Chylothorax:

Indications for Surgery

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THE MANAGEMENT OF chylothorax can be extremely difficult because of the tremendous diversity seen in its magnitude and etiology. Moreover personal experience is usually limited by its infrequent occurrence, so that unrecognized deterioration can occur rapidly due to the devastating metabolic effects of excessive chyle loss.

For years this entity was associated with a mortality rate of almost 50 per cent. Only in the past quarter-century have survival statistics improved. This is directly attributable to the introduction of successful transthoracic ligation of the thoracic duct by Lampson[2] in 1946. This has proven to be a sound surgical approach to the management of chylothorax. By no means, however, should this imply that all patients should undergo ductal ligation. It is often unnecessary and at times even contraindicated. Herein lies the crux to the treatment of this entity. A familiarity with the indications for operation in chylothorax is essential for most effective management.

Recent experience with two cases of widely differing magnitude has prompted a review of the instances of chylothorax treated at the University of Cincinnati Medical Center during the past 29 years. It is intended in the context of this review to illustrate the dangers of prolonged nonoperative therapy, and to better define the clinical setting in which surgical intervention is indicated.

Anatomy

A surgical approach to the thoracic duct requires a clear understanding of its anatomy. A bilateral structure embryologically, it has the potential of having many varied anatomical patterns. The "standard" pattern is only present about half of the time. Many minor variations occur in lymphatic and lymphaticovenous anastomoses. A rich collateral network exists that permits ligation of the duct at any point throughout its course. Most commonly, the duct originates from the cisterna chyle in the midline at the level of the second lumbar vertebra. It enters the thorax through the aortic hiatus to the right of midline, and is covered by the aorta. In the inferior thorax it lies beneath the mediastinal pleura between the aorta and azygous vein and is covered by the esophagus. It crosses to the left at about the level of the fourth or fifth thoracic vertebra. Here it lies behind the aortic arch and, more superiorly, the left subclavian artery. Having entered the neck it curves ventrally to cross the scalenus anticus muscle and phrenic nerve, and empties into the junction of the left internal jugular and subclavian veins.

A significant point in surgical anatomy is that the duct is essentially always a single structure on the right between the eighth and twelfth thoracic vertebrae. Accordingly a right thoracotomy can be utilized for ductal ligation with confidence in those cases where there are no other factors indicating the side of entry. The appropriate side of approach is obvious in cases of unilateral effusion and in those resulting from initial thoracic surgery.

Clinical Material

Fifteen patients were treated for chylothorax at the University of Cincinnati Medical Center from July 1942 through July 1971. Eight were children under five years

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of age and seven were adults over 21 years of age. Ten were female and five male. Seven cases occurred on the right, five on the left, and three were bilateral. All 15 had at least one thoracentesis revealing typical chylous fluid.

Seven patients had major complications during the period of nonoperative therapy (Table 1), and five patients died.

The number of thoracenteses in each case ranged from one to 34 (Table 2). The highest average volume was seen in the adult trauma group (27,900 cc.) and the lowest in the neonatal idiopathic group (220 cc.).

Seven instances of nontraumatic etiology were encountered (Table 3). Three resulted from compression of the thoracic duct by mediastinal involvement of an underlying disease. One patient had mediastinal tubercular lymphadenopathy, another metastatic thyroid carcinoma, and the third malignant lymphoma. Each patient was treated nonoperatively and eventually died from the primary disease. Three other instances presented idiopathically in the neonatal period and were also treated nonoperatively. Their average total chyle flow was only 220 cc. and all three patients recovered completely. The final nontraumatic instance occurred in a woman with congenital angiomatous transformation of the lymphatic system who declined slowly over a 2-month period with only a minimal but continuous chyle leak. Operation to relieve severe pulmonary-constricting chylofibrosis was unsuccessful and she died intraoperatively.

Eight occurrences resulted from trauma (Table 4). Four occurred in children following cardiovascular surgery. Two of these required reoperation for thoracic duct ligation and all four were cured. One man acquired chylothorax following a left parotidectomy and radical neck dissection for carcinoma of the parotid gland. His chylothorax was voluminous and transthoracic ligation of the thoracic duct was necessary. Another patient developed chylothorax following resection of a thoracic aortic aneurysm, was not reoperated upon, and represents the only death in the traumatic group. Two nonsurgical traumatic cases occurred. The first resulted from a gun shot wound in which the bullet grazed the hepatic dome and crossed the diaphragm to finally lodge in the body of the eleventh thoracic vertebra. After having drained 56,000 cc. of chyle over a 6-week period, the leak stopped spontaneously. This case occurred in 1942, prior to Lampson's introduction of thoracic duct ligation. The final traumatic case is presented in detail to illustrate some of the therapeutic difficulties which can be encountered in the management of chylothorax.

TABLE 2. *Magnitude of Chyle Loss*

Patient Groups		Total Vol. (ml.)	No. Taps
Nontraumatic			
Children			
Idiopathic	3	52–300	1–3
Malignancy	1	3300	11
Adults	3	1100–12,500	2–10
Traumatic			
Children	4	110–1800	1–6
Adults	4	12,000–56,400	4–34

Case Report

Case 14. G.H., a 22-year-old policeman was accidentally thrown from his motorcycle on April 13, 1971 resulting in a spinal dislocation between the twelfth thoracic and first lumbar vertebrae. The only abnormalities noted on admission were decreased sensation in the distribution of T-12 and L-1 bilaterally and dysesthesias over both lower extremities. Chest x-ray was normal. On the fourth hospital day severe dyspnea was noted. Examination and roentgenography of the chest revealed a large right pleural effusion (Fig. 1). Two chest tubes, 12 mm. in diameter, were inserted to release 4000 cc. of serosanguineous fluid which assumed a chylous nature by the following day. Sudan stain was positive for fat.

The patient was given a low fat, high calorie, high protein diet and daily albumin infusions. Chyle flow was averaging 2000 cc. per day with a consequent fall in serum albumin from 3.8 to 1.1 Gm./100 ml. and a loss of 30 pounds in body weight. Due to the chyle's gelatinous nature, chest tube obstruction frequently occurred in spite of streptokinase instillation, and tube replacement was often necessary. On April 26 the patient sustained a pulmonary embolus which necessitated postponing intended thoracic duct ligation.

On April 30 the patient underwent inferior vena cava clipping and thoracic duct ligation. Numerous fresh pleural adhesions and

TABLE 1. *Complications of Nonoperative Therapy (7 Patients)*

Inherent to chylothorax	
Pleural adhesions and fibrosis	3
Malnutrition	3
Tension pneumothorax	2
General	
Pulmonary embolism	2
Thrombophlebitis	2
Stress ulcers	1
Cardiac arrhythmia	1
Total	14

TABLE 3. *Nontraumatic Chylothorax*

Case	Age Sex	Etiology	Duct Ligation	Result
1	55 F	Tuberculous adenopathy	No	Dead in 4m
2	68 F	Thyroid carcinoma	No	Dead in 3y
3	4 M	Malignant lymphoma	No	Dead in 3m
4	12d F	Idiopathic	No	Cured
5	3m M	Idiopathic	No	Cured
6	1d F	Idiopathic	No	Cured
7	55 F	Thoracic duct anomaly	Yes	Died at Surgery

TABLE 4. *Traumatic Chylothorax*

Case	Age Sex	Etiology	Duct Ligation	Result
8	23 M	Gunshot wound—body T-11	No	Cured
9	54 F	Resection of thoracic aortic aneurysm	No	Died
10	3 F	Blalock procedure	Yes	Cured
11	4 F	Blalock procedure	No	Cured
12	2 F	Division of patent ductus	Yes	Cured
13	41 M	Left radical neck dissection	Yes	Cured
14	22 M	Spinal dislocation—T12-L1	Yes	Cured
15	4m F	Correction of vascular ring	No	Cured

a fibrinous pleural peel were encountered in the right thoracic cavity. The thoracic duct was identified just above the diaphragm deep in the costovertebral angle. A laceration in the center of its exposed portion was emitting a pulsatile flow of chyle. Proximal and distal ligation of the duct was performed and the leak stopped. Follow-up chest x-rays showed no recurrence of the chylothorax (Fig. 2). The postoperative course was uneventful. The patient was discharged from the hospital on June 2, 1971 in a body spica cast for support of his spinal dislocation. He had lost 27,000 cc. of chyle over a 13-day period before surgical correction was performed.

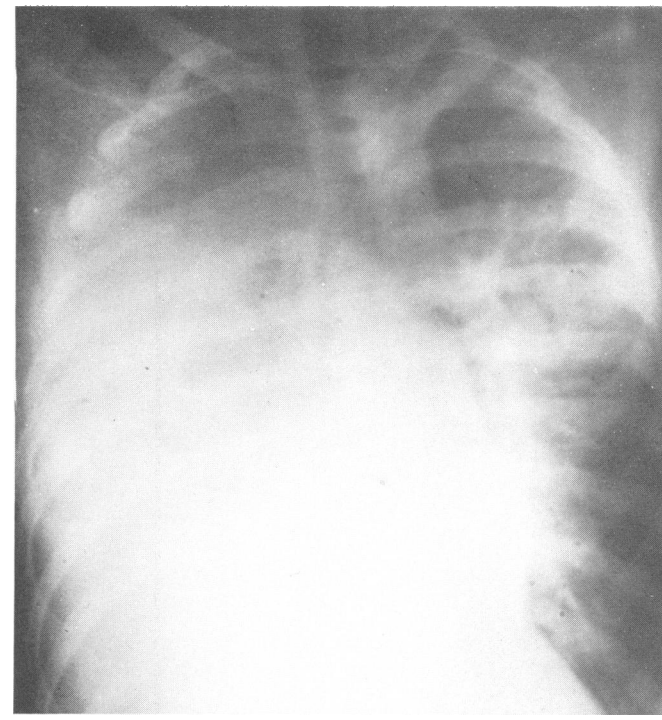

FIG. 1. Supine chest x-ray showing 4000 ml. of right pleural fluid. Note the obliteration of the right hemidiaphragm and the right hilar lucent area representing the almost completely collapsed right lung.

Discussion

Early reviews of chylothorax have adequately documented the results of nonoperative management. Shackelford[5] summarized 41 cases of traumatic chylothorax that had appeared in the literature prior to 1938. Therapy consisted of drainage and dietary adjustments to decrease the flow of chyle. The mortality rate was 48 per cent. The first successful transthoracic ligation of the thoracic duct was performed by Lampson[2] in 1946. The beneficial effect of a direct approach to this problem is well demonstrated by Goorwitch's[1] collection of 31 traumatic cases in 1955. The overall mortality rate was 10 per cent and there were no deaths among the 15 patients who were treated surgically.

Subsequently a number of authors have reemphasized the validity of an initial trial of nonoperative therapy, and have expressed concern that this method was becoming too quickly and unnecessarily replaced by thoracic duct ligation. Maloney and Spencer[3] presented 13 young patients with chylothorax resulting from cardiovascular surgery. Eleven were treated successfully with multiple thoracenteses. Williams and Burford[6] have concluded that surgical intervention is rarely indicated in traumatic cases and often ineffective in nontraumatic cases. This therapeutic controversy in chylothorax seems to stem from an uncertainty as to the exact clinical factors which indicate surgical intervention.

TABLE 5. *Magnitude of Chyle Loss in Traumatic Cases*

Case	Age	Total Volume (ml.)	Nonoperative Period (days)	Aver. Loss (ml./d)	No. of Taps	Duct Ligation
8	23	56,400	49	1100	34	No
9	54	12,000	43	280	24	No
10	3	1,800	7	350	6	Yes
11	4	900	7	130	2	No
12	2	1,500	12	125	3	Yes
13	41	16,100	9	1800	4	Yes
14	22	27,000	13	2000	—*	Yes
15	4 m	110	1	110	1	No

* Continuous tube drainage almost exclusively

The dangers involved with prolonged nonoperative management relate primarily to the tremendous metabolic deterioration that may occur. The daily volume of thoracic duct flow can approach 2500 cc. with electrolyte and protein concentrations approximating plasma values. Sixty or 70 per cent of ingested fat is conveyed to the blood stream by this route. Therefore the magnitude of fluid, electrolyte and nutrient losses can be great. Replacement of these is compounded by inaccuracy in their measurement. Chest tubes often become obstructed due to the gelatinous disposition of chyle. Frequent thoracentesis can also result in incomplete drainage and may be complicated by the production of hemothorax and/or tension pneumothorax. Additional local intrathoracic problems may result from chyle loculations and fibrosis. Of six patients in the present series in whom examination of the pleural cavity was possible, three demonstrated intrapleural chylous adhesions. One

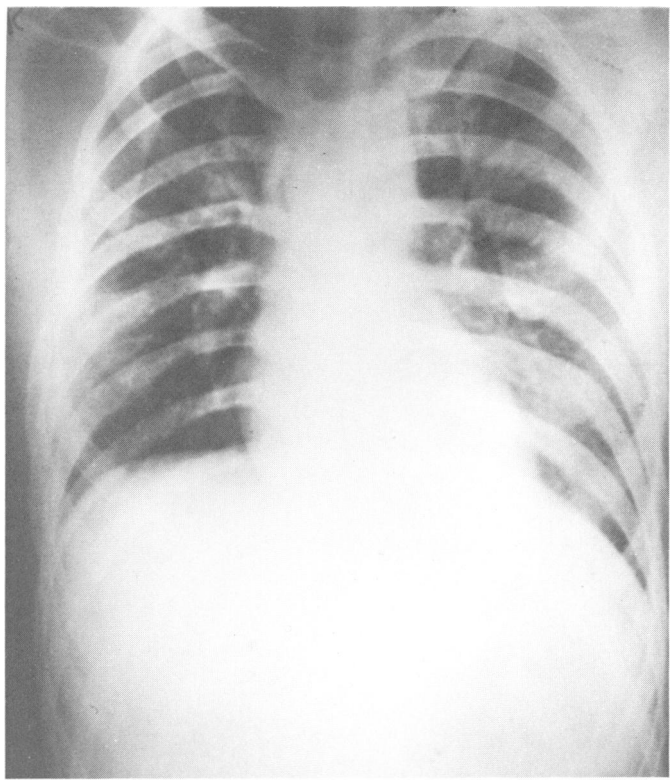

FIG. 2. Postoperative chest x-ray showing complete resolution of the right chylous effusion.

patient (Case 7) eventually died as the result of severe pulmonary constriction due to chylofibrosis. Fortunately intrapleural infection is uncommon due to the bacteriostatic properties of chyle. Negative cultures in all 15 of the cases reported here confirm this feature which is well documented in previous reports.

Some patients, however, demonstrate spontaneous resolution of the chylous effusion without operative intervention and without morbidity. The problem is that of defining those who will require operative intervention, early in their course, before complications occur.

The cases of nontraumatic etiology can usually be managed nonoperatively. Those patients in whom the chylous effusion was due to extrinsic compression of the duct by another disease process all died of that primary disease. Chylothorax was never a major determinant in the medical outcome. In the absence of trauma and exclusive of the neonatal group, chylothorax is an ominous sign, generally signifying widespread mediastinal involvement of a rapidly fatal illness. Operative intervention is usually ineffective and should therefore be avoided. The neonates with idiopathic chylothorax conversely, all responded well to thoracentesis. Randolph and Gross [4] have reported a similar experience with neonatal chylothorax, finding it necessary to operate on only two in a series of 15.

The approach to traumatic chylothorax presents a more difficult therapeutic problem. There is general agreement that an initial trial of nonoperative therapy is indicated. The problem occurs in defining the appropriate situation and time for performing ductal ligation. Two patients in the present series were subjected to excessively prolonged nonoperative management (Table 5). One (Case 8) occurred in 1942 before ligation of the thoracic duct had been successfully performed. The other (Case 9) gradually declined to death, emphasizing that even with slow leaks (280 cc. per day) a prolonged nonoperative approach may be hazardous. A pulmonary embolus delayed operation in another patient (Case 14). With these exceptions a fairly good correlation can be found between patient age, rate of chyle flow, operative intervention, and survival (Table 5). Review of these cases has provided a rough guide for determining when ductal ligation should be considered. A daily chyle flow not exceeding 1500 cc. in adults or 100 cc. per year of age in children is reasonably well tolerated for as long as 5 days. If this rate of flow for this period of time is exceeded, intervention should be strongly considered. Careful observation and frequent chest x-rays are necessary to be certain that the full rate of loss is appreciated. Daily losses should be faithfully replaced intravenously with solutions containing appropriate concentrations of electrolytes and protein.

Summary and Conclusions

The cases of 15 patients with chylothorax treated at the University of Cincinnati Medical Center during the past 29 years are reviewed. A wide variety of causes and a wide range of magnitude of chyle drainage is displayed. Eight cases resulted from trauma. The review was conducted in an attempt to more accurately define the indications for operative intervention. The following has been concluded:

1. Idiopathic cases in the neonate usually respond well to thoracentesis.
2. Nontraumatic chylothorax, exclusive of the neonatal group, usually suggests a widespread fatal illness. Operative intervention is usually ineffective and should therefore be avoided.
3. In cases resulting from trauma an initial trial of nonoperative management is indicated. Transthoracic ligation of the thoracic duct is indicated when:
   a) the average daily chyle loss has exceeded 1500 cc. in adults or 100 cc. per year of age in children for a 5-day period.
   b) the chyle flow has not diminished while approaching 14 days in duration.
   c) nutritional complications appear imminent.

4. Early surgical intervention should especially be considered in traumatic chylothorax in the pediatric age group.
5. Prolonged nonoperative management is endangered by complications specific to chylothorax, as well as those of a general nature.

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Book Reviews

Hemobilia (Biliary Tract Hemorrhage) History, Pathology, Diagnosis, Treatment, By PHILIP SANDBLOM, M.D., Ph.D., Professor Emeritus and Past President, University of Lund, Sweden. With a Foreword by Warren H. Cole, M.D., Professor Emeritus of Surgery, University of Illinois. Charles C Thomas, Publisher, 146 pages, 38 illustrations, $19.75.

IT IS UNUSUAL when a mature monograph is written by the man who introduced the term which embodies the subject. While Professor Sandblom traces the history of hemobilia back to Glisson's paper in 1654, it was Sandblom himself who brought the subject to the attention of surgeons and physicians of this century and who introduced the descriptive term "hemobilia" for a variety of conditions in which blood leaves the circulation and traverses the bile passages.

The book is divided into two parts: Part I gives a definition, including the history, pathology, symptoms, diagnosis and treatment. Part II approaches the subject from the standpoint of etiology and describes the role of trauma, both accidental and iatrogenic, inflammation, gallstones, tumor, and vascular disorders. This is followed by an Appendix, listing a number of unpublished cases of hemobilia, and a thorough Bibliography with both an author index and a subject index for easy reference.

Professor Sandblom has long been one of the best known and most highly regarded of European surgeons in this country, and his scholarly discussions and presentations at the meetings of the American Surgical Association and the Southern Surgical Association are well known to many readers of the *Annals of Surgery.*

The monograph is characteristically thorough and yet clear and succinct. The illustrations are well selected and meaningful. The purpose of the book is beautifully stated in the Epilogue. A portion of which reads as follows:

> Three hundred years have now passed since Francis Glisson showed that bleeding from the digestive tract may originate in the liver or biliary tract. Yet not until our day has this become general knowledge and the syndrome found its way into the textbooks. Hemobilia has now become the currently used term for the condition. As is evident from the more than five hundred cases reviewed in this monograph, the incidence of this syndrome is not rare. Judging from the figures from different periods of time it is also increasing in frequency. . . . This may be due to the fact that more widely disseminated knowledge of the syndrome and improvement in method have meant that fewer cases escape diagnosis today. On the other hand, there may be a genuine increase because of the rising number of traffic accidents which often result in liver injury.
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> It is depressing to think about all of the patients in the past who were mismanaged or who died because the diagnosis was made too late or missed altogether. Nearly every case chosen to illustrate various points in this book was subjected to one or more inappropriate operations before the true situation was realized. As mentioned, the reason for this is that hemobilia is apparently so uncommon that hardly any clinicians encountering it recognize it from their own experience, and only a few have previous knowledge of it. One is reminded of Coleridge's words: "The light which experience gives us is a lantern on the stern which shines only on the waves behind us."
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> My aim in writing this book has been to hang a lantern on the bow as well so that by the light of knowledge the clinician may discern the snags and hazards ahead and steer a safe course between them.

Hemobilia is an important reference but unlike so many important references, it is a pleasure to read. Written as it is by the man with whom the term "hemobilia" is so clearly identified, it will be sought by many collectors of landmarks in medicine.

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