PST | PEDIATRIC SURGERY IN TROPICS

GUNSHOT WOUNDS IN CHILDREN IN THE WESTERN CAPE: A CHANGE IN INCIDENCE WITH A REVIEW OF PROPOSED PREVENTATIVE MEASURES

Mohamed Abdelsalam, Corné de Vos

Division of Pediatric Surgery, Tygerberg Hospital, Stellenbosch University, Cape Town

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Keywords	**Abstract**
Gunshot wounds Prevention Trauma	**Introduction:** Globally abdominal gunshot injuries in children seem rare with reported incidence of 0.55 per 100,000 in the last 10 years. It is more prevalent in war zones, countries with urban violence and undefined legal regulation. In the United States of America (USA) gunshot related injuries is responsible for 20,000 visits to the emergency department and leading cause of death for these children in the USA. In South Africa the incidence seems lower with 163 patients included between 2001-2011 in a study published in 2004. **Case presentation:** We present a case series of 5 children that were treated in our department, a level 2 Paediatric trauma unit, in 2024. Age of presentation ranged from 3-11 years, the majority (3:2) being male. All 5 children were injured unintentionally. They were all resuscitated, underwent radiological investigations and were taken for emergency laparotomies, all with positive outcomes. **Conclusion:** Abdominal injuries secondary to gunshots can be the cause of severe morbidity and mortality in children. Patient care requires a dedicated trauma center and multidisciplinary team approach. Furthermore, non-operative approaches seem to be a feasible option in dedicated pediatric trauma centers. More research is needed specifically in

	children to prove the efficiency of this approach. We recommend following the preventive strategies suggested by the CDC and WHO coupled with community education and restriction of firearm availability to reduce the incidence of these unintentional GSW injuries in children.
Abbreviations	GSW/'s: Gunshot wound/s USA: United States of America RIF: Right iliac fossa Bpm: Beats per minute GCS: Glasgow coma scale CT: Computed tomography HECTIS: Hospital Emergency Centre Triage and Information System CDC: Center for Disease Control WHO: World Health Organization

INTRODUCTION

Globally abdominal gunshot injuries in children seem rare with a reported incidence of 0.55 per 100,000 in the last 10 years. [(1)] It is more common in war zones, countries with urban violence and undefined legal regulation. In the United States of America (USA) gunshot related injuries is responsible for 20,000 visits to the emergency department and is the leading cause of deaths in children in the USA. [(1)] In a local study conducted in South Africa by Redcross War Memorial Children's Hospital in 2004, 163 patients were admitted with GSW's between 2001-2011. [(2)]

We present a case series of 5 children that were treated in our department, a level 2 Pediatric trauma unit, in 2024. All 5 children were injured unintentionally. We have a subjected feeling that the number of children that present with gunshot injuries is increasing in our center, the majority of those being unintentional and likely preventable injuries.

We present our 5 cases, review the literature, and propose preventive measures to decrease these incidents.

CASE SERIES

Case 1:

An 11-year-old male was admitted to our unit with an abdominal gunshot wound secondary to crossfire. He sustained this injury as a result of being caught in the crossfire of gang violence while he was walking outside his house. On presentation he was conscious, oriented, afebrile, tachycardic and normotensive. Physical examination revealed an entrance wound on his left lower back and the bullet was palpable in the left anterior abdominal wall. (Fig 1a&b)

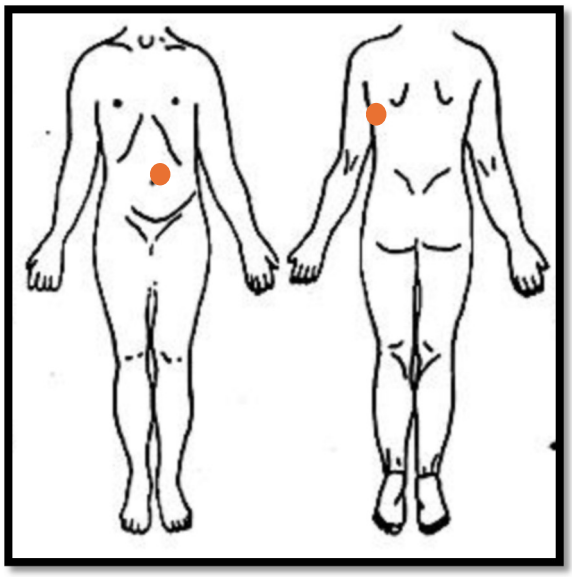

Fig 1a. Exit wound case 1, Fig 1b. Entrance wound case 1

The patient received fluid resuscitation, an arterial blood gas, full blood count, blood group and cross match were done. Low dose X-rays (Lodox) revealed no pneumoperitoneum with the bullet visible intra-abdominally. (Fig 2)

Fig 2. Lodox of 11-year-old with an abdominal GSW

The patient was taken for an exploratory laparotomy within two hours of admission, and the findings were as follows; a through and through gastric injury, through and through proximal jejunum injury as well as colonic injuries at both the splenic flexure and sigmoid colon. The gastric and jejunal injuries were repaired and a left hemicolectomy with colostomy was performed for the colonic injuries. Post-operatively the patient did well, they started feeding on day five post-surgery and were discharged home on day eight.

Case 2:

A 9-year-old male patient was admitted with a trans-pelvic gunshot. He was shot accidentally while he was playing outside his house when gang violence erupted. His vital signs on admission were representative of hypovolemic shock with a tachycardia. On examination an entrance wound in the right iliac fossa (RIF) and exit wound in the left gluteal region was identified. (Fig 3a&b) A Lodox was done revealing no pneumoperitoneum or other visible injuries. He was resuscitated and taken to theatre three hours after admission.

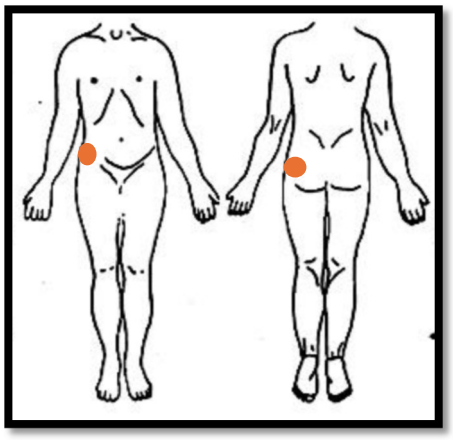

Fig 3a. Entrance wound case 2, Fig 3b. Exit wound case 2

Surgical findings included a through and through injury to the terminal ileum 30cm from the ileocecal valve, and a right intraperitoneal rectal injury. Ileal and rectal injuries were repaired, and a sigmoid colostomy was fashioned. Post-operatively the patient had an uneventful course and was discharged on day seven post-surgery.

Case 3:

Our youngest patient was a 4-year-old male that presented with an abdominal GSW with an entrance wound through the umbilicus and no visible exit wound. He was playing outside his house when local gangs started shooting. The bullet passed through a nearby adult before it penetrated the child's abdomen. The adult patient died on the field, while the child was rushed to hospital. On admission the patient had a heart rate of 92 beats per minute (bpm), a GCS of 15/15, respiratory rate of 28 breaths per minute and oxygen saturation of 100% on room air. Abdominal examination revealed tenderness in the center with no guarding or rigidity. A Lodox was done and revealed large, dilated loops of bowel, no pneumoperitoneum, and a visible bullet in the lower abdomen. (Fig 4) A computed tomography (CT) of the abdomen showed the bullet breeching the peritoneum with no free air or fluid collection or additional solid organ injury. The patient was resuscitated and taken to theater five hours after admission. Intra-operative finding revealed the bullet to be superficial, not penetrating the peritoneum, with no intra-abdominal organ injury.

Fig 4. Lodox of a 4-year-old with a superficial abdominal GSW

Case 4:

An 11-year-old female involved in a mass shooting while she was in a barbershop presented to our unit. During the same shooting her older sibling passed away from fatal GSW's. The 11-year-old girl was admitted to our hospital 5 hours after the incident. She was tachycardic with heart rate of 134 bpm, was febrile and had a GCS of 15/15. On examination it was revealed that she had an entrance wound in the right lower abdomen with an exit wound in the left buttock region. There was diffuse abdominal tenderness and guarding. Resuscitation was done and blood was sent for investigation and cross match. LODOX was performed which came back as normal.

CT abdomen revealed free air and free fluid in the pelvis suggestive of bowel injury, accompanied with left acetabular and iliac fractures. (Fig 5) A right retroperitoneal hematoma in zone 2 was the only intra-abdominal finding at laparotomy, done three hours after

presentation to the trauma unit. Orthopedic surgeons treated the acetabular and ileac fractures conservatively, and the patient was discharged on day twelve after surgery. Unfortunately, she is still suffering from the psychological trauma of the incident and is being followed by psychologists.

Fig 5. Abdominal CT reveals right acetabular fracture with pelvic free air and fluid collection

Case 5:

Our last, and most severe case was a 3-year-old female patient that presented with a GSW injury to her abdomen during a robbery at home. On presentation she was conscious, tachycardic with heart rate of 150 bpm and afebrile. The entrance wound was through her right lower back with an exit wound through her anterior abdominal wall. Abdominal examination showed eviscerated bowel. The rest of the examination was normal. CT abdomen highlighted the bowel evisceration and pneumoperitoneum with a large abdominopelvic fluid collection. (Fig 6a&b) Additionally, it revealed a fracture of the L4 vertebra with spinal canal displacement of bone fragments which was treated conservatively. She was taken to theatre, and an exploratory laparotomy was performed. Findings included multiple ileal perforations with a mesenteric injury. Bowel resection with a primary anastomosis was done. This case was complicated with an intra-abdominal collection requiring a pigtail insertion and treatment with

broad-spectrum antibiotics. She was discharged 19 days after admission with no further complications and no neurological fallout.

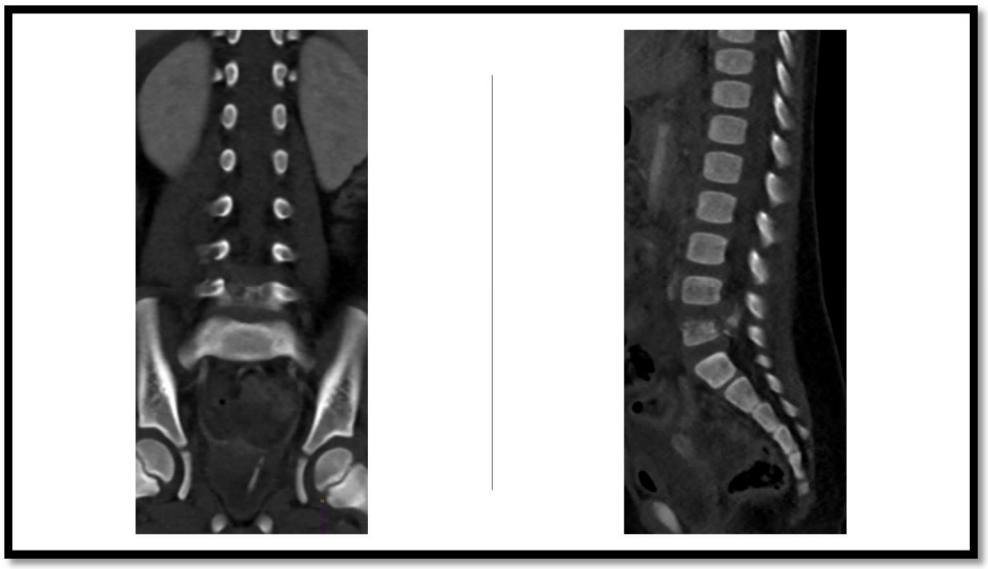

Fig 6a. Coronal view L4- 5 fracture, Fig 6b. Sagittal view L5 fracture

DISCUSSION

Gunshot injuries among children are a major clinical and public health problem that has become a growing concern. In an article from 2020, Daniel C Semenza stated that gunshot wound (GSW) injuries are the leading cause of child mortality in the United States of America (USA). [(3)] Locally in South Africa more people are killed by gunfire each year compared to motor vehicle accidents. [(4)]

Our small case series revealed five children of different ages that presented to our unit in 2024. Three patients were male and two were female. This is consistent with the literature stating that most children injured by firearm are males and that the majority are caught in crossfire close to their homes. [(2)]

The management of patients with penetrating abdominal injuries requires a multidisciplinary team approach. Historically, all children with penetrating abdominal injuries were treated with urgent exploration. More recently, conservative treatment measures seem to have gained popularity especially in the hemodynamically stable patient. [5] Two of our patients had no intra-abdominal findings and a case can be made for no exploration of children with GSW not crossing the midline and having no abnormal findings on abdominal CT. Large multicenter research is needed to standardize the care of children with abdominal gunshot wounds and to distinguish between those that need an urgent laparotomy with those that can be treated expectantly.

We also had one patient with spinal injuries, posing a special problem. According to a report published by Merckling in 2024, gunshots are the mechanism of injury to the spine in 8.3% of all spinal trauma. [6] More research is needed, especially in prevalent countries, to confirm these findings.

GSW in children is an added but preventable burden on the already overloaded system. All our cases were children simply being in the wrong place at the wrong time. According to the Hospital Emergency Centre Triage and Information System (HECTIS), we treated twenty-one fire-arm related injuries in children in 2024, a 133% increase from 2023. (Table 1) Prevention programs and community education have been shown to assist in the prevention of violent crimes.

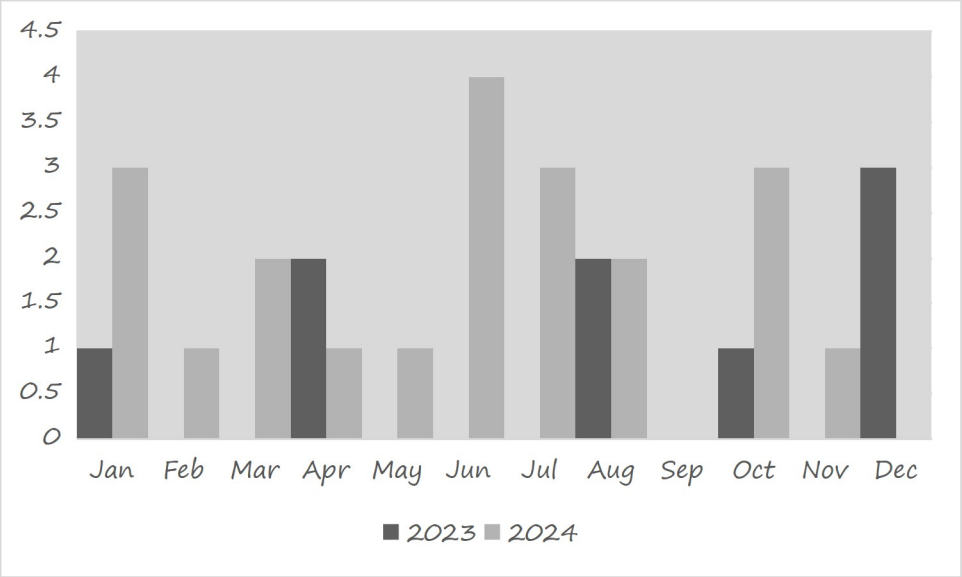

Table 1. Pediatric fire-arm related injuries in 2023 and 2024 (HECTIS)

The public health approach suggested by the Center for Disease Control (CDC) and Prevention and the World Health Organization (WHO) outline violence prevention based on four steps. [7,8] These strategies include defining and monitoring the problem, identifying risk and protective factors, developing, and testing prevention strategies, and lastly ensuring widespread adoption of effective strategies. [7,8] In South Africa, more specifically the Western Cape province, has shown a steady decline in total GSW sustained after the initiation of firearm control in 2004. [2] Gun control, community education programs, places of safety especially during school holidays for children in endemic areas and educational programs at schools, can all assist to increase community awareness and hopefully decrease the total number of unintentional fire-arm related injuries in children ultimately leading to a decrease in the burden of disease on an already overloaded system.

CONCLUSION

Abdominal gunshot wounds (GSWs) remain a significant cause of morbidity and mortality in the pediatric population. Optimal management requires a multidisciplinary team and adherence to standardized protocols. Patient selection for operative intervention should be judicious, with

exploratory laparotomy primarily reserved for those presenting with peritonitis, bowel evisceration, hemodynamic instability, or trans-midline GSWs.

Preventive strategies, as recommended by the CDC and WHO, including community education, firearm safety measures, and effective gun control policies, are essential to reducing the incidence of unintentional firearm injuries in children. All these are critical steps in preventing GSW injuries and shielding children from both the physical and psychological consequences of gun violence.

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