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Management of liver trauma in cirrhotics

Essay

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دراسة إصابات الكبد فى المرضى المصابين بتليف الكبد وطرق علاجها

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Etiology and Pathophysiology

Cirrhosis is not uncommon in the injured population, with the existing literature reporting an incidence in trauma patients of approximately 1% of all admissions [1, 2, 3]. The incidence of cirrhosis was found to be constant throughout the 10-year study period. Blunt injuries were the most common mechanism of injury in cirrhotic patients (91%), consisting predominantly of falls (43%). This is in agreement with a previous study that reported falls as the most common mechanism of injuries in cirrhotic patients [2].

The liver consists of a relatively fragile parenchyma contained within the Glisson's capsule, which is thin and does not afford it great protection. Hence, the parenchyma and its vasculature are very susceptible to blunt and penetrating trauma. The vasculature consists of wide-bore, thin-walled vessels with a high blood flow, and injury is usually associated with significant blood loss [4].

Histological changes in liver cirrhosis and its impact in liver trauma

Cirrhosis is an irreversible distortion of normal liver architecture characterized by hepatic injury, fibrosis, and nodular regeneration. Increased or altered synthesis of collagen and other connective tissue or basement membrane components of the extracellular matrix is implicated in the development of hepatic fibrosis and thus in the pathogenesis of cirrhosis. Increased collagen deposition in the space of Disse (the space between hepatocytes and sinusoids) and the diminution of the size of endothelial fenestrae lead to the capillarization of sinusoids. Activated stellate cells also have contractile properties. Both capillarization and constriction of sinusoids by stellate cells contribute to the development of portal hypertension[5].

The firm consistency of the liver making it more susceptible to the effect of Tensile strain created by compressing or stretching the tissue or by changes in speed (acceleration or deceleration) create shear strain. Even minor trauma to cirrhotic liver produce profuse bleeding due to portal hypertension and coagulopathy.[6]

Because the liver occupies most of the right upperquadrant of the abdomen and extends across the midline, any blunt or penetrating trauma to the lower chest or upperabdomen places the liver at risk of injury. For patients undergoing surgery, the incidence of liver injury is approximately 35% in cases of blunt trauma and as high as 60% in cases of penetrating trauma.

Segmental anatomy of the liver(Fig. 1)

The liver is divided into two lobes along a plane from the inferior vena cava posteriorly to the gallbladder fossa anteroinferiorly (Cantlie's line); the plane defined by the middle hepatic vein demarcates the division of the lobes. The umbilical fissure, lying to the left of Cantlie's line, marks the point of attachment of the ligamentum teres that continues into the falciform ligament anteriorly. The widely accepted numbering system of Couinaud, that divides the liver into functional segments on the basis of hepatic venous drainage, is the most useful classification.

Three main hepatic veins divide the liver into four sectors, and each of these sectors receives its blood supply from independent portal pedicles.

The sectors are further subdivided into segments, each supplied by a branch from a portal pedicle.

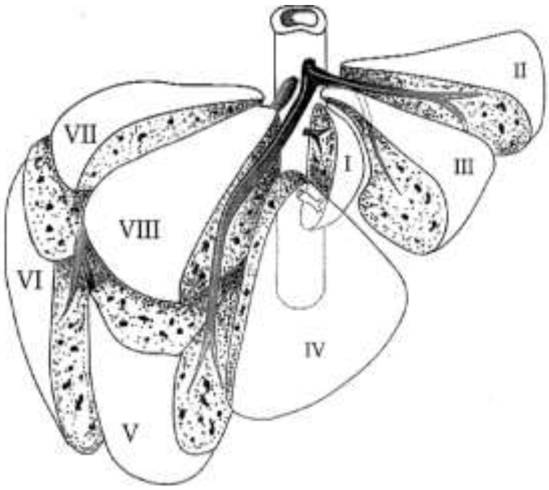

Figure 1 Couinaud's segmental picture of liver. The representative appearance of the hepatic segments separated within the liver.

The right lobe contains segments V, VI, VII, and VIII. The left lobe contains segments II, III, and IV. Segment I (caudate lobe) is located just anterior to the inferior vena cava, inferior to the entrance of the main hepatic veins into the vena cava, and posterior to the hilum. This segment may receive branches from both the right and the left portal systems, and the bile ducts may enter the left or the right ducts or the duct confluence. Hepatic veins from segment I may enter the left or middle hepatic veins or drain directly into the vena cava **[7]**.

A) Blunt trauma

1) Biomechanics of Blunt Trauma

Blunt trauma results in two types of forces during impact. First, changes in speed (acceleration or deceleration) create shear strain, and second, deformity changes (stretch or compression) create tensile strain. Abdominal injuries can result as a consequence of acceleration of the viscera at a rate out of proportion to movement of the points of attachment. The kidneys, small intestine, large intestine, and spleen are all vulnerable to this type of shear injury. Similarly, with deceleration, the liver may continue to travel relative to the ligamentum teres, generating shear forces that transect or lacerate the hepatic parenchyma. Tensile strain creates injury by directly compressing or stretching the tissue. In the abdomen, the pancreas, liver, spleen, and occasionally the kidneys are subject to tensile strain injuries, particularly following a frontal (or, for the kidney, flank) impact. In addition, direct compression of the abdomen may increase intraabdominal pressure, rupturing the diaphragm[6,27].

2)Patterns of Blunt trauma

1) Motor Vehicle Collisions

Specific patterns of injury are recognized for various types of motor vehicle collisions. These include: (a) head-on or frontal impact, (b) rear impact, (c) lateral or side impact, (d) rotational impact, and (e) rollover. In general, a vehicle's occupant receives a kinetic energy transfer similar to that of the vehicle itself. As an automobile collides with an object, passengers collide with the interior of the automobile, and the internal organs collide with the body wall or are sheared from anatomic attachments.

2) Motorcycles

Motorcycle injuries involve four types of impacts: frontal, angular, ejection, and rear end collision.

3) Pedestrians

Two general patterns are seen in motor vehicle pedestrian accidents, depending on whether the patient is an adult or a child. In adults, the initial impact is often by the car bumper, producing fractures to the tibia and fibula. As the victim falls over the moving vehicle, the pelvis and upper femur are struck by the front of the vehicle's hood, and the abdomen and thorax continue onto the top of the hood. The secondary strike can result in fractures of the femur or pelvis and produce serious intraabdominal or intrathoracic injury. A third impact occurs as the victim falls away, striking the ground. This impact commonly leads to head injury as well. In children, the initial impact is predictably higher and may produce injury to the pelvis or upper femur. The second impact occurs when the front of the hood strikes the thorax. The final impact may not occur on top of the hood but rather as the child is dragged underneath the vehicle.

4) Falls

Falls result in multiple impacts. Energy transfer is a result of the velocity that develops during the fall, so the height of the fall usually determines the magnitude of injury. Falls from more than three times the height of the victim, or from more than 20 feet, are considered severe. The surface on which the victim lands and its degree of compressibility also have an effect on the energy transfer and the types of shear and tensile strain that occur. A typical injury pattern after falls in which the victim lands on the feet is transaxial and includes bilateral calcaneal fractures and multiple compression fractures of the thoracic and lumbar spine.

5) Restraint Device Injury

Theoretically, three-point passenger restraints, when used properly, allow the kinetic energy transferred by the impact to be absorbed by the bony pelvis and chest. If improperly positioned, however, lap belts may rise above the pelvis, delivering the compression force to the soft tissues of the abdominal cavity or retroperitoneum. Common injuries when lap belts are incorrectly strapped above the anterior iliac crest include compression injuries of the intraabdominal organs (liver, pancreas, spleen, small bowel, large bowel), increased intraabdominal pressure and diaphragmatic rupture, and anterior compression of the lumbar spine.***[6].***

Examples of blunt liver trauma

In a road traffic accident, or fall from a height, may result in a deceleration injury as the liver continues to move on impact. This leads to tears at sites of fixation to the diaphragm and abdominal wall. A well recognized deceleration injury involves a fracture between the posterior sector (segments VI and VII) and the anterior sector (segments V and VIII) of the right lobe (Fig.2) this type of injury may be associated with a significant vascular injury due to a tear of the right hepatic vein. In contrast, a direct blow to the abdomen may produce a central crush injury, with an extensive stellate-type laceration involving segments IV, V, and VIII (Fig. 2).

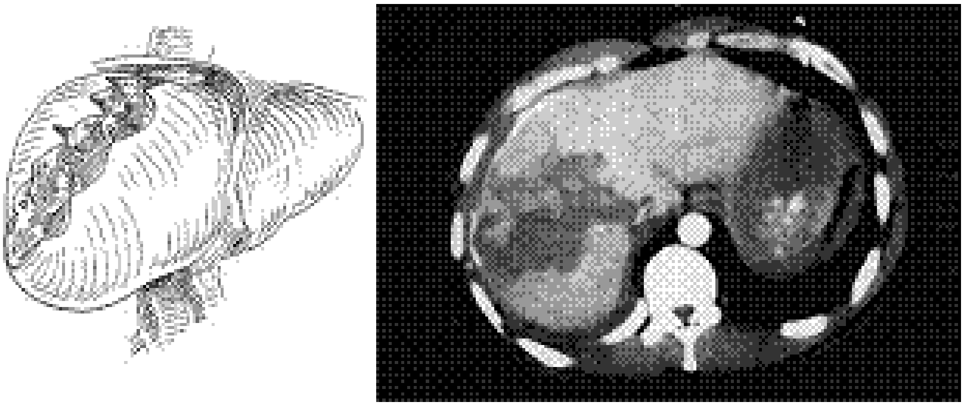

Fig.2 A deceleration-type fracture injury between the anterior and posterior sectors of the right lobe (left) demonstrated on CT scan right.

With this pattern of injury, an associated major vascular injury may be present, with disruption of the hepatic arteries, portal veins, or the major hepatic veins. This type of injury may also be associated with bleeding from the caudate lobe (segment I).

Fig. 2 A central crush injury resulting in a stellate-type laceration

Such an injury may occur with a blow from a fist or weapon, or a central crush in a road traffic, industrial, or farming accident. Overall, blunt trauma more commonly affects the right hepatic lobe, particularly the posterior sector, with the caudate lobe rarely affected .[9,10].

Most liver injuries (>85%) involve segments 6, 7, and 8 of the liver. This type of injury is believed to result from simple compression against the fixed ribs, spine, or posterior abdominal wall. Pressure through the right hemithorax may propagate through the diaphragm, causing a contusion of the dome of the right lobe of the liver. The liver's ligamentous attachment to the diaphragm and the posterior abdominal wall can act as sites of shear forces during deceleration injury.

Liver injury can also result from transmission of excessively high venous pressure to remote body sites occurring at the time of impact. Liver injury occurs more easily in children than in adults because the ribs are more flexible, allowing force to be transmitted to the liver. In addition, the liver is not fully developed in children, who have a weaker connective tissue framework than do adults. A steering-column injury may cause trauma to an entire lobe of the liver. Deceleration injuries produce shearing forces that may tear hepatic lobes from each other and often involve the inferior vena cava and hepatic veins. Increasing numbers of central liver hematomas caused by accidents involving mountain bikes are being encountered[27].

B) Penetrating trauma

The liver is the most common abdominal organ injured by penetrating trauma. Penetrating trauma of the liver may be caused by bullets, shrapnel, knives, and other sharp objects.**[26].**

1) Biomechanics Of Penetrating Injuries

Penetrating trauma involves the transfer of energy to a relatively small tissue area. The velocity of a gunshot wound is exceedingly high compared with any type of blunt trauma. The kinetic energy of a bullet disrupts and fragments cells and tissues, moving them away from the path of the bullet. The actual size of the frontal area of impact is determ ined by three factors: profile, tumble (spin and yaw), and fragmentation

2)Patterns of Penetrating trauma

1) Low-Energy Stab Wounds

Low-energy missiles include knives and other objects that produce damage only by their sharp cutting edges. Cavitation is minimal and injury can be predicted simply by tracing the pathway of the weapon within the body. Knowledge of the type of weapon is sometimes helpful. The attacker may stab and move the knife or weapon inside the body, which can lead to more injury than that perceived from the cutaneous wound. Judgment of the potential scope of injury by examination of the entrance wound is not reliable.[6].

2) Low- and Medium-Energy Gunshot Wounds

Low-energy gunshot wounds are defined as those with an initial muzzle velocity of less than 1,200 ft/s. Medium-velocity projectiles have muzzle velocities between 1,200 and 2,000 ft/s. Most handguns and some rifles are low- or medium-energy weapons.

3) High-Energy Weapons

The essential difference between high-energy weapons and the typical civilian gunshot wound is that their projectiles produce a much larger cavity or pressure cone than low- and medium-velocity missiles. The proliferation of semiautomatic weapons also has resulted in an increased number of wounds a victim may experience. Instead of a single gunshot wound, the surgeon may be faced with multiple wounds in multiple body locations.**[6]**

4) Blast Injuries

Blast injuries caused by close-range shotgun fire constitute devastating injuries comprising extensive tissue destruction. Besides specific organ injury, blast injuries have the highest potential for secondary infection. These injuries, in general, should be surgically explored, devitalized tissue should be extensively debrided, and the wounds should be left open and packed with sterile dressing that should be changed and reviewed serially in the operating room.[8]

Examples of penetrating Liver trauma

Penetrating injuries may be associated with a significant vascular injury. For example, a stab injury may cause major bleeding from one of the three hepatic veins or the vena cava and also from the portal vein or hepatic artery if it involves the hilum. Gunshots may similarly disrupt these major vessels; this disruption may be much more marked than with stab wounds due to the cavitation effect, particularly with bullets from high-velocity weapons.

The connection between the thin-walled hepatic veins and the inferior vena cava (IVC), at the site where the ligamentous mechanism anchors the liver to the diaphragm and posterior abdominal wall, represents a vulnerable area, particularly to shearing forces during blunt injury. Disruption here leads to the ‘‘juxtahepatic’’ venous injuries, which are usually associated with major blood loss and present a particularly challenging management problem[7,9,10].

c) Iatrogenic liver injuries

Iatrogenic liver injuries may occur from percutaneous liver procedures, liver or biliary operations, or therapeutic anticoagulation. The use of percutaneous liver puncture for biopsy, cholangiography, and drainage of the biliary tract has become common, sparing many patients open surgical procedures for the diagnosis and management of some hepatic diseases. These procedures, however, are the equivalent of a penetrating liver injury that is treated nonoperatively.[17-19,20-25].

Scoring Systems and Injury Assessment

Trauma scoring systems describe injury severity and correlate with survival probability. Various systems facilitate the prediction of patient outcomes and the evaluation of aspects of care. The scoring systems vary widely, with some relying on physiologic scores (eg, Glasgow Coma Scale [GCS] score, Revised Trauma Score), and others relying on descriptors of anatomic injury (eg, Abbreviated Injury Score, Injury Severity Score). No universally accepted scoring system has been developed, and each system contains unique limitations. This limitation has resulted in the use of a number of such systems in different centers around the world.[16]

Revised Trauma Score and Triage

The trauma score developed by Champion and Sacco in 1981 is the most widely applied and the most useful scoring system for the initial evaluation of trauma victims. It mathematically combines the physiologic parameters of blood pressure, respiratory rate, and Glasgow Coma Score to assess injury severity and predict which patients need the most timely and sophisticated medical care.[11]

Abbreviated Injury Scale

Abbreviated Injury Scale (AIS) was developed in 1971 for use in blunt trauma and has subsequently been updated on a periodic basis. The 1990 revision of the AIS includes descriptors for penetrating trauma. Injury severity is determined in six different body areas on a scale of 0 to 6, where 0 indicates no injury, 5 indicates critical injury, and 6 indicates a nonsurvivable