INTRODUCTION

The abdomen can be injured in many types of trauma; injury may be confined to the abdomen or be accompanied by severe, multisystem trauma. The nature and severity of abdominal injuries vary widely depending on the mechanism and forces involved, thus generalizations about mortality and need for operative repair tend to be misleading ***(Ramanuj and Panchal, 2016).***

Penetrating injuries may or may not penetrate peritoneum and if they do, may not cause organ injury. Stab wounds are less likely than gunshot wounds to damage intra-abdominal structures; in both, any structure can be affected. Penetrating wounds to the lower chest may cross the diaphragm and damage abdominal structures ***(Fitzgerald et al., 2006).***

Penetrating abdominal trauma results when an object (usually a bullet, knife, shrapnel, etc.) has breached the abdominal cavity.

Trauma remains the most common cause of death for all individuals between the ages of 1 and 44 years and is the third most common cause of death regardless of age ***(Ramanuj and Panchal, 2016).***

Abdominal trauma is traditionally classified as either blunt or penetrating. Penetrating abdominal trauma can usually be diagnosed easily and reliably, whereas blunt abdominal trauma is often missed because clinical signs are less obvious. Blunt abdominal injuries predominate in rural areas, while penetrating ones are more frequent in urban settings. Penetrating abdominal trauma is often subdivided into stab wounds and gunshot wounds, which require different methods of treatment Penetrating thoracic or abdominal or combined injuries are one of the common injuries caused by assault ***(Ramanuj and Panchal, 2016).***

Penetrating chest injuries are a great challenge for medical professionals because of high mortality rate. External injuries look insignificant but majority of them prove fatal due to damage of vital organs and major blood vessels. Survival of victim depends upon the extent of damage and promptness of medical services. These injuries are associated with high risk of life threatening intra-abdominal or intra thoracic organ injury. Due to the inadequate treatment of the injuries, many of the cases are fatal ***(Dodia and Sansiya, 2015).***

Penetrating trauma in the thoracoabdominal region may create injuries in both the chest and the abdomen, including the diaphragm. Unstable patients present a challenging management dilemma, regarding which body cavity to enter first. ***(Dodia and Sansiya, 2015).***

Penetrating thoracic or abdominal or combined injuries are one of the common injuries caused by assault. These injuries are associated with high risk of life threatening intra-abdominal or intra thoracic organ injury. The knowledge in the management of penetrating trauma is progressively increasing due to the data gathered from different parts of the world ***(Dodia and Sansiya, 2015).***

Abdominal trauma represents an important part of day to day care activity in radiology. Non-surgical treatment has become the standard of care in hemodynamically stable patients with abdominal trauma as a result of exhaustive and rigorous assessment of the consequences of the injury by imaging. In addition; the developments in interventional radiology instrumentations and techniques was a venue for non operative management of patients whom otherwise would have required exploratory laparotomies and thoracotomies ***(Mama et al., 2012).***

Aim of the Work

The aim of the study is to review the different management strategies of penetrating abdominal and thoracic trauma.

HISTORY AND EVOLUTION OF TRAUMA

The historical documentation of abdomino-thoracic trauma is probably as old as history itself. The oldest medical and scientific document known is the Edwin Smith Surgical Papyrus. This is thought to be an undated version of documents prepared by Imhotep around 3000 BC. Greek soldiers in the Trojan War, in the 1st century AD, were removed from the battle field and looked after in certain barracks or ships which seemed to be the earliest trauma centers. Until the late 19th century penetrating abdominal trauma was managed expectantly, with modalities including rest, wound dressings, and opium. Around the time of world war I, operative management became the accepted standard for penetrating wounds to the abdomen. It has since been realized, however, that not all penetrating abdominal wounds require operation. As early as 1960 **Shaftan** advocated “observant and expectant treatment" rather than mandatory laparotomy in the management of penetrating abdominal injury ***(Loria, 1948)***.

This was reinforced in 1969 by **Nance and Cohn** for the management of abdominal stab wounds. Since that time, selective non operative management of stab wounds to the anterior abdomen has become more readily accepted. Gone shot wounds (GSW) to the abdomen, however, are still commonly treated with mandatory exploration because of multiple reports

emphasizing a high incidence of intra-abdominal injuries and the complications of a missed injury or an injury delayed in recognition and treatment ***(Loria, 1948).***

With increased mechanization of life, abdomino-thoracic injuries have more taken a different turn. Penetrating injuries can now be caused by accidental impaction of pointed objects attached to machines or other structures. Blunt injuries following fall from heights such as scaffoldings of buildings under construction or following run over under wheels of heavy vehicles have become commoner. Firearm injuries take the biggest toll in warfare***(Loria, 1948).***

All strategies for the management of abdominal trauma underline the need for an interdisciplinary approach to diagnosis and therapy. This requires focused and intelligent use of efficient diagnostic procedures and tools such as routine investigations like X-ray, ultrasonography, computed tomography which play a vital role in triage of patients with abdominal trauma ***(Saadia, 2000).***

Minimally invasive surgical techniques have become increasingly utilized in all areas of surgery. Current use of laparoscopy in the evaluation and management of trauma patients is one natural extension of this trend ***(Saadia, 2000).***

Several studies have analyzed various aspects of its application to the trauma patient. Although utilized for both blunt and penetrating injuries, laparoscopy has gained the most widespread acceptance as a useful tool in the management of patients with penetrating abdominal injuries. Its ability to accurately determine anterior peritoneal penetration from stab and gunshot wounds has been proven. Others have expanded its role beyond simply a screening tool for injury to its current use in some centers as a diagnostic and therapeutic modality ***(Miles et al., 2004).***

Penetrating trauma presents considerable difficulties for the clinician. Potential challenges include; the use of external wounds as markers of internal injuries, injury patterns that are not always predictable, multiple wounds and single wounds that traverse multiple anatomic areas (i.e., chest and abdomen), hemodynamic instability, major vascular injuries which are much more common than in blunt trauma and are substantially worse, reliability of the physical examination for detecting peritonitis in the context of a rapid increase in morbid obesity. Common traps include, but are not limited to; missing additional wounds and therefore missiles, assuming a straight line of trajectory, assuming "entry" versus "exit" wounds, relying on "probing" a wound, missing cavitary penetration, relying on initial hemodynamic stability and not recognizing missile and/or air embolization ***(Ball, 2014).***

ANATOMY

The thorax

The thorax (or chest) is part of the anatomy of humans and various other animals located between the neck and the abdomen. The thorax includes the thoracic cavity and the thoracic wall **(Figure 1).** It contains organs including the heart, lungs, and thymus gland, as well as muscles and various other internal structures. The three main anatomical components of the thorax are:

1. *Thoracic wall:*

a) Muscles:

The muscles of the thoracic and abdominal walls are in general arranged in external, middle and internal layers. In the thorax, these are:

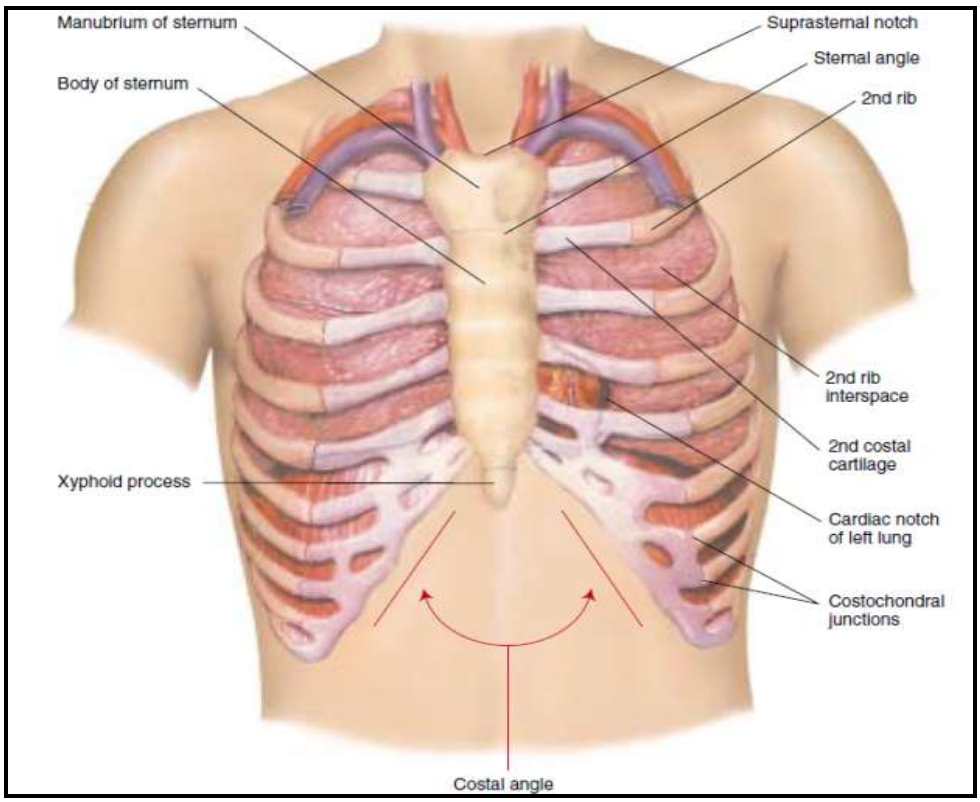

Figure (1): Thorax anatomy ***(O'rahilly and Mu□ller, 1983).***

The external intercostal muscles:

The external intercostal muscles are attached to the lower margins of ribs 1 to 11. Their fibers pass inferior and anterior to

insert on the upper margin of the rib below. They are responsible for inspiration ***(O'Rahilly, 1983).***

The internal intercostal muscles:

The internal intercostal muscles are attached to the lower margins of the ribs and costal cartilages and to the floor of the costal groove. For the most part, they are muscles of expiration ***(O'Rahilly, 1983).***

The innermost intercostal muscles:

The innermost intercostal muscles may be regarded as those parts of the internal intercostal muscles that are internal to the intercostal vessels and nerves. All these muscles are supplied by the corresponding intercostal nerves.

The internal layer and the thoracic skeleton are separated from the costal pleura by the endothoracic fascia. The diaphragm separates the thoracic and abdominal viscera ***(Loukas et al., 2006).***

The diaphragm:

The diaphragm is the boundary between the thorax and abdomen. Its peculiar dome shaped configurations makes an overlap area between chest and abdomen where an external trauma to this area, even when passing strictly in the same axial plan, would possibly traverse into the two cavities **(Figure 2).**

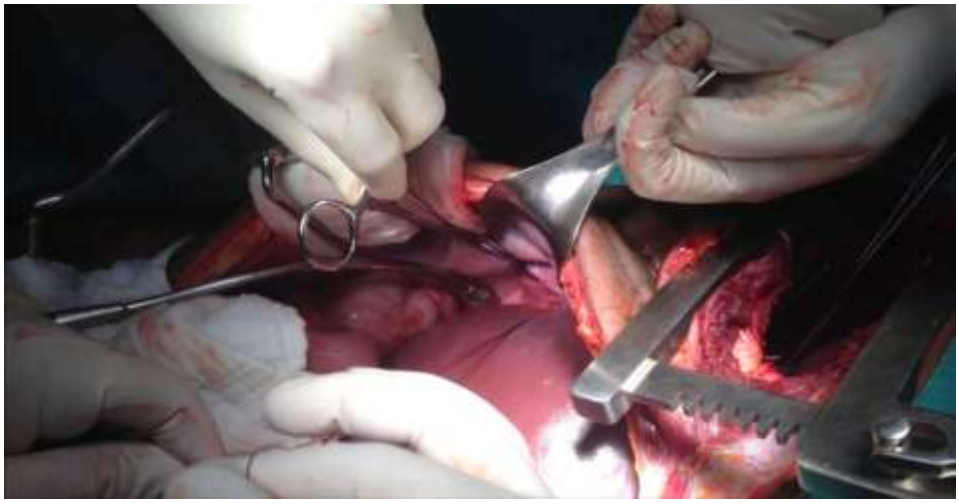

Figure (2): Intra-operative view thoracotomy and transverse incision ***(Cothren and Moore, 2006).***

The diaphragm is the most important muscle in respiration. Three of its parts (sternal, costal and lumbar) are inserted into the central tendon, a trifoliate structure that lies immediately inferior to the heart. The sternal part consists of slips from the xiphoid process, which (in vivo) descend to the central tendon. On each side, a small gap known as the sternocostal triangle is present between the sternal and costal parts. It transmits the superior epigastric vessels and some lymphatics, and it may be the site of a diaphragmatic hernia. The costal parts, which form the right and left "domes," arise from the inner surfaces of the lower costal cartilages and ribs and interdigitate with the transversus abdominis. They are inserted into the central tendon anterolaterally **(Figure 3)** ***(O'Rahilly, 1983).***

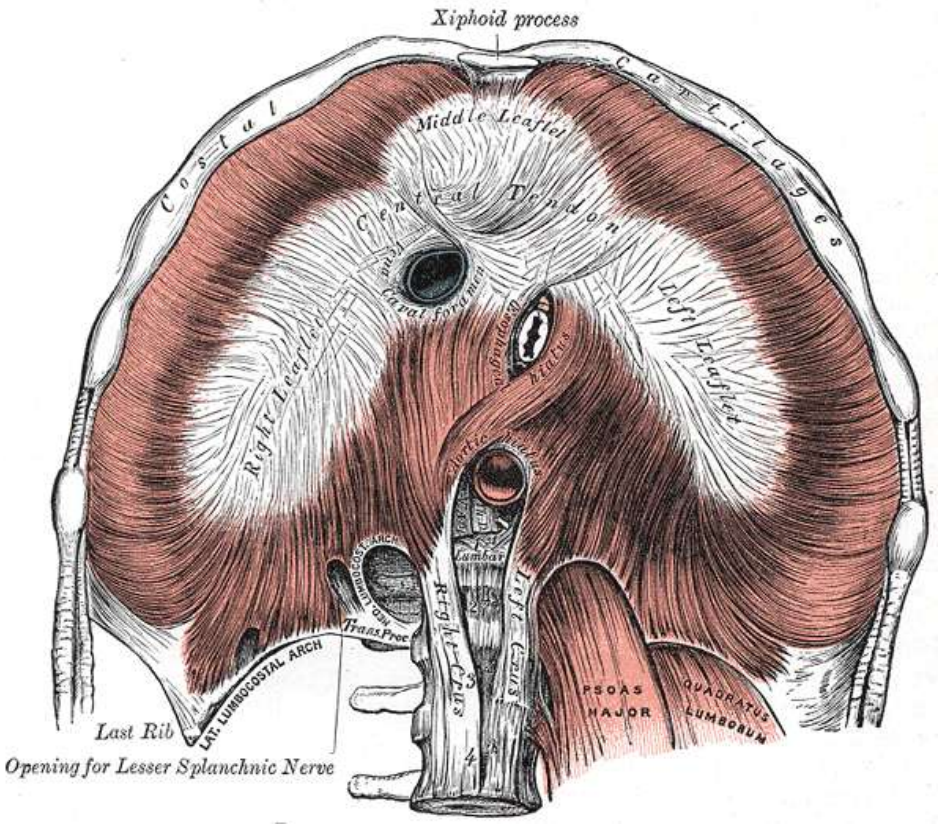

Figure (3): The Under surface of the diaphragm ***(Gardner, 1960).***

The diaphragm has three major openings. The esophageal opening in the right crus transmits the esophagus and vagus nerves. The aortic opening lies posterior to the crura and transmits the aorta, the thoracic duct and greater splanchnic nerves, and occasionally the azygos vein. The foramen for the inferior vena cava, in the right half of the central tendon, transmits the vena cava, right phrenic nerve, and lymphatic vessels. Other structures that pierce or are related to the diaphragm include the splanchnic nerves, sympathetic trunk, subcostal nerves and vessels, superior epigastric and musculophrenic vessels, and azygos and hemiazygos veins.