

INTRODUCTION

The use of laparoscopy as a diagnostic tool was introduced as early as **1976 by Gazzaniga**. With the development of modern technology, interest in applying laparoscopic techniques in the care of trauma patients has been renewed (**Antonio, 2003**).

Laparoscopy has been used increasingly for the diagnosis and treatment of intra-abdominal and pelvic disorders (**Uranus, 2005**).

Laparoscopy was valuable in blunt abdominal trauma, avoiding laparotomy in more than two-thirds of patients with suspected intra-abdominal injuries and can serve as a useful adjunct for the evaluation of blunt abdominal trauma as the procedure is associated with low rate of complications and missed injuries (**Chelly et al., 2003**).

Despite improved diagnostic tools such as computerized tomography (CT scan) and magnetic resonance imaging (MRI), conventional treatment of patients with abdominal trauma injuries often requires exploratory laparotomy procedures to accurately diagnose and treat patients' injuries. Studies show that nontherapeutic (i.e., negative) laparotomy rates range from 5% to 40%, depending on the clinical situation. Many surgeons now perform diagnostic laparoscopic procedures before or instead of exploratory laparotomy procedures in hemodynamically

stable patients with abdominal trauma injuries. Although laparoscopy in patient with abdominal trauma injury does have limitations, it is an effective tool for preventing negative laparotomies and for creating minor abdominal incision **(Fabian and Croce, 2000)**.

In the setting of blunt abdominal trauma, laparoscopy is used mainly for diagnosis, and its role in definitive operative repair is still debated and used mainly in treatment of multiple injuries to small bowel with a favourable outcome **(Iannelli et al., 2003)**.

On the basic of the laparoscopic findings, laparoscopy may be enough in patients with blunt abdominal trauma for gastric wall repair, small bowel repair, small bowel resection-anastomosis, ligation of bleeders in the mesentery and omentum, sigmoid colon repair, Hartmann's procedure, cholecystectomy, distal pancreatectomy and splenectomy **(Balien, 2005)**.

Patients who will undergo therapeutic laparoscopy for resolution of their abdominal trauma injures will have decreased hospital stays, less wound infection, post-operative pain, better cosmetic result and earlier ambulation **(Chol, 2003)**.

AIM OF THE WORK

This work aims at focusing on the value of laparoscopy in the management of blunt abdominal trauma.

As it can serve as a useful adjunct procedure which is associated with low rates of complications and missed injury.

PATHOPHYSIOLOGY AND ETIOLOGY OF BLUNT ABDOMINAL TRAUMA

The main problem with blunt abdominal trauma lies in establishing the correct diagnosis soon enough to prevent death and limit morbidity. Two major life threatening situations occur following blunt trauma to the abdomen, hemorrhage and hollow viscus perforation with associated chemical and bacterial peritonitis (*Fabian and Croce, 2000*).

Intra-abdominal injuries secondary to blunt force are attributed to collisions between the injured person and the external environment and to acceleration or deceleration forces acting on the person's internal organs. Blunt force injuries to the abdomen can generally be explained by 3 mechanisms.

Deceleration

Rapid deceleration causes differential movement among adjacent structures. As a result, shear forces are created and cause hollow, solid, visceral organs and vascular pedicles to tear, especially at relatively fixed points of attachment. For example, the distal aorta is attached to the thoracic spine and decelerates much more quickly than the relatively mobile aortic arch. As a result, shear forces in the aorta may cause it to rupture. Similar situations can occur at the renal pedicles and at the cervicothoracic junction of the

spinal cord. Classic deceleration injuries include hepatic tear along the ligamentum teres and intimal injuries to the renal arteries. As bowel loops travel from their mesenteric attachments, thrombosis and mesenteric tears, with resultant splanchnic vessel injuries, can result (*John, 2008*).

Crushing

Intra-abdominal contents are crushed between the anterior abdominal wall and the vertebral column or posterior thoracic cage. This produces a crushing effect, to which solid viscera (eg, spleen, liver and kidneys) are especially vulnerable (*John, 2008*).

External compression

Whether from direct blows or from external compression against a fixed object (eg, lap belt, spinal column), External compressive forces result in a sudden and dramatic rise in intra-abdominal pressure and culminate in rupture of a hollow viscous organ (i.e., in accordance with the principles of Boyle law). The liver and spleen seem to be the most frequently injured organs, though reports vary. The small and large intestines are the next most frequently injured organs. Recent studies show an increased number of hepatic injuries, perhaps reflecting increased use of CT scanning and concomitant identification of more injuries (*John, 2008*).

Table (1): Mechanism of Injury and the Associated Injury Pattern

Mechanism	Injury pattern
Fall from height	Pelvic fracture, bladder, abdominal & solid organ, Spine and calcaneal fracture
Bicycle handle-bar	Bowel, pancreas
Sporting injury	Spleen, kidney
Seat belt	Small bowel, duodenum, Pancreas, fracture spine
Vehicular frontal impact	Head, chest, abdominal solid organ, lower limb fracture dislocation
Vehicular lateral impact	Pelvic fracture, liver, spleen, Rib fractures, lung contusion

(Jansen et al., 2006)

Clinical examination of the abdomen is important, as the presence of localized abdominal pain or tenderness should increase the suspicion of intra-abdominal injury. In a study by "**Velmahos**", 23% of patients with the "seat belt sign" had significant intra-abdominal injury (**Velmahos, 2002**).

Body Response to Injury:

With serious traumatism, the stimuli are many and intensified, and the reflexes are aimed at an integrated attempt by the organism to restore cardiovascular stability, preserve the oxygen supply, mobilize the caloric substrates

and increase the supply of fundamental substrates, especially glucose (*Schwartz and Seymour, 2005*).

Metabolic responses

"**Cuthbertson**" defined two phases of the metabolic response to trauma, an ebb phase and a flow phase. "**Wilmore**" subsequently divided the flow phase into catabolic and anabolic stages (*Waxman, 2000*).

Ebb phase:

The first, or ebb, phase lasts from two to three days and is characterized by frank hemodynamic instability, here represented by hypotension, hypovolemia, reduced blood flow, increased systemic vascular resistance, catecholamines, glucocorticoids and mineralocorticoids, disturbances in the transport of oxygen beyond increased intake and depletion of hepatic glycogen (*Stahel et al., 2005*).

Flow phase:

Catabolic phase:

Following the initial injury, the flow phase, characterized by hypermetabolism in response to the aggression suffered by the organism, represented by water retention, increased vascular permeability and reduced vascular resistance with growing levels of glucocorticoids and catecholamines, resulting in hyperglycemia and

proteolysis. However, in some patients there is imbalance of these compensatory metabolisms, which organic stress does not resolve it and there is systemic dysfunction, which may or may not be linked to the infection. There are alterations to the state of consciousness, metabolic acidosis, peripheral intolerance to glucose, fever, tachypnea, leukocytosis, hypoxemia, hypocapnia, hyperbilirubinemia and increased urinary and plasmatic creatinine. The total body metabolic response is the combined response of the organs and their individual metabolic demands as modulated by the neuroendocrine system and exogenous nutritional support (**Hassett and Border, 2003**).

Anabolic phase:

During this stage, each physiologic alteration that occurred during catabolic stage may be reversed. This reversal process does not occur quickly. The anabolic stage recovery generally takes longer than the acute injury and catabolic stages and thus may last many days or weeks during this period, patients require psychological support, nutritional support, and physical rehabilitation for complete recovery to occur (**Waxman, 2000**).

Physiologic Responses:

Altered mental status as anxiety, immobilization, withdrawal, and antagonism are commonly seen after major trauma. It is important to be aware that this can signify severe hypovolemia, hypoxemia, or both. Fever may be seen after fluid resuscitation, which can be caused by the sustained inflammatory response. It is critical to be vigilant for infectious causes. Blood pressure may not become significantly decreased until the patient has lost 30% to 40% of circulating blood volume. Therefore, blood pressure correlates poorly with either blood volume or flow. Tachycardia can persist even after fluid resuscitation and pain is adequately controlled. Generalized edema is common secondary to increased total body salt and water within the interstitium. This is a result of increased sympathetic vasoconstriction, altered capillary permeability, and hypoproteinemia. Also, local inflammation at the wound site leads to edema formation secondary to the release of locally acting cytokines (*Zuckerbraun and Harbrecht, 2008*).

Altered protein, glucose, and fat metabolism Energy requirements are increased following injury, with the magnitude of the additional energy need dependent on the severity of injury, magnitude of tissue destruction, and lean body mass of the patient. Protein loss is approximately 300 to 500 grams per day of lean body mass, with visceral proteins spared at the expense of skeletal muscle proteins. Proteins are

broken down to constituent amino acids that are catabolized to ammonia (forms urea) and precursors of the tricarboxylic cycle (TCA). Carbohydrates provide 4 kilocalories per gram when oxidized. Muscle glycogen (storage form of glucose) is used only by skeletal muscle (i.e., not released systemically), whereas hepatic glycogen provides glucose for glucose-dependent tissues (brain, leukocytes). Gluconeogenesis can occur from amino acids, glycerol, lactate, or pyruvate via TCA or Krebs' cycle. Lipids, which are used by tissues that are not glucose dependent, are the largest source of energy (9.4 kcal/g) in the body. Lipids are catabolized to form ketone bodies in the liver along with CO₂ and energy from glycerol and fatty acids. Leukocytosis Elevation in the white blood cell count can be seen after injury (***Zuckerbraun and Harbrecht, 2008***).

DIAGNOSIS OF BLUNT ABDOMINAL TRAUMA

Clinical assessment

History:

The circumstances of the accident and the clinical condition of the patient before admission to the emergency room should be ascertained from emergency medical services records, the patient (if possible) and eyewitnesses (*Mayer, 2005*).

The history of the injury is often incomplete, either because the patient is unconscious, or because of the lack of eyewitnesses. Whenever possible, the “AMPLE” history (Allergies, Medication, Past illnesses, Last meal, Events and environment) as recommended in the Advanced Trauma Life Support (ATLS) protocol, should be obtained. In the majority of cases, the mechanism of injury is usually known, and is a good guide to diagnose intra-abdominal as well as other associated injuries (*Yeo, 2004*).

General Examination:

The vital signs are reported and should include the heart rate, blood pressure, respiratory rate, pulse oximetry readings and Glasgow Coma Scale (GCS) score. Temperature should always be reported, especially when there is prolonged environmental exposure in a cold (or

hot) location. This will enable the trauma team to more readily prepare a variety of warming (or cooling) measures for use immediately on the patient's arrival (*Christensen et al., 2007*).

After following the **ABCDE** rules and complete "primary survey" which provide the opportunity for evaluating and stabilizing the trauma patient, evaluate the completely undressed patient, front and back, and from head to toe. Evaluate each system (head and neck, chest, abdomen, perineum, musculoskeletal, vascular, neurological...etc.) (*Lekawa, 2006*).

Table (2): Important Information to Obtain Based upon the Mechanism of Injury

Mechanism of injury	Information to seek
Motor vehicle crash	• Position in vehicle (e.g., driver) • Use of restraints (seatbelts/airbags) • Ejection • Direction of cars/point of impact • Speed of patient car • Loss of consciousness at scene • Condition of windshield of the motor vehicle
Motorcycle crash	• Driver/passenger • Helmet use • Other protective gear present • Patient position relative to motorcycle when found
Jumps/falls	• Height of fall • Type of surface impacted • Position patient found on surface • How the patient landed

(*Merlino et al., 2007*)

Anatomical considerations:

The surface markings of the abdominal cavity extend from the level of the fifth intercostals space (nipple level in the male) on full expiration, to the inguinal ligaments and pubic symphysis inferiorly. It is vital that abdominal evaluation includes the flanks and back, since wounds can classically be concealed in these regions. The flank encompasses the area between the anterior and posterior axillary lines. The back lies posterior to this, and may benefit from some partial protection due to its thick musculature (***Velmahos, 2002***).

The peritoneal cavity contains the majority of the abdominal organs including the liver, spleen, stomach, small bowel, parts of the duodenum and parts of the large bowel. On full expiration it extends up to the level of the fifth intercostal space, and the ribs provide some protection to the upper abdominal organs. Therefore abdominal injury should be suspected in all cases of lower chest trauma (***Velmahos, 2002***).

The retro peritoneum is divided into **(3)** zones that have relevance at operation, where the mechanism and location of injury will determine whether surgical exploration or conservative management is applied. The central zone (**zone I**) contains the major vessels, and haematomas should be explored surgically in both blunt and penetrating trauma. The lateral zones (**zone II**)

containing the kidneys, ureters and colon are only explored in blunt injury when the hematoma is expanding; however, they should be explored with care in cases of penetrating injury. The pelvis comprises **(zone III)**, and while penetrating trauma in this zone should be explored, hematoma from blunt trauma should not: observation, packing and interventional radiology techniques are more appropriate *(Velmahos, 2002)*.

Abdominal examination:

The abdominal examination, proceeds in an orderly fashion, with the recognition that abdominal findings may range from absent to immediate peritoneal irritability from stomach or colon perforation. Associated injuries may mimic peritoneal signs, such as lower rib fractures and abdominal wall contusions, or distract the patient from abdominal complaints, such as extremity and pelvic fractures. The abdominal exam is notoriously unreliable in the presence of head injury, shock, hypoxia, metabolic derangements, and intoxication *(Richards et al., 2007)*.

A distended abdomen in a hypotensive patient usually represents hemoperitoneum but might occasionally be a manifestation of a massive retroperitoneal hematoma following a pelvic fracture. An operation in this situation would likely increase pelvic bleeding, rather than offer benefit *(Nathens, 2005)*.

Abdominal injury may be associated with the use of motor vehicle seat belts. The most specific abdominal injury associated with seat belts is "**Chance's fracture**" which is fracture of an upper lumbar vertebra, usually L-1, associated with rupture of the small intestine; usually the jejunum but abdominal seat belt injuries may include lacerations of the colon, small bowel, liver, duodenum, pancreas and spleen (*Debas, 2004*).

a) Inspection:

The physical examination always begins with a general inspection of the patient, followed by inspection of the abdomen itself. Patients with peritoneal irritation experience worsened pain with any activity that moves or stretches the peritoneum. These patients typically lie very still in the bed during the evaluation and often maintain flexion of their knees and hips to reduce tension on the anterior abdominal wall (*Postier and Squires, 2007*).

The patient must be fully undressed. The anterior and posterior abdomen, as well as, lower chest and perineum, should be inspected for abrasions, contusions from restraint devices, laceration, penetrating wounds, impaled foreign bodies, evisceration of omentum or small bowel, and the pregnant state (*Mohapatra et al., 2003*).

The abdomen should first be inspected for gross injury or bleeding. Ecchymoses should be noted. Peri-