

Conservative management of intra-abdominal injuries

South Africa has a particularly high volume of blunt trauma in paediatric injury.

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Management of paediatric abdominal trauma has evolved over the last 4 decades. Current strategies for non-operative management of most blunt solid-organ injuries developed from the observation that most of these injuries would 'heal themselves' and that operative intervention could interfere with this process. Organs most commonly injured are the liver and spleen, followed by kidney, pancreas and hollow viscera. In this article I concentrate on the subset of patients injured by blunt mechanisms, unless, under exceptional circumstances, management of penetrating abdominal injury should be active and aggressive, with non-operative management being the exception. Although conservative management is appropriate for the vast majority of patients who have sustained blunt abdominal trauma, one must not compromise the care of unstable patients by persevering with a conservative approach in the case of life-threatening haemodynamic instability. Such patients require urgent surgery. The challenge is to identify these patients without delay.

Isolated tachycardia is a red flag.

Blunt trauma comprises the vast majority of paediatric injuries worldwide. South Africa sees a particularly high volume of such cases, primarily owing to a high incidence of motor vehicle and pedestrian vehicle accidents. Unfortunately, these cases have been poorly documented in recent years. The improvement of road safety needs to be prioritised to reduce such incidences.

Irrespective of the presence and/or standard of pre-hospital emergency medical services, in-hospital treatment hinges around a thorough examination in the resuscitation room, appropriate medical intervention, especially fluid therapy, further directed haematological and radiological investigation, and thereafter appropriate ongoing care, which, with appropriate monitoring, is conservative in the vast majority of cases.

Resuscitation room diagnosis and treatment

On admission, initial clinical assessment is traditionally done using Advanced Trauma Life Support (ATLS) protocols, with clinical endpoints measured against age-appropriate ranges for heart rate and blood pressure, and monitoring urine output as a surrogate bedside indicator of end-organ perfusion. While we currently

advocate adherence to the ATLS protocols, emerging evidence supports less aggressive intravenous access than that currently prescribed, and advocates the placement of one large-bore peripheral line that is immediately utilised, rather than prolonged attempts at establishing two peripheral lines and a central venous catheter, without actually starting the resuscitative process.

Certain situations require urgent laparotomy.

Regardless of which part of the anatomical system has been injured, the goal of initial treatment is to restore and/or preserve adequate end-organ perfusion and subsequent oxygen delivery to vital tissues. Because of their altered physiological response to hypovolaemia, children with haemodynamic instability do not present with typical adult clinical findings, and tachycardia, in the presence of a normal blood pressure, may be the only clinical sign of class III shock. Hypotension may only manifest itself with up to 25% loss of the circulating blood volume. Therefore isolated tachycardia is a red flag, necessitates immediate bolus administration of 20 ml/kg of warmed crystalloid or colloid fluid, and mandates prescription of adequate analgesia, localisation of blood loss, ongoing clinical evaluation thereafter, and radiological investigation. It is well recognised that clinical parameters alone are inadequate endpoints as markers of adequate resuscitation, and in addition they discriminate poorly between compensated and uncompensated shock. Therefore, after initial fluid administration, metabolic endpoints need to be evaluated or re-evaluated with an arterial blood gas measurement, where base deficit, lactate and haemoglobin levels guide further therapy.

Continued haemodynamic instability in the resuscitation room is an indicator for transfusion of packed red blood cells, once again using a volume of 20 ml/kg. If this state persists in the case of a localised abdominal source, despite appropriate fluid and blood administration, urgent open exploration of the peritoneal cavity is indicated.

Paediatric surgeons are strong proponents of conservative management of blunt intra-abdominal injury, but certain situations require urgent laparotomy. These include haemodynamic instability completely unresponsive to fluid and blood therapy, an acute abdomen with peritonitis, and the radiological presence of free intraperitoneal air. In the immediate absence of the aforementioned findings, conservative management should be embarked on,

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ideally in a high-care or intensive care environment.

Acute intra-operative management

Operative intervention deserves a brief mention. While 90 - 95% of intra-abdominal injuries are successfully managed conservatively,¹ the remainder necessitate operative intervention. The aim of laparotomy, via wide exposure, is to arrest ongoing bleeding and facilitate stabilisation of the patient. While the paediatric surgeon favours splenic and renal organ preservation, this dictum should not put the patient at risk of further harm and, if required, these organs should be removed. Operative time should be minimised, avoiding the triad of hypothermia, acidosis and coagulopathy.² If necessary, the principles of damage control surgery should be applied.

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Radiological diagnosis

Although discussed in a separate paragraph, the majority of radiological investigations should ideally occur in or near a resuscitation room. An important adjunct to the diagnostic process is the use of the Statscan machine (Lodox, Johannesburg) that screens the entire patient with diagnostic quality X-rays using a low total radiation dose. This can be performed while fluid resuscitation is proceeding and a naso- or orogastric tube and urinary catheter are being inserted.³ Focused abdominal sonography for trauma (FAST) can be performed to establish the presence of free intraperitoneal fluid and a solid visceral source. Unfortunately FAST has a low sensitivity and specificity for the detection of intra-abdominal injury,¹ and in either eventuality it is recommended to proceed to a contrast-enhanced CAT scan, with the addition of intravenous contrast, to localise the source of the haemoperitoneum and 'grade' the injury. While oral contrast may aid in the diagnosis of intestinal and pancreatic injuries, it takes time to administer and is not recommended in the acute setting. Extrapolated from adult practice,

significant emphasis has been placed on the radiological grade of injury. A higher proportion of patients with grade 4 and 5 injuries may ultimately be operated on, but the presence of such high-grade injuries should not influence the initial decision-making algorithm. Emphasis should be placed on the patient's haemodynamic profile rather than on graded radiological images. If the patient does not respond to fluid therapy, in spite of ongoing transfusion requirements, treatment has failed.⁴ There is absolutely no evidence to suggest that diagnostic peritoneal lavage is indicated in children.

Operative diagnostic adjuncts

A difficult subset of patients to manage are those who, on imaging, demonstrate free intraperitoneal fluid without an obvious solid visceral source and also have a normal serum amylase. Here the concern centres around the source of the bleeding - whether it is a perforated hollow viscus or large mesenteric tear. Serial clinical abdominal examination and regular monitoring of the patient's inflammatory markers are mandatory. If significant suspicion exists further examination is indicated using exploratory laparoscopy,¹ which has an ever-expanding role in the management of paediatric trauma. Should laparoscopy not be available, a laparotomy should be done. Currently, experienced laparoscopic surgeons will repair many of these injuries, while others will convert to an open procedure for definitive repair or conservative treatment.

Acute conservative care

During the admission process the following should be prescribed: intravenous maintenance fluids, appropriate analgesia, a nil per os regimen, and bed rest for a 'clinically appropriate' duration. The setting, i.e. a high-care/intensive care or ward environment, will be dictated by the clinical and metabolic condition of the patient and by associated injuries, particularly intracranial pathology. The Hospital for Sick Children in Toronto first reported conservative management of blunt splenic trauma in 1968,⁵ and in 2000 the American Pediatric Surgical Association published recommendations to this end, providing guidelines for length of hospital admission and restriction of activity, based on the radiological grade of injury.⁶ Wherever the patient is monitored, regular repeat assessment is mandatory from a clinical and metabolic perspective, and occasionally laparotomy will be indicated because of acute peritonitis or significant

continued bleeding. The duration of bed rest after injury is not standardised. Previously it was in excess of a week, but the current trend is for significantly shorter periods of bed rest and hospitalisation.

The single most common indication for exploration of the injury remains ongoing transfusion requirements in excess of 40 ml/kg packed red blood cells.

Liver and spleen

Bile leaks are specifically related to hepatic trauma, with an unknown incidence in children. It occurs in 1 - 6% of adults with liver injuries.⁷ Anatomically, these disruptions can involve the intra- and extrahepatic biliary tree, the former typically associated with parenchymal, and often arterial, laceration, while the latter may occur in the absence of hepatic visceral injury. Presentation of these injuries is often delayed, with significant morbidity, and a high incidence of suspicion is required. Some authors propose early aggressive investigation and recommend radio-isotope scintigraphy in high-risk injuries.⁸ These include any lacerations greater than 4 cm in length or injuries extending into the porta hepatis. Notably, and concordant with a 'conservative' approach, the majority of bile leaks are treated by percutaneous drainage of intraperitoneal collections with the addition of trans-ampullary biliary stents where necessary, thus avoiding open surgery.⁷ Angio-embolisation of the splenic artery is a well-described modality of treatment in the literature on adult patients. Evidence-based guidelines for the use of this technique do not exist in the paediatric surgical literature, and its use remains extremely limited.⁹ It is important in the management of hepatic trauma, either as the primary intervention in cases of evidence of active bleeding on CT scan, or as an adjunct to laparotomy with perihepatic packing in the damage control scenario.

Pancreas and kidney

Injuries to the pancreatic duct are treated in a similar fashion, percutaneously

draining peripancreatic collections and/or pseudocysts, with the addition of transampullary stents where indicated.¹⁰ An exception is early diagnosis of complete ductal transection over the vertebral column. In this situation, if the diagnosis is made within 12 hours of injury, distal pancreatectomy with splenic preservation is preferred. Management of renal injuries falls into the same algorithm, draining peri-renal urinomas percutaneously with the placement of double J stents as an adjunct.¹¹

One specific complication is the development of a 'primary' intra-abdominal compartment syndrome as a direct result of aggressive fluid resuscitation.¹² It is over-diagnosed in many instances, but remains a real entity. If accurately diagnosed with intra-abdominal or intravesical pressure monitoring (intra-abdominal pressure higher than 15 - 20 mmHg), it will require treatment by means of a decompressive laparostomy.

It is not necessary to repeat radiological imaging routinely.

Failure of conservative care

In patients with a documented intra-abdominal injury, the initial 24-hour period is critical, with the majority of treatment failures occurring within the first 12 hours. The single most common indication for exploration of the injury remains ongoing transfusion requirements in excess of 40 ml/kg packed red blood cells. Bleeding and hollow visceral injury aside, a percentage of conservatively managed patients may ultimately come to some type of intervention for ongoing complications, particularly biliary and urine leaks and delayed vascular complications. The

majority of these can be managed outside of the acute period and, in addition, many interventions will be performed percutaneously and endoscopically, avoiding open exploration. Despite delayed intervention, the long-term outcome of this group of patients is not compromised, with the benefit that they are spared the insults of early surgery.

Controversy abounds with regard to length of bed rest and hospital stay and the role of follow-up imaging. It is not necessary to repeat radiological imaging routinely, and we request it on an individual basis. However, higher-'grade' injuries should be reviewed after 6 weeks, especially where the patient may not participate in contact sport until the injury has healed.⁹ Based on the pathology of the healing process, this would mandate a 10 - 12-week period of rest. No level 1 evidence exists to support these practices.

Summary

Paediatric blunt abdominal injuries remain extremely prevalent in our communities and much needs to be done to reduce their incidence. Initial management should be according to ATLS guidelines, focusing on end-organ perfusion and oxygenation of vital organs. Fluid resuscitation should be aggressive and instituted early, remembering the altered physiological response of children compared with that of adults. Serum lactate, base excess and haemoglobin must be measured, and an inadequate response to fluid resuscitation is a marker for blood transfusion and for identifying the source of the bleeding. Less than 5% of patients will proceed to laparotomy. The remainder will be successfully managed with conservative care, although this may be complicated by various vascular problems and biliary, pancreatic and urine leaks. These too can ultimately successfully be managed using a variety of drainage procedures. Excluding the small subset of patients in whom immediate life-saving surgery is indicated,

if facilities do not allow for appropriate ongoing monitoring of the patient, he/she should be promptly transferred to the closest referral centre where such care can be provided.

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In a nutshell

- Blunt trauma is the commonest cause of childhood injury.
- The spleen is the most commonly injured organ, followed by the liver, kidney, pancreas and hollow viscera.
- At least 95% of such patients can be managed conservatively.
- Treatment begins on arrival in the emergency room. Fluid management is core, tailored by the patient's clinical and metabolic response.
- In the absence of an acute abdomen or non-responsive hypovolaemic shock, definitive diagnosis and further classification by appropriate radiological imaging should be performed.
- A pitfall is persistence of conservative management in the 'non-responder'. This patient requires urgent surgery.
- 'Conservative' management should occur in a high-care environment, with ongoing clinical and metabolic evaluation.
- In the absence of such a facility, the patient should be transferred.