

CHYLE LEAKAGE AFTER BLUNT TRAUMA

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ABSTRACT

Three patients developed chylous leakage after major blunt trauma. In one patient with non-remitting right-sided chylothorax, lymphangioscintigraphy as well as conventional oil contrast lymphography demonstrated disruption of the thoracic duct at the aortic hiatus which eventually required transpleural mediastinal ductal ligation proximal to the fistula. The other two patients had chylous retroperitoneum and/or chylous peritoneum which was self-limited although one patient (a three-year-old boy) died of multiorgan failure from associated pulmonary contusions and cervical spine injuries. Chylous leak after non-penetrating trauma is usually attributed to hyperflexion-extension of the vertebral column with shearing of tethered lymphatics. Alternatively, sudden compression of lipemic and engorged mesenteric lymphatics, adjacent nodes and the lower thoracic duct aggravated by deformations associated with stretching and tearing motions may also directly disrupt chyle-containing lymphatics.

Non-penetrating trauma to the abdomen and lower chest is associated with a multitude of minor and also life-threatening injuries. Among the rarer manifestations, however, are chyloretroperitoneum, chylous ascites, and chylothorax or the leakage of milky lymph that derives from mesenteric lacteals (1-3).

We now report three previously otherwise healthy patients with chylous leakage after major blunt trauma. Each patient sustained serious associated trauma at the time of accident (motor vehicle in two and fall from building in the other) and in one (a three-year-old child) the spinal and pulmonary injuries eventually proved fatal.

CASE REPORTS

1. A 30-year-old truck driver sustained blunt abdominal-thoracic trauma following a road accident. Initially, he was in profound hemorrhagic shock and underwent at the 3rd Charles University Hospital in Prague prompt laparotomy with findings of hemoperitoneum (~1500ml coagulated blood), jejunal perforation and retroperitoneal hematoma to the left of the abdominal aorta. A rent was also seen in the retroperitoneum to the right of the aorta where a pool of chyle had accumulated. The mesenteric lacteals were dilated, engorged with chyle (indicative of a recent meal), and a prominent retroperitoneal lymph node (~15mm diameter) was ruptured and leaking lipemic lymph. The jejunum was repaired, bleeding was corrected, and the retro-peritoneum was drained. Conventional (oil-contrast) lymphography nine days after operation showed unremarkable retroperitoneal trunks, variable nodal size, and specifically no contrast extravasation (*Fig. 1*). The post-operative course was otherwise

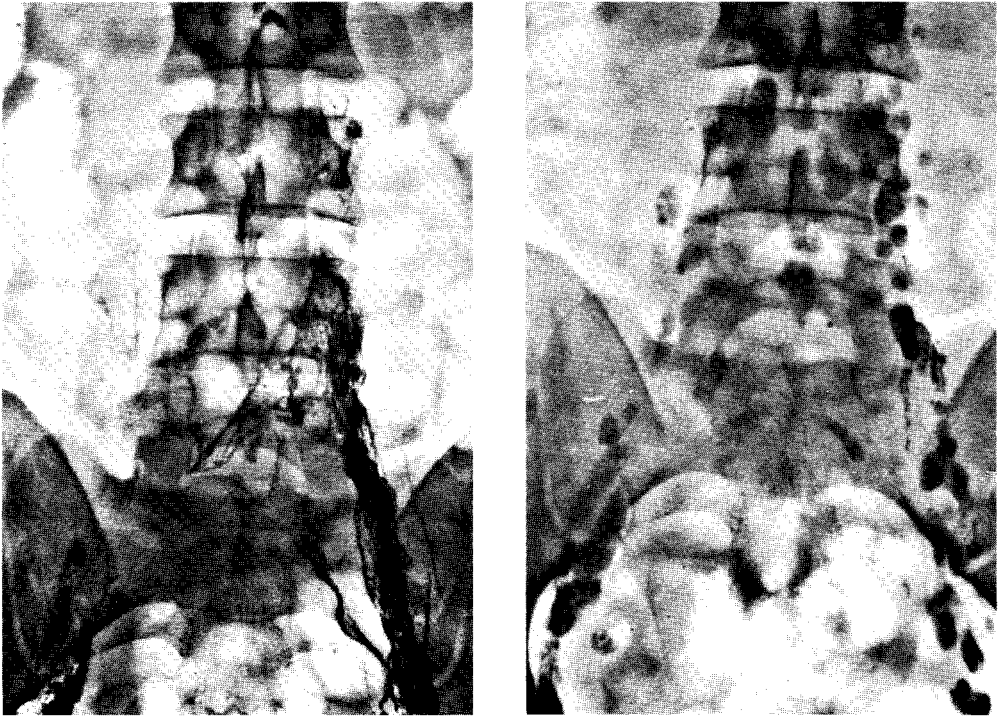


Fig. 1. Conventional lymphography (patient 1) demonstrating Left — minimal dysplasia of lymphatic collectors without extravasation of oil contrast. Right — 24 hours later, normal retroperitoneal lymph nodes are seen.

benign, and one year later he remained well.

2. A 3-year-old boy fell five stories sustaining severe blunt trauma to the head, chest, and abdomen and a supracondylar fracture of the right humerus and distal left radius. Initially he was resuscitated in Mexico and 10 hours later air-lifted to University Medical Center in Tucson, Arizona. Soon after arrival, he had to be resuscitated for profound hypotension and cardiac arrest. Further evaluation indicated probable disruption of the atlanto-axial cervical spine, severe pulmonary contusions bilaterally, frontal bone fracture with cerebrospinal fluid leakage and retroperitoneal-intraperitoneal fluid accumulation consistent with intraabdominal hemorrhage (*Fig. 2*). At operation, the forehead skin site of the cerebrospinal fluid leakage was thoroughly cleansed and the soft tissue and skin simply oversewn.

Celiotomy disclosed massive chylous retroperitoneum and intraperitoneal effusion (~250cc). Milky fluid had extravasated widely into both flanks. Subsequent lipoprotein electrophoresis on the intraperitoneal fluid showed chylomicrons consistent with chyle (*Fig. 2D*). Despite extensive exploration, no injury to mesenteric lacteals, nodes, or retroperitoneal lymph trunks was found. Indeed, except for mild contusion of the left kidney, there was no other intraabdominal trauma. The postoperative course was complicated by pneumomediastinum, worsening pulmonary interstitial edema and lung dysfunction and multiorgan failure which proved fatal 12 days later. Autopsy permission was denied.

3. A 14-year-old boy sustained a severe fracture-dislocation of the spine (T8-T10) with immediate paraplegia after a fall from a horse. After appropriate resusci-

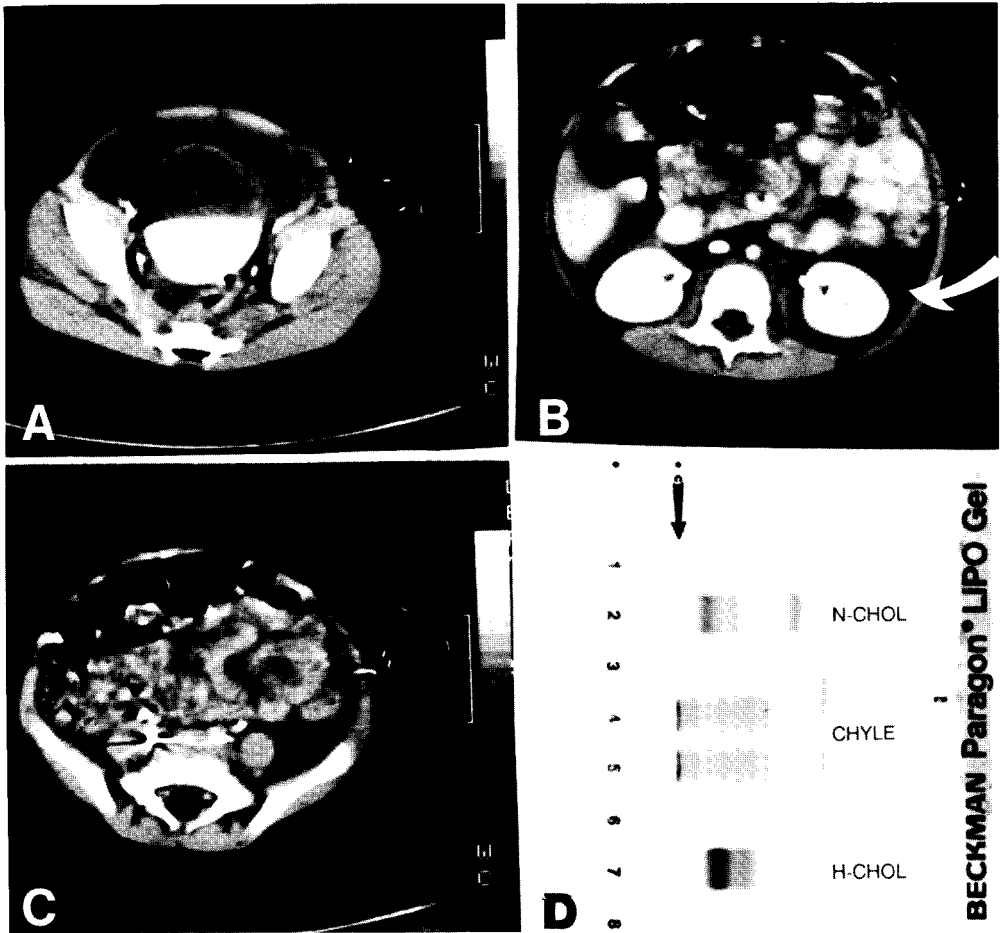


Fig. 2. (A-C): Abdominal computer tomography (patient 2) demonstrating fluid accumulation in the pelvis, perirenal space (arrow), and among loops of bowel, which at celiotomy proved to be chylous retroperitoneum and chylous ascites. (D): Lipid electrophoresis of ascitic fluid of patient 2 (lanes 4,5) compared with a patient with normal cholesterol level of 161mg/dl (lane 2) and one with hypercholesterolemia of 297mg/dl (lane 7). Arrow (c) indicates point of electrophoretic origin. Note the non-migrating dense band in lanes 4,5 consistent with chylomicra, which after ultracentrifugation represents 73% of the total triglyceride content.

tation, the vertebral column was stabilized by insertion of Harrington rods. The postoperative course was complicated by progressive right hydrothorax, which on aspiration yielded frank chyle. Despite non-operative methods (medium-chain triglyceride diet, restrictive fluid oral intake, and eventually nothing by mouth), the pleural effusion persisted requiring multiple thoracenteses and eventually closed thoracostomy with daily removal of >1 liter

of liquid. Lymphangioscintigraphy using technetium radiolabeled human serum albumin (^{99m}Tc -HSA) administered intracutaneously into both feet demonstrated leakage of tracer from the distal thoracic duct (just to the left of the midline) with a fistulous communication into the right chest and tracer exiting via the thoracostomy tube (Fig. 3). These findings were confirmed by conventional (oil-contrast) lymphography (Fig. 4). Because of



Fig. 3. Lymphangioscintigraphy in patient 3 demonstrating leakage of tracer (^{99m}Tc -human serum albumin) on Left—near the lower thoracic spine (arrow) with Right—tracer accumulation in the right chest and closed thoracostomy tube (arrowheads). A circular midline marker has been placed at the upper sternum. At operation, a thoracic duct disruption was located just posterior and to the left of the descending thoracic aorta.

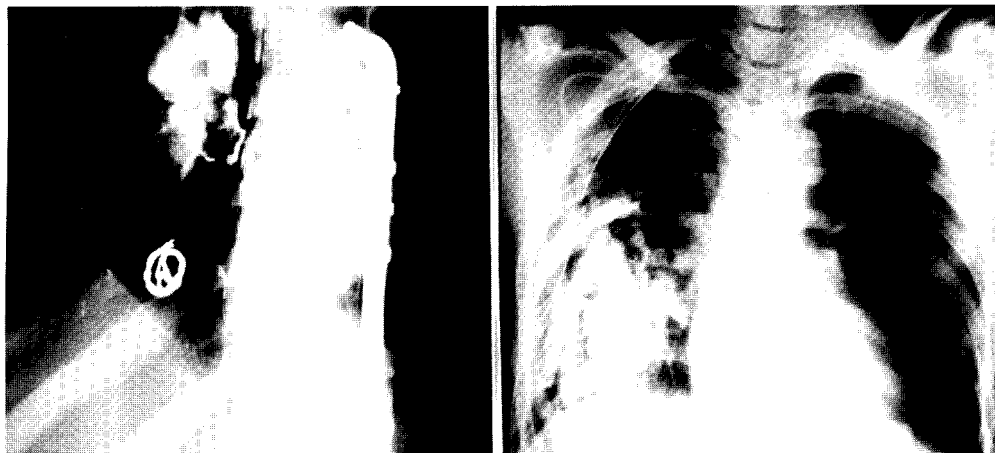


Fig. 4. Conventional (oil contrast) lymphogram confirming a thoracic duct fistula as shown by earlier lymphangioscintigraphy (see Fig. 3).

persistence of a high output thoracic duct fistula, a right thoracotomy was performed (Dr. Tyler Kent) with ligation of the thoracic duct just proximal to its disruption. Of note, the thoracic duct was located just to the left of the midline behind the aorta as indicated by the lymphangiostigraphy. Thereafter, chyle leakage ceased.

DISCUSSION

Chylous leakage or effusion usually is associated with congenital abnormalities of the lymphatic system (e.g., lymphangiectasia, "atresia" of the receptaculum chyli), tumorous blockage of the lacteals or thoracic duct (e.g., lymphoma), developmental anomalies (e.g., pulmonary lymphangiomatosis) or penetrating trauma such as after operations (i.e., iatrogenic) on the left neck (e.g., radical neck dissection), chest (e.g., esophageal, lung, or cardiac procedures), abdomen (e.g., radical gastrectomy), or from bullet or knife wounds transecting the thoracic duct or its adjacent tributaries (1-5). In contrast, chylous leakage after non-penetrating trauma is uncommon with most reports involving chylothorax following blunt force to the back, chest, with or without fracture-dislocation of the vertebral column or rib cage (6-11). Post-traumatic chyloperitoneum or chyloretroperitoneum is even rarer with most occurring in conjunction with chylous pleural effusion and associated with injuries near the aortic hiatus and lymph spillage both antegrade and retrograde (3,12,13).

During planned operations, interruption of visceral lymphatics ordinarily is associated with transient lymph leakage and no morbidity unless lymphatics are dysplastic or obstructed (e.g., chylous reflux syndromes or infiltrating malignant tumors) or are overloaded (e.g., cirrhosis of the liver with portal hypertension) (14,15). Occasionally, a major iatrogenic transection of the thoracic duct produces unremitting chylous hydrothorax or an external chylous fistula often requiring insertion of a chest tube to ease respiratory embarrassment from progressive pleural effusion (4,6,16).

Initially, management is directed at reducing mesenteric lymph formation and fat absorption by restricting oral intake of long-chain triglycerides (absorbed exclusively into intestinal lymph) and providing a diet high in medium-chain triglyceride (absorbed primarily into the portal venous system) or limiting oral intake altogether to minimize the volume of lymph transported by the central lymphatics, thereby promoting spontaneous closure of the thoracic duct fistula (16-18). Nonetheless, if a high output lymph production continues over several weeks with attendant nutritional and volume depletion, operative correction is generally advisable. Because repair of the injured site is usually impractical, ligation of the thoracic duct proximal to the fistula site is generally performed (17-20). Not only is loss from drainage promptly arrested but because of other natural lymph-venous connections below the ligatured thoracic duct (21), lymph absorption quickly is restored and patient well being is fully reinstated.

This approach is exemplified by the course of the third patient in this report where, after blunt trauma to the chest cage and thoracic vertebra, thoracic duct lymph leakage persisted and ultimately successful transpleural mediastinal ligation of the thoracic duct had to be performed. It is noteworthy that lymphangiostigraphy, a radionuclide tracer study that is simple and safe to perform, accurately delineated the fistulous communication from the thoracic duct, and furthermore guided the surgeon to its precise location behind and slightly to the left of the aorta. Because experience with this technique for traumatic lymph fistulae is limited, a corroborating conventional oil contrast lymphogram was also done. As shown by comparison of Fig. 3 with Fig. 4, however, the latter test did not provide additional information. Conventional lymphography was also much more cumbersome to perform and supports recent recommendations that lymphangiostigraphy is the preferred screening test for most lymphatic truncal disorders accessible by extremity intracutaneous

injection (22).

The other two patients with chylous retroperitoneum and/or chylous peritoneum after blunt abdominal/ thoracic trauma represent exceedingly rare complications but tend to corroborate the self-limited nature of this entity (23). In the young child who fell from a building, no discrete lymphatic injury could be delineated despite a vigorous intraoperative search. Nonetheless, after evacuation of the extravasated chylous lymph, no further intraabdominal complications occurred although the patient died 12 days later of progressive multiorgan failure probably related to initially insufficient volume resuscitation, pulmonary contusion, and spinal injury. Similarly, in the other adult patient where a disrupted lymph node at the root of the mesentery was seen to be leaking lipemic lymph, no further lymph truncal sequela occurred and no notable residual lymphatic dysfunction was detected by direct lymphography nine days later. It is noteworthy in this latter patient that intestinal lacteals were bulging with milky lymph at the time of operation.

The mechanism of chylous leakage especially into the chest after blunt trauma is usually attributed to hyperflexion-extension injury of the lower thoracic spine with or without an accompanying fracture-dislocation of the adjacent vertebra (4,6-11,17-20). Ostensibly, the thoracic duct is tethered to the medial crus of the diaphragm anteriorly and to the ninth or tenth thoracic vertebra and becomes disrupted by the subsequent stretching-shearing force involved (11,12). Although this explanation is reasonable and conforms to the concomitant spinal injury in patient 3, it is also noteworthy that chylous hydrothorax occurs in the absence of rib or vertebral fractures (9,10), that relatively minor blunt injuries to the back or chest or simply violent coughing spells may be associated with thoracic duct injuries (13,19,24,25), and that violent blunt force often spares other nearby structures such as the aorta, intercostal vessels, esophagus, greater splanchnic and vagus nerves. Occurrence of chylous retroperitoneum and ascites without

vertebral injury, accordingly, raises an alternative explanation whereby a compressive blunt force transmitted suddenly to thin-walled lymphatics and adjacent lymph nodes engorged with chyle (25) acutely raises intraluminal pressure with bursting of the paper-thin truncal wall or nodal capsule. Although stress-strain or shearing forces likely increase the deformation and the likelihood of lymphatic disruption, it is not necessary to implicate extreme flexion-extension of the spine to account for traumatic chylous leakage. In the case of chylous retroperitoneum-ascites after blunt trauma, the problem is likely to be self-limited although laparotomy may be undertaken in the mistaken belief that the extravasated fluid is indicative of ongoing hemorrhage. On the other hand, chylothorax associated with disruption of the thoracic duct may ultimately require proximal ligation of the thoracic duct, and, in this regard, lymphangioscintigraphy may be of distinct value as a simple, safe, and accurate method to pinpoint the exact site of ductal disruption.

REFERENCES

1. Huth, F. General pathology of the lymphovascular system. In: *Lymphangiology*. Földi, M, JR Casley-Smith (Eds.). Schattauer-Verlag, Stuttgart, 1983, p. 331.
2. Nix, JT, M Albert, JE Dugas, et al: Chylothorax and chylous ascites: A study of 302 selected cases. *Am. J. Gastro.* 28 (1957), 40-55.
3. Little, JM, C Harrison, A Blalock: Chylothorax and chyloperitoneum. *Surg.* 11 (1942), 392-401.
4. Ross, JK: A review of the surgery of the thoracic duct. *Thorax* 16 (1961), 12-21.
5. Bourdon, B, V Bismuth, JP Desprez-Curely: Chylous ascites and lympho-intestinal fistulae. In: *Progress in Lymphology*. A. Ruttiman (Ed.). Thieme-Verlag, Stuttgart, 1967, p. 36.
6. Gruwez, JA, G Cardoen, C Dive, et al: Chylothorax. In: *Progress in Lymphology*. A. Ruttiman (Ed.). Thieme-Verlag, Stuttgart, 1967, p. 30.
7. Cellan-Jones, CJ, W Murphy: Traumatic chylothorax. *Brit. Med. J.* 2 (1940), 590-591.

8. Dorsey, JE, GE Morris: Traumatic rupture of the thoracic duct with chylothorax. *JAMA* 119 (1942), 337-338.
9. Florer, R, A Ochsner: Traumatic chylothorax. *Surg.* 17 (1945), 622-629.
10. MacNab, DS, EP Scarlett: Traumatic chylothorax due to intrathoracic rupture of the thoracic duct. *Can. Med. Assoc. J.* 27 (1932), 25-36.
11. Birt, AB, NK Connolly: Traumatic chylothorax. *Brit. J. Surg.* 39 (1952), 564-568.
12. Brown, AL: Chylous ascites and chylothorax. *Arch. Surg.* 34 (1937), 120-128.
13. Vollman, RW, WJ Keenan, AJ Ereaklis: Posttraumatic chylous ascites in infancy. *New Eng. J. Med.* 275 (1966), 875-877.
14. Vasko, JS, RI Tapper: The surgical significance of chylous ascites. *Arch. Surg.* 95 (1967), 355-368.
15. Witte, MH, CL Witte, AE Dumont: Progress in liver disease: Physiological factors involved in the causation of cirrhotic ascites. *Gastro.* 61 (1971), 742-750.
16. Maloney, JV, FC Spencer: Nonoperative treatment of traumatic chylothorax. *Surg.* 40 (1956), 121-128.
17. Meade, RH, JR Head, CW Moen: The management of chylothorax. *J. Thoracic Surg.* 19 (1950), 709-723.
18. Rutherford, RB, DN Campbell: Thoracic injuries. In: *The Management of Trauma*. Zuidema, GD, RB Rutherford, WF Ballinger (Eds.). 4th Ed. WB Saunders, Phila, Lond, 1985, p. 416.
19. Lampson, RS: Traumatic chylothorax. *J. Thoracic Surg.* 17 (1948), 778-791.
20. Goorwitch, J: Traumatic chylothorax and thoracic duct ligation. *J. Thoracic Surg.* 29 (1955), 467-479.
21. Lee, FC: The establishment of collateral circulation following ligation of the thoracic duct. *Johns Hopkins Hosp. Bull.* 33 (1922), 21-31.
22. McNeill, GC, MH Witte, CL Witte, et al: Whole body lymphangioscintigraphy: Preferred method for initial assessment of the peripheral lymphatic system. *Radiology* 172 (1989), 495-502.
23. Boysen, BE: Chylous ascites. Manifestation of the battered child syndrome. *Am. J. Dis. Child.* 129 (1975), 1338-1339.
24. Martin, S: Details of a case of chylous ascites and chylous hydrothorax. *Lancet* ii (1890), 875-876.
25. Kraeft, NH: Idiopathic chylothorax. *Am. Surg.* 25 (1959), 401-404.
26. Shackelford, RT, AM Fisher: Traumatic chylothorax. *South. Med. J.* 31 (1938), 766-775.

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