CASE REPORT

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Lacerations of the Hepatoduodenal Ligament, Pancreas and Duodenum in a Child due to Blunt Impact

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ABSTRACT: Descriptions of the nature of pediatric injury as reported by parents and caretakers is frequently tainted, even fraudulent. We present here such a case of trauma incurred in the presence of a parent which resulted in hepatoduodenal ligament laceration with associated pancreatic and duodenal injuries, the certain result of severe blunt force abdominal trauma. These findings were at variance with the father's description of the events leading up to the child's untimely demise.

KEYWORDS: forensic science, blunt abdominal trauma, hepatoduodenal ligament, child abuse, intra-abdominal hemorrhage

Child abuse is a well-described entity. The 1962 description of the Battered Child Syndrome by Kempe et al. (1) brought it to the forefront. Since then, reports in the medical and lay press have mushroomed. We report here on a child who suffered repeated bouts of physical abuse, culminating in his death, following exsanguinating intra-abdominal hemorrhage.

Though uncommon, the portal triad and its components are vulnerable to blunt and penetrating trauma. Many reports in the literature have described injuries to the Hepatic artery (HA), Portal vein (PV), and Common bile duct (CBD), individually or in combination. However, we have been unable to find a comparable instance in which blunt trauma caused the specific constellation of injuries discovered in this case: hepatoduodenal ligament laceration with transection of the HA, PV, and CBD with associated pancreatic and duodenal injuries.

Case Report

The deceased was a $2\,^1/_2$-year-old male who arrived at an emergency room (via ambulance) without vital signs. His rectal temperature was below 338C and rigor mortis was present in the jaw.

The child's father claimed that he left his son unattended in the bathtub, and that he re-entered the bathroom when he heard a noise. The father noted no obvious injuries on the child, but within a few minutes, the child's eyes were closed and he was breathing heavily. The father thought the child was having an asthma attack. When the child stopped breathing, the father called 911.

At autopsy, the child was a 36 inch long, 23 pound male with a well-healed $1\,^1/_2$ in. scar anterior to the right tragus and a $^3/_4$ in. scar of the mid chin. Multiple contusions were evident over the anterior and lateral left chest, thoracolumbar spinal area and forearms. There were no externally visible abdominal injuries. X-rays of the chest and abdomen showed multiple healing rib fractures and free air in the peritoneum surrounding the falciform ligament, along the right flank, and beneath the central portion of the diaphragm.

Autopsy disclosed a laceration of the width of the hepatoduodenal ligament with transection of the HA, PV, and CBD. The entire anterior wall of the duodenum, extending from the pylorus to the Ligament of Treitz, was lacerated and gaped open. The head of the pancreas was lacerated and contused (Figs. 1a and 1b). The peritoneal cavity contained 500 cc of blood. Examination of the brain showed old contusions of the left orbital gyrus. Multiple healing rib fractures were confirmed.

Following the autopsy, the police again questioned the child's father. During the latter interrogation the father admitted only that he had hit the boy three times with an open palm, once to the left upper chest, once to the mid-left chest, and once to the left hip.

Further investigation revealed that two other siblings, also under their father's care, had incurred extremity fractures which had gone without the benefit of medical attention.

Discussion

The hepatoduodenal ligament is the portion of the lesser omentum (a peritoneal reflection) extending from the undersurface of the liver (in the region of the porta hepatis) to the proximal portion of the duodenum. Nestled between its two layers lie the HA, PV, and CBD.

Because of its location deep in the abdomen, the portal triad is well protected. Its components are more susceptible to penetrating trauma and are fairly impervious to all but major blunt trauma (2–4). This case demonstrates that blunt trauma may well result in injury of the hepatoduodenal ligament and its surroundings.

Leber et al. (5) reported a single instance involving hemorrhage arising from the region of the hepatoduodenal ligament, due to a laceration of the HA. The peritoneum covering the PV was denuded

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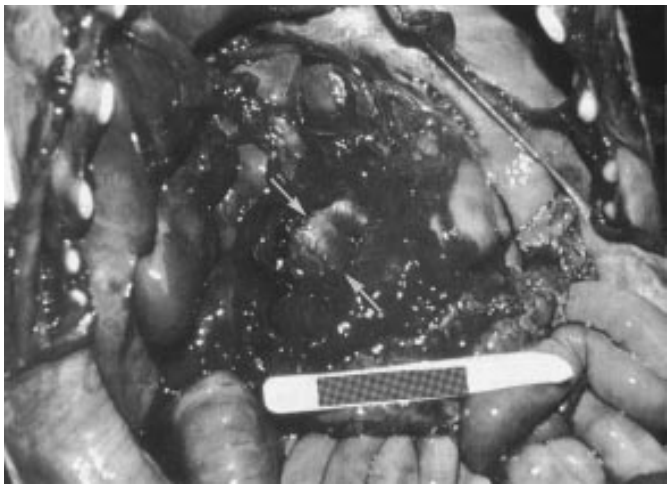

FIG. 1a—*Autopsy photograph of lower chest and abdomen. There is extensive hemorrhage in the area of the disrupted hepatoduodenal ligament (arrows).*

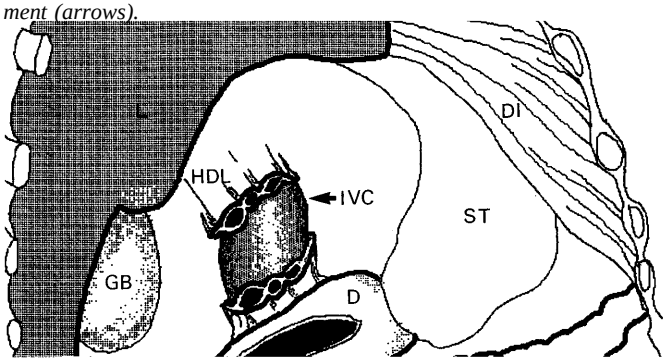

FIG. 1b—*Artist representation of photograph 1a. GB = gallbladder, L = liver, HDL = hepatoduodenal ligament (with laceration), IVC = inferior vena cava, ST = stomach, DI = diaphragm, D = duodenum (with laceration), P = pancreas (contused).*

and the CBD was avulsed from the pancreas. The head and body of the pancreas were badly contused and there was a duodenal laceration, all resulting from blunt force trauma.

Dawson et al. (2) reported an instance in which the portal triad structures were all injured, however, the cause of the injury was not described.

In their series, Busuttil et al. (6) described injuries to the PV and HA following penetrating trauma only. Common bile duct injuries were noted equally in blunt and penetrating trauma.

Petersen et al. (3) reviewed 28 PV injuries: 25 due to penetrating and only 3 due to nonpenetrating trauma.

Knowledge of the anatomy of this region is crucial in understanding the mechanism of injuries. The interrelationships of these structures in the mid-abdomen clearly influence the degree and vector of the force endured.

The head and body of the pancreas are firmly fixed to the posterior parieties. The duodenal bulb is somewhat mobile, but the remainder of the duodenum is fixed by peritoneum. This is an important anatomic detail, as ductal injuries from blunt trauma occur predominantly at points of fixation (6). For example, damage to the CBD usually occurs at its point of entry into the superior border of the pancreas (6–8). As the CBD within the hepatoduodenal ligament is mobile, impact in this area may separate it from the relatively fixed pancreas (9).

Sudden high velocity impact to the upper abdomen may crush the pancreas and duodenum against the rigid vertebral column while simultaneously displacing the liver cephalad and the transverse colon and hepatic flexure caudad. With these divergent motions, the intervening, less mobile structures (e.g., the hepatoduodenal ligament) are placed under significant tension and may tear (9,10). Injury to more than one of the portal triad structures typically is associated with an especially violent force (2) (Fig. 2).

The retroperitoneal second and third portions of the duodenum are common sites of injury (11). Undoubtedly the short segment of the duodenum where it crosses over the spine is the most susceptible to injury from a direct blow. The remainder of the duodenum is relatively spared from direct trauma, as it falls away into the somewhat more protected paravertebral regions. Transmission of force through gas or liquid in the closed loop of duodenum, from

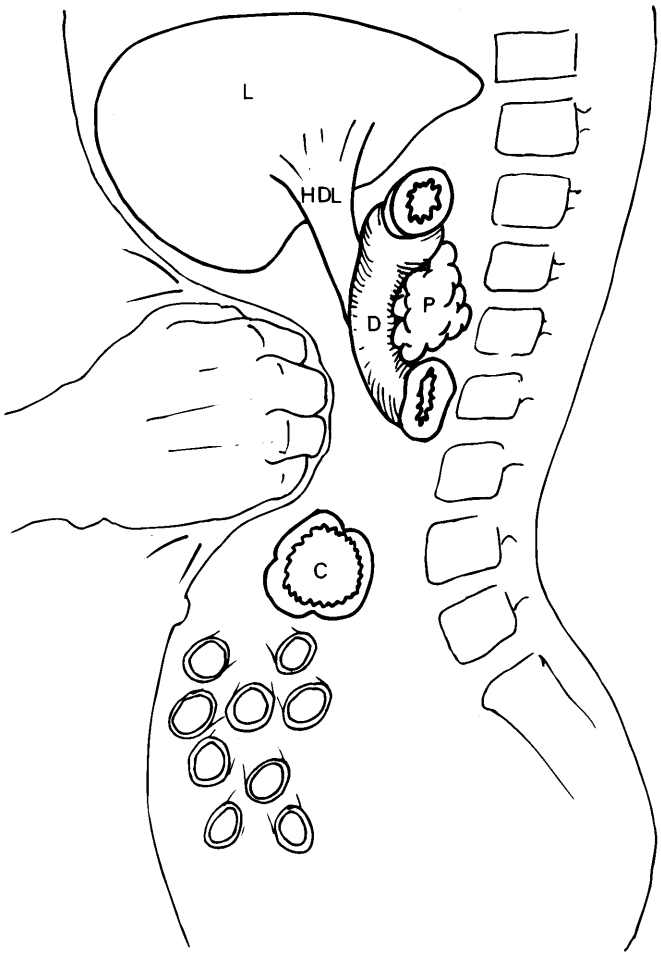

FIG. 2—*A proposed mechanism of injury. L = liver, P = pancreas, D = duodenum, C = colon, HDL = hepatoduodenal ligament.*

the pylorus to the ligament of Treitz, has been proposed as a mechanism for more extensive damage to the duodenum involving these less vulnerable areas (10).

Rarely, the PV may be injured in isolation without extensive injuries to surrounding organs (12). The paucity of isolated HA injuries due to blunt impact may be attributed to its elasticity and redundancy (13). The CBD is injured more frequently than the other structures, likely because it is shorter and is less mobile.

Ahmed (14), in a review of 33 instances of bile duct injury in children, found that the modes of injury were as follows: motor vehicle accident (MVA)—73%, heavy object falling on the abdomen—12%, child abuse—6%, kick to the abdomen—3%, fall from height—3%, unknown—3%.

Michelassi et al. (8) discussed major causes of blunt trauma to the extrahepatic biliary system: MVA—65%, work related accidents—10%, falls—7%, blows in a fight—8%, and unknown—10%.

Among the portal triad structures, injury to the PV is the most likely to lead to a fatal outcome, as the PV is the principal efferent blood conduit from the abdominal viscera and the main afferent blood supply to the liver. In adults this vessel averages 2 cm in diameter. Its intraluminal pressure averages 10 mmHg, and has an average flow rate of 1 liter/minute, making this a low pressure but high flow vessel. Laceration of this vessel will almost certainly result in rapid hemorrhage with prompt exsanguination. High mortality (approaching 50%) prevails in such settings.

Injuries isolated to the PV are uncommon. In most instances, at least one other organ will be affected: in 70–85%, another vascular structure. Other commonly injured nearby organs are the liver, duodenum, pancreas, stomach, colon, small bowel and CBD. The mortality is affected by the number and extent of additional structures injured. In the Dawson series (2), no individual with injury to more than one porta hepatis structure survived (3 of 3). However, others have reported survival (15).

Kempe et al. (1), in a notable discussion, stated that the "Battered Child Syndrome," as he called it, should be considered in any child who dies suddenly, or where the degree and type of injury is at variance with the history given.

This case report emphasizes that suspicion for the Battered Child Syndrome must remain foremost in the mind of the forensic practitioner, particularly if there is anatomic-historic disharmony in assessment of childhood trauma. The terminal injuries seen in this child are not consistent with minor trauma as described by the father. When compared with the descriptions in the literature of similar degrees of injury, the findings in this case demand a full investigation of the manner of injuries incurred and radiographic assessment for additional evidence of child abuse.

The case also reinforces the need for a complete autopsy in children who die at home or soon after arrival in the emergency room (before medical studies can be completed), even in the presence of a compelling medical history (which may be misleading). Children who are sick can be and often are abused.

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