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HOLLOW ORGAN INJURY IN BLUNT ABDOMINAL TRAUMA- COCEPTUALIZING LUCID INTERVAL IN CLINICAL MANIFESTATION IN A COHORT OF PATIENTS AT A HIGH VOLUME TRAUMA CENTER

Surgery

Samir Misra	Professor, Department of Trauma Surgery, King George's Medical University, UP, Lucknow
Sandeep Tiwari	Professor, Department of Trauma Surgery, King George's Medical University, UP, Lucknow
Yadvendra Dheer*	Assistant Professor, Department of Trauma Surgery, King George's Medical University, UP, Lucknow *Corresponding Author
Anita Singh	Assistant Professor, Department of Trauma Surgery, King George's Medical University, UP, Lucknow
Narendra Kumar	Assistant Professor, Department of Trauma Surgery, King George's Medical University, UP, Lucknow
Ankit Kumar	Senior Resident, Department of Trauma Surgery, King George's Medical University, UP, Lucknow

ABSTRACT

Blunt abdominal trauma is one of the most common cause of surgical emergency admission. Non-operative management of these patients has been adopted by trauma surgeons, since the mordern diagnostic investigations like FAST and CT scan have given the surgeon a window of opportunity for better analysis of injuries.

The young adult, who are most common victims have good reserve and give time to the surgeons to understand the mechanism of injury and predict the injuries sustained. But a large subset of the patients do not cleary define themselves in operative or non-operative category. Many of the patients do not have clearcut signs and symtoms and present late and migrate from a non-operative category to operative category. This period of late presentaion was called as ***Lucid interval*** in these patients.

KEYWORDS

Lucid interval

INTRODUCTION

Trauma is the leading cause of mortality and morbidity in the young to middle aged population across the globe, particularly in the age group of 15-45 years. Trauma to the abdomen can be sustained by a variety of injuries like road traffic accidents, fall from heights, assaults, blows, and penetrating or lacerating wounds; but broadly speaking, trauma surgeons tend to categorize the mechanism of these injuries into two types, viz., blunt and penetrating. Most of the victims who suffer polytrauma experience both these types of injuries and land up in trauma bay. Patients brought to the emergency department require immediate attention and thorough evaluation. Most of these patients require prompt treatment and this mandates early, quick and efficient survey of these patients to prevent further physiological impairment.

By far blunt abdominal trauma (BAT) is more common than penetrating forces, accounting for nearly 85% of all abdominal injuries. Abdominal injuries require surgery in about 25% of the cases. Patients with penetrating abdominal trauma present less of a diagnostic challenge; the management of these wounds is less precarious, since exploration is the rule. However, the evaluation and management of patients with BAT is onerous as it is quite challenging to understand and reconstruct the event with reference to the mechanism of injury to predict the intraabdominal injuries. There has been increasing trend towards non operative management (NOM) of BAT amounting to 80% of the cases with failure rates of 2-3%. While advances in imaging have helped us make the decision of NOM, it is not always a clear cut choice. Following BAT, obscure hollow viscous organ injury at times may manifest late after subtle initial presentation posing a dilemma in patients undergoing NOM. Our study is an account of patients with BAT in an apex trauma centre of a developing country, concurring with this notion.

METHODS

This study employed a retrospective, observational, descriptive design. It was conducted at the Department of Trauma Surgery of King George's Medical University, UP, Lucknow, India between April 2017 and February 2019. Data was collected from the registries of patients with BAT admitted to our department. Patients who were less than 10 years of age were not included in this study because they were treated by the paediatric surgery team. The sequence of diagnostic and therapeutic procedures adopted was in agreement with latest standards established by Advanced Trauma Life Support (ATLS) group.

Sociodemographic data like age, sex, residence and arrival time after trauma was collected. Clinical data collected include findings of primary survey and secondary survey. Findings of radiological investigations like plain chest radiograph including upper abdomen, focussed assessment with sonography for trauma (FAST) and computed tomography (CT) of the abdomen, if done were recorded. Data from laboratory investigations like complete blood counts, coagulation profile, blood group and blood products transfused was noted. Patients were classified and observations made based on the mechanism of BAT, type of management, time of operative intervention and operative findings which included the type and locations of their injuries. Associated extra-abdominal injuries were also noted. Data from serial clinical examinations were also collected. Depending on type of management, there were two patient groups, i.e. operative and non-operative. Patients who were operated were classified as early if they underwent surgery within 6 hours of being injured, or late if they underwent surgery after 6 hours of being injured. Those who were operated late included patients with late presentation to our hospital after injury without previous in-hospital management, patients transferred from other hospitals after initial NOM or patients initially treated as NOM in our department.

RESULTS

- A total of 1870 patients of BAT were admitted to the Department of Trauma Surgery from April 2017 to February 2019.
- 18 patients were moribund and expired within a couple of hours of admission despite aggressive resuscitation and were conveniently excluded from the study, since these patients did not receive any trauma protocol based treatment. The remaining 1852 patient constituted the study group.
- Out of 1852 patients, 1419 patients were males (76.6%) and 433 patients were females (23.4%).

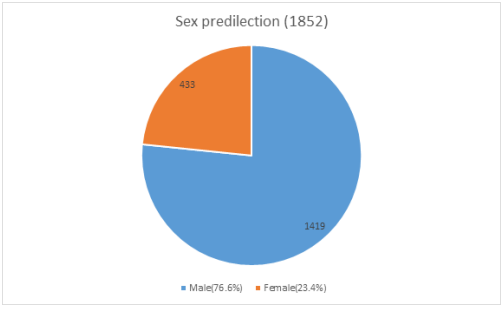

Figure 1: Most of the patients of BAT were males (76.6%).

- 1031 out of 1852 (55.7%) patients were injured by road traffic accidents, which was the most common cause responsible for BAT in our study. 514 (27.7%) patients suffered BAT due to fall from height and 237 (12.8%) patients were admitted due to assault.

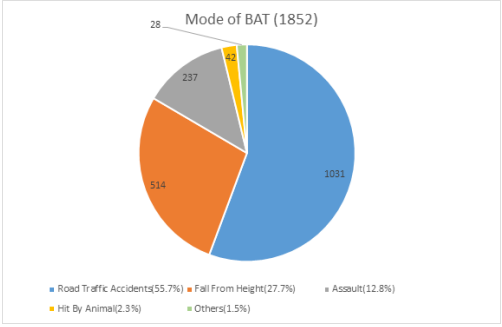

Figure 2: The most common mode of BAT was Road Traffic Accidents (RTA) (55.7%)

- Of these 1852 patients, 846 (45.7%) belonged to the age group between 21-30 years.

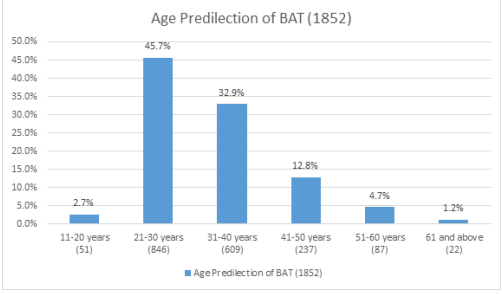

Figure 3: The most common age group affected by BAT was 21-30 years (45.7%).

- Out of these 1852 patients, 1018 were managed with non-operative measures whereas 834 patients were operated.

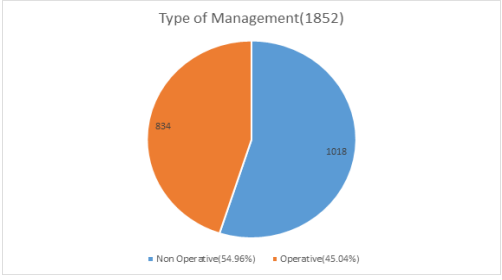

Figure 4: More than half of the patients of BAT were managed non-operatively (54.96%). A slightly lesser number of patients were operated (45.04%).

- Out of the 834 patients who landed in the OR, 328 patients had isolated solid visceral organ injuries, 449 patients were treated for isolated hollow visceral organ injuries, 42 patients had both solid as well as hollow visceral organ injuries and 15 patients intraoperatively showed only peritoneal collection with no obvious intraabdominal injuries.

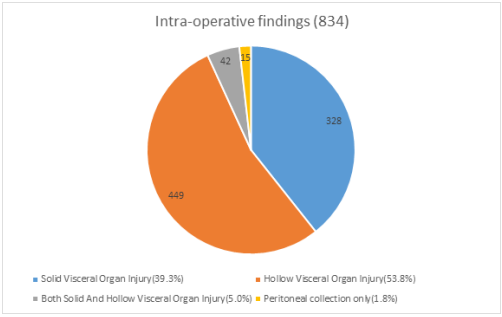

Figure 5: Of the 834 patients of BAT who were operated, 53.8% and 39.3% patients intraoperatively had hollow visceral and solid visceral organ injuries respectively. Only 5.1% patients had a combination of both.

Solid Visceral Organ Injury

- Of the 328 patients who had isolated solid visceral organ injuries alone, 243 patients were operated early (within 6 hours of BAT), whereas 85 patients were operated late.

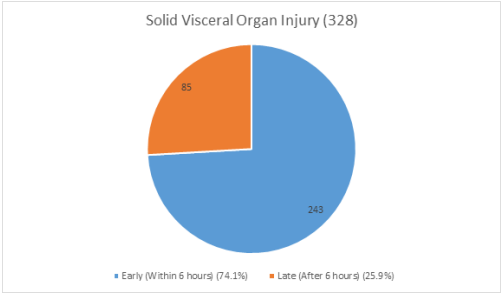

Figure 6: Of the 328 patients who were treated for solid visceral organ injuries alone, 74.1% patients were operated early, whereas 25.9% patients were operated late

- Out of a total of 328 patients operated for solid visceral organ injuries, 165 patients had isolated splenic injury, 96 patients suffered from isolated hepatic injury, 33 patients of BAT had isolated pancreatic injury, 8 patients had isolated renal injury and 26 patients suffered from multiple solid organ injuries.
- Out of a total of 328 patients operated for solid visceral organ injuries, 169 patients had associated injuries, viz.: 78 patients had associated pelvic injury, 52 had associated thoracic injury and 39 had associated head injury or cervical spine injury.

Hollow Visceral Organ Injury

- Total 449 patients were treated for isolated hollow visceral organ injuries. 262 patients were operated early and 187 patients were operated late.

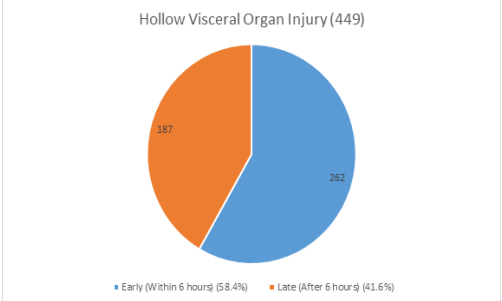

Figure 7: Of the 449 patients who were treated for hollow visceral organ injuries alone, 58.4% patients were operated early and 41.6% patients were operated late.

- 245 out of 449 patients suffered from isolated small bowel injury, 92 patients had isolated mesenteric injury, 48 patients had isolated large bowel injury, 23 patients suffered from isolated gastric injury and 41 had combination of injuries to various hollow visceral organs.
- Out of a total of 449 patients operated for hollow visceral organ injuries, 180 patients had associated injuries, viz.: 92 patients had

associated pelvic injury, 47 had associated thoracic injury and 41 had associated head or cervical spine injury.

- Out of the 187 patients who were operated late, 79 presented late to our hospital after injury without previous in-hospital management, 67 were transferred from other hospitals after initial NOM and 41 patients were initially treated as NOM in our department.
- Out of the 187 patients who were operated late, 83 had isolated mesenteric injury, 56 had isolated small bowel injury, 35 had combination of injuries to hollow visceral organs which mainly included small bowel and mesenteric injuries, and 11 had isolated large bowel injury and 2 had isolated gastric injury mainly at gastro-oesophageal junction.

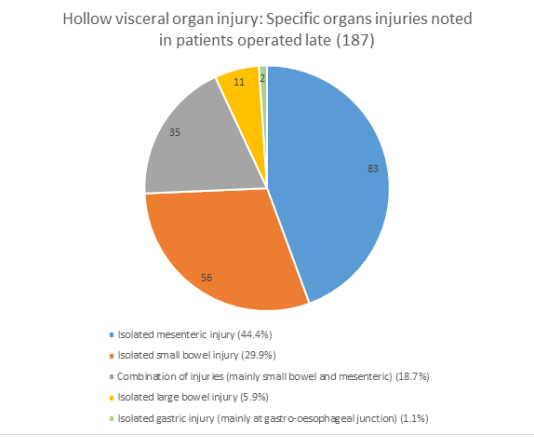

Figure 8: Majority (174) of the 187 patients who were operated late with hollow visceral injury sustained small bowel or/and mesenteric injuries.

- These patients initially had a negative FAST and a CT scan which was inconclusive to warrant surgery. Based on clinical deterioration either in the form of hemodynamic instability or gradual evolution of abdominal signs (suggestive of peritonitis), correlated with one or more of the laboratory (falling haemoglobin, raised total leucocyte count, elevated lactate and base deficit or need for repeated transfusions) or radiological investigations (repeat FAST positive or pneumoperitoneum on repeat abdominal radiograph), the decision of surgery was made. The duration between the time when patient sustained injury and the time when he underwent surgery was beyond 48 hours in most patients.
- Majority (174) of these 187 patients who were operated late sustained small bowel or mesenteric injuries. Injuries encountered intraoperatively in them included mesenteric tears including bucket handle tears, small contained perforations of the small bowel with minimal peritoneal contamination, gangrenous small bowel, impending perforations or a combination of these.
- Of the 42 patients who were treated for both solid and hollow visceral organ injuries, surgery was mainly required for the hollow visceral organ component. These mainly included small bowel injury found in 35 of 42 patients. The most frequently injured solid organ was spleen, but splenectomy was needed only in 10 cases. 14 of these 42 patients were operated late after initial NOM. 15 operated patients had no other finding except peritoneal collection; 12 of these were operated late after initial NOM.

DISCUSSION

Abdomen is one of the most frequently injured anatomical area of the body in trauma patients. This trauma could be sustained by blunt or penetrating mechanisms, the former being more common. Any patient who has sustained injury to the torso from a direct blow, deceleration, blast, or penetrating injury must be considered to have an abdominal visceral, vascular, or pelvic injury until proven otherwise. The most frequently injured organs after BAT are spleen (40 to 55%), liver (35 to 45%), and small bowel (5 to 10%). Unrecognised abdominal and pelvic injuries are the major cause of preventable death after BAT. Rupture of a hollow viscus or bleeding from a solid organ or the bony pelvis may not be easily recognized. Ongoing bleeding from a solid visceral organ in a stable patient of BAT who is being managed by NOM may be detected late. However, such bleeding can be managed without surgery even when detected late with close monitoring, transfusion of blood products, immobilization and interventional radiological procedures like embolization of the bleeding vessel. On the contrary, hollow visceral organ injuries tend to be less forgiving as they are amenable only to operative management. Any delay in the diagnosis of such an injury risks the patient's life due to ongoing bowel damage and peritoneal contamination breeding sepsis and multiorgan dysfunction. This along with the metabolic stress due to trauma allows the delay in the obligatory surgery to take its toll on the trauma victim in the form of increased morbidity and mortality. Early detection of hollow visceral organ injuries after BAT therefore saves the patients from undue delay and worsening of their operative risk. It also improves the outcome, while reducing the undue burden of unnecessary NOM on the hospital.

Following BAT, hollow visceral organ can be injured by various mechanisms. A direct blow to the abdomen such as contact with steering wheel can cause compression and crushing of hollow visceral organs. These forces deform the hollow visceral organs and can cause rupture with secondary haemorrhage and contamination by visceral contents leading to peritonitis. Shearing injuries due to inappropriately worn restraint devices can produce a crush injury of hollow visceral organs leading to ischemia and necrosis. Deceleration injuries in which there is differential movement of the fixed and mobile parts of the body can cause bucket handle tears of the small intestine. Blast injuries cause sudden forceful compression of the torso and associated secondary, tertiary and quaternary mechanisms aggravate the insult leading to hollow visceral organ injury. Following BAT, the most common small bowel injury was “blowout” perforation on the antimesenteric border of the bowel (55.5%), while the most common large bowel injury was a serosal tearbruise (62.2%). Most patients with these injuries will have signs of tenderness or peritonitis, and ample radiological or laboratory evidence to allow surgery. However, certain injuries to hollow visceral organs preclude timely detection, which include mesenteric tears including bucket handle tears, small contained perforations, bowel gangrene and impending perforations or a combination of any of these. Besides their subtle initial presentation, patient assessment and diagnosis is often compromised by alcohol intoxication, use of illicit drugs, injury to brain and spinal cord, and injury to adjacent structures such as the ribs and spine. Also another reason is the insensitivity of FAST for the diagnosis of hollow visceral organ injury. In this study, a significant number (41.6%) of patients of BAT who had hollow visceral organ injuries diagnosed intraoperatively underwent late surgery. Most (93.04%) of these patients who were operated late had aforementioned types of small bowel and mesenteric injuries. Most of these patients were operated after 48 hours of injury, when repeat clinical evaluation became significant, or laboratory and radiological evidence of injury was found upon repeat testing.

The interval between time of injury and the time of surgical intervention in hollow visceral organ injury may be highly variable, depending on the onset of clinical features or obtaining investigative evidence (to the tune that warrants surgery). Delay in obtaining such conclusive evidence for surgery prolongs this interval, wherein the patient might have undetected injury. This interval between time of injury and time of surgery is what we called as the ***lucid interval*** in hollow visceral injuries seen with BAT. It can be defined as 'the time period after injury with subtle ongoing damage, which manifests late either clinically, biochemically or radiologically, after which the patient needs surgery'. The term has been used to draw an analogy from the lucid interval seen in patients of head injury with an extradural hematoma, wherein the patient feels normal or asymptomatic after the initial insult, only to succumb later to the ongoing bleeding. In BAT, the ***lucid interval*** provides us with a window of opportunity where we can detect the injury before it manifests and requires surgery. The genesis of this ***lucid interval*** is multifactorial; multiple mechanisms of injury that come in play in BAT, masquerading intra-abdominal symptoms, overzealous use of analgesics and antibiotics in an 'operative' patient and late presentation in trauma bay with superimposed shock/other life-threatening injury are implicated. The detection of hollow visceral organ injuries in the ***lucid interval***, which was 48 hours in this study, can best be done by direct visualisation of the injury. Diagnostic laparoscopy can be used as a method for direct visualisation of injury in this ***lucid interval***. This is in the best interest of the patient as the minimal access approach has benefits of less anatomical and metabolic insult. Also the procedure can be used for therapeutic intervention if the initial diagnostic evaluation is positive. Using this technique, undue delay in management of patients requiring surgery can be avoided, and those who don't require surgery can be screened.

CONCLUSION

Patients with hollow visceral organ injury after BAT is a subset which is difficult to diagnose timely. Patients with initial inconclusive evaluation may land up in the ***lucid interval*** which in our study was 48 hours. ***Lucid interval*** starts from the time of injury and ends when the patient, who by the virtue of his obscured injury was a surgical candidate, is finally operated. Diagnostic laparoscopy can emerge as a tool for screening of hollow visceral injuries in patients of BAT in the ***lucid interval***, with initial inconclusive results.

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