but also against malaria as there have been case reports of deaths from malaria after splenectomy (26). In a study of the outcome of splenic injury from Rabaul, 88% of patients had malaria parasites in their peripheral blood smear when tested

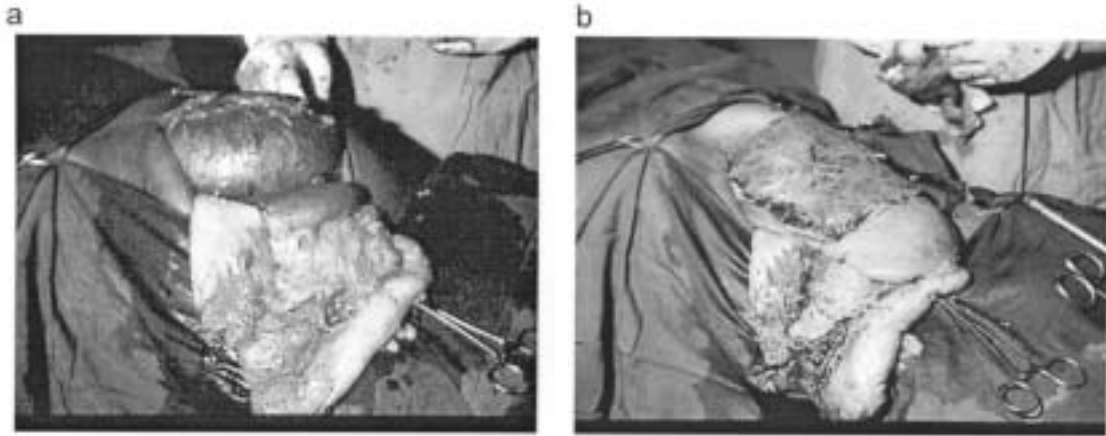


Figure 1. a. A subcapsular splenic cyst in a 25-year-old man presenting with an epigastric mass some months after abdominal/splenic trauma. b. The cyst was easily excised from the surface of the spleen, preserving the enlarged spleen.

1-10 years after splenectomy. This was significantly greater than the 30% in patients who had had their spleens conserved by nonoperative management (27). Although antimalarial prophylaxis should be lifelong few patients in PNG will comply.

In the tropics abdominal trauma must usually be managed without diagnostic backup. The key aspects are repeated clinical assessment and rapid transfer to theatre of patients who are unstable and in whom stopping the bleeding quickly is a life-saving aspect of resuscitation. Ultrasound assessment is a luxury for stable patients as ultrasound machines (and a radiologist to use them) are not available in the emergency rooms of tropical hospitals on a 24-hour basis. CT scanning is only available privately in Port Moresby although it is available in Suva, Fiji. However, clinical assessment is adequate for decision-making if the surgeon is willing to intervene whenever there is uncertainty or the patient's condition changes. We believe our results attest to this. We do not believe that any of the deaths occurred due to lack of investigations. However, some may have occurred because decisions were not made quickly enough on the basis of the clinical information available.

This study has shown that the outcome from abdominal trauma is usually good for those patients who reach hospital alive. However, the time from injury to arrival in hospital is usually longer than an hour and some die before arrival who would certainly be saved by

earlier resuscitation and operation. If transport to hospital were more efficient we might have seen more deaths in that some unavoidable deaths would have occurred after arrival. However, others may have been saved as in the case of three patients in Lae who died despite surgery to stop the bleeding. Avoidable deaths from abdominal trauma still occur. A previous study in Port Moresby found 3 potentially avoidable deaths from abdominal trauma (1). A recent audit of 300 surgical mortalities showed there were 4 potentially avoidable deaths from abdominal trauma in Port Moresby in the years 1996-1998 (21). Our results have therefore been presented in the knowledge that there is room for improvement, but we expect the improvement to come from better clinical decision-making rather than the introduction of new technology or ordering more investigations.

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