

EDITORIAL

THORACIC DUCT DECOMPRESSION: AN IDEA WHOSE TIME HAS COME – AGAIN

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ABSTRACT

Thoracic duct decompression (TDD) is an idea first proposed and applied as a novel therapeutic strategy by lymphologists in the 1960's. TDD is recently being reexamined and, in selected patients with portal hypertension from hepatic cirrhosis or with central venous hypertension from isolated right-sided heart failure, undertaken using advanced surgical and image-guided interventional radiologic approaches.

Keywords: thoracic duct, overload, decompression, thoracic duct-venous junction, stent-graft, shunts, hepatic cirrhosis, right heart failure

The article by McGregor et al (1) in this issue of *Lymphology* and their report earlier this year (2) rekindle an original idea first proposed in the 1960's that resistance to elevated lymph flow at the thoracic duct – venous junction constitutes a crucial obstacle to central lymph return, and further, that bypassing this site of resistance might be of potential benefit in certain clinical situations. The authors undertook thoracic duct decompression (TDD) through an image-guided thoracic duct-central venous stent-graft in their patient with recurrent massive esophageal varix hemorrhage secondary to portal hypertension from hepatic cirrhosis

complicated by portomesenteric venous obstruction. This disorder is uniformly characterized by greatly increased hepatosplanchnic and thoracic duct lymph formation. Serial images during and following the procedure visualized the "pinchcock" thoracic duct-venous connection pre-stenting, unimpeded flow afterward, and patency at three months. Esophageal varix hemorrhage has since not recurred.

Other recent studies (3-5) have advocated TDD in pure right-sided heart failure associated with chylous reflux complications including protein/lymph-losing enteropathy, such as occur after Fontan procedures to correct single ventricle complex congenital heart disease. In this situation, shunting thoracic duct lymph to the "normally" functioning left heart, i.e., via a direct thoracic duct to pulmonary vein shunt, indirectly using an interposition venous graft, or direct left atrial shunt (surgical or interventional) is designed to bypass the obstacle posed by central venous hypertension thereby facilitating central lymph return.

The concept of TDD has been nascent since the 1960's and the birth of lymphology as a formal discipline. At the time, the thoracic duct and central lymphatic system – visualized and cannulated for the first time in living humans – was an area of great interest to the surgeons and radiologists who founded and led the International Society of

Lymphology. Among the papers and talks presented at the first International Congress of Lymphology in Zurich in 1966 and Miami in 1968 and subsequently published were several, including our own collaborating with Washington University School of Medicine cardiothoracic surgeon William Cole (6-9), describing thoracic duct lymph overload, impediments to lymph flow, and therapeutic effects of external drainage and internal thoracic duct-venous shunting in patients and experimental models of hepatic cirrhosis and right heart failure.

Several years earlier, in 1960, when Dr. Charles Witte (late Chief Editor of *Lymphology*) and I were senior medical students at New York University School of Medicine, we came under the influence of Professor and Head of Surgery John Mulholland as we chose a senior research project. Dr. Mulholland encouraged us to explore an entirely new area into which few surgeons had ventured – the lymphatic vasculature and lymph circulation – a subject extensively covered in a textbook (10) he had just received to review. He suggested that we work with a young academic surgeon in the Department – Allan E. Dumont (subsequently twice ISL President 1979-81, 81-83) – who had just reported on thoracic duct lymph drainage in patients with acute pancreatitis, where clinical improvement was noted as the "inflammatory" thoracic duct lymph was diverted to the outside (11). Dumont had also observed that ascites was relieved in one of these patients who happened to suffer from hepatic cirrhosis. Other preliminary observations suggested that esophageal varix hemorrhage from portal hypertension abruptly stopped when the thoracic duct was vented to the outside and produced with a drop in portal pressure (12). And several patients with end-stage right heart failure were rapidly "decongested" after extensive thoracic duct lymph drainage. Experimental work was ongoing in his laboratory to confirm and delve more deeply into the basis for these observations. Thus began our life-long

adventure in lymphology resulting in hundreds of publications to pinpoint the hemodynamic and lymphodynamic forces and factors involved in excessive thoracic duct lymph formation in hepatic cirrhosis (8) and in right heart failure (9), the source of the excess lymph, and potentially reversible obstacles to central lymph return to the venous system as fast as it is formed in those patients whose thoracic duct lymph circulation "failed."

Early on, a flurry of reports supported the notion that even without draining thoracic duct lymph externally, an internal thoracic duct-venous anastomosis bypassing the cervical junction or connecting the thoracic duct to the lower pressure azygous vein in the chest, also alleviated ascites both clinically in hepatic cirrhosis and in experimental models simulating this condition, as cited by McGregor et al (1,2). But the advent of liver transplantation eclipsed this very different approach aimed at correcting the lymph imbalance responsible for the complications stemming from portal hypertension (i.e., by increasing central lymph return to match the elevated lymph formation) without replacing the diseased liver. This fundamental principle was further supported by remission of ascites, hepatorenal syndrome, and associated salt and water retention from secondary hyperaldosteronism after peritoneo-venous shunting in a patient with advanced hepatic cirrhosis (13), who was still alive more than 30 years later!

Fast forward to early years of 2000, when infants and small children with life-threatening intractable chylous reflux into the chest, lungs, intestine, and abdomen began presenting in increasing numbers after successful management with a Fontan procedure to reconstruct single ventricle complex congenital heart disease. It became clear that central venous hypertension needed to maintain pulmonary blood flow was precipitating these chylous complications. Once again, clinical and experimental observations by lymphologists from the 1960's about the key role played by central venous hypertension in right heart failure promoting

excess thoracic duct lymph formation and also restricting its return to the central venous system in right heart failure were brought to the fore. Thoracic duct to pulmonary vein shunt in an experimental model of isolated right heart failure (6) had reduced central venous hypertension and reversed the major extracardiac manifestations of congestive heart failure (ascites and associated salt and water retention) despite persistence of the surgically-induced tricuspid insufficiency and pulmonic valvular stenosis. This experimental study was reexamined nearly 50 years later, the rationale presented in an article in *Lymphology* (3) and a variation of TDD undertaken in select patients at the Medical College of Wisconsin (4) and in Buenos Aires (5). After surgical TDD, the signs and symptoms of "congestion" were relieved.

The next breakthrough was occurring at the University of Pennsylvania where interventional radiologists Constantin Cope in the mid-1990's, later joined by Max Itkin, were non-invasively accessing the thoracic duct, cisterna chyli, and its tributaries and gluing refluxing and leaking chylous lymphatics with fluorooscopic guidance after inguinal node MR-lymphography, direct transcutaneous puncture, and transvenous retrograde catheterization (14). (Historically, in a prescient *Lymphology* article in 1974, Seeliger et al (15) had accomplished thoracic duct endoscopy and retrograde cannulation ("lymphoscopy") via an external jugular vein after inguinal node injection of lipiodol in dogs). The new image-guided procedure was primarily being used to treat chylous reflux leakage syndromes associated with congenital central lymphatic maldevelopment or after trauma. Central lymphatic-venous shunts had been sporadically performed surgically over many prior years in select patients diverting the backlog of backed up and leaking chylous lymph into the systemic or mesenteric venous system (16).

Today, advances in microsurgical and interventional radiologic techniques are being brought together to devise, select, and evaluate

in a more controlled fashion procedures to decompress the overloaded or obstructed thoracic duct lymph system via a limited surgical procedure or non-invasively with image-guided thoracic duct-central venous stent-grafting now shown capable of remaining patent by McGregor et al. It is ironic and sobering that the thoracic duct lymph system, once inaccessible, invisible, and thought to be inconsequential and irrelevant except when damaged during surgery or trauma, is providing new understanding and a novel approach – TDD – to such common diseases as liver cirrhosis and congestive heart failure and other rarer ones. Further, it now appears that events at the thoracic duct-venous junction in the neck might be a crucial determinant of life and death in patients suffering from these disorders.

CONFLICT OF INTEREST AND DISCLOSURE

The author declares no competing financial interests exist.

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