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Maintenance of Long-term Thoracic Duct Fistulas for the Achievement of Immunosuppression in Man

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Summary

The achievement of immunosuppression by thoracic duct lymph fistulas requires long-term drainage from one to three months. Manipulation of the immune system during profound lymphocyte depletion, unadulterated by the protean effects of pharmacologic agents, offers a unique opportunity to study and treat auto-immune disease and organ rejection phenomena. The protocol for thoracic duct cannulation and maintenance of long-term fistulas must be rigidly observed for successful thoracic duct drainage. Surgical technique and important caveats are reviewed

The effectiveness of prolonged thoracic duct drainage as an immunosuppressive modality in man has been well substantiated by a number of investigators (1, 2, 3). Likewise, the difference between transient effects of short term lymph diversion and the profound immunosuppression associated with longer term depletion has been well documented (4). Although methods for thoracic duct drainage have appeared from time to time in the surgical literature there is evidence that technical inadequacies have been the limiting factor in observing the effects of lymphocyte depletion in a number of otherwise well designed clinical protocols.

The experience with 20 long-term thoracic duct fistulas has served to illustrate, for us, the important technical considerations of thoracic duct cannulation, and the principal impediments to long-term patency, which must be anticipated, recognized, and corrected during the course of drainage. The important chronology of clinical and immunologic changes which are critical to monitoring the course of thoracic duct drainage have been previously reported (4). The mean drainage time in this group of patients was 70 days, with a mean lymphocyte output of 44.4 x 10^{10} cells. The daily lymph output ranged between 500 and 1600 ml/day.

Surgical technique

The thoracic duct arises at the cisterna chyli, the confluence of the infradiaphragmatic lymphatics. Ascending the posterior mediastinum it enters the cervical region in the retroesophageal position. In approximately 90% of individuals, the main thoracic duct trunk ascends the left side of the posterior mediastinum passing behind the left internal jugular vein and terminating by emptying into the central venous system at the angle of the jugular vein-subclavian vein junction. This section is characterized by a dilated ampulla which also serves as a terminus for the brachiocephalic lymphatics which join the main thoracic duct in a variety of anatomic patterns. The main thoracic duct trunk is most accessible for cannulation at this point, though the surgeon must be certain that the main thoracic duct trunk is distinguished from the other small trunks joining the ampulla at the same anatomic site (Fig. 1). Although we have not utilized dye injections or lymph-angiography to assist in this identification, we have found that 30 ml of heavy cream or olive oil given orally 6 to 8 hours pre-operatively will sufficiently opacify the thoracic duct lymph to facilitate differentiation from the brachiocephalic trunks.

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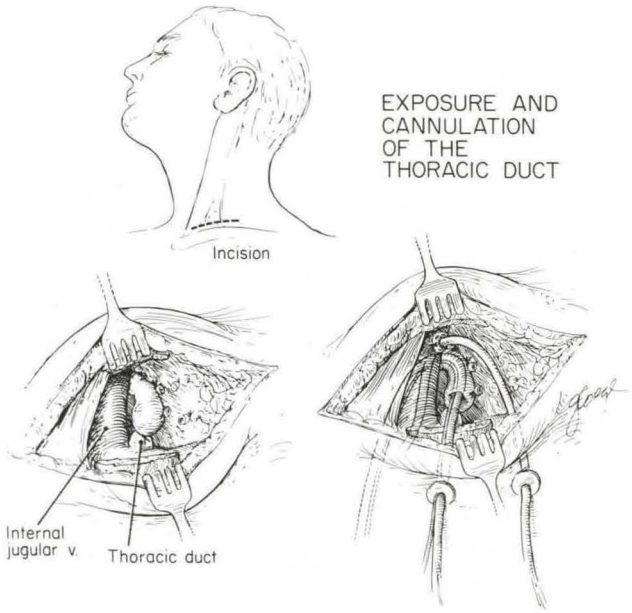

Fig. 1 Anatomic Relationships in cannulation of the thoracic duct. The ampulla of the thoracic duct is seen at the jugular-subclavian vein junction with major brachiocephalic trunks ligated

Although we have performed the operative procedure under local infiltration anesthesia, general endotracheal inhalation anesthesia is preferable. The incision is made parallel to, and 2 to 4 cm superior to the left clavicle, over the clavicular head of the sternocleidomastoid muscle. The patient is positioned with the head slightly hyperextended and turned to the right side. The clavicular head of the sternocleidomastoid muscle is divided and the jugular vein identified. The jugular vein is mobilized from the Scalene fat pad, and the jugular-subclavian vein junction is located. By retracting the jugular vein medially the ampulla is generally quite evident. The ampulla is ligated at the jugular subclavian junction, after which the thoracic duct and brachiocephalic trunks become quite distended and easily visible in the pre-scalene area. The brachiocephalic trunks are isolated and ligated. An incision is made on the anterolateral aspect of the thoracic duct wall and small lacrimal duct probes are gently passed in a retrograde fashion towards the posterior mediastinum. Several sets of semilunar valves are usually encountered. Disruption of these valves facilitate the passage of the thoracic duct cannula deep enough into the duct to establish a secure fistula.

It is useful to have several different types of cannulae available although we have found that the most effective is a double lumen catheter made of soft medical-grade silastic. One lumen, which is the smaller of the two, permits a continuous heparin infusion into the thoracic duct at the catheter tip. The second lumen permits exit of, and collection of the heparinized lymph. A wire coil embedded in the wall of the cannula extends from the tip of the tube including the entire portion that will remain in the subcutaneous tissue. The coil prevents kinks of the tube and consequent obstruction to lymph flow by flexion, extension, or head movements. At the time of thoracic duct cannulation we place a second silastic tube into the internal jugular vein so that cell free lymph reinfusion can be accomplished.

Important considerations during the course of drainage

1. Sepsis

To avoid problems of sepsis, lymph must be handled in a meticulously aseptic fashion consistent with the design of the protocol. Our general procedure has been to reinfuse, centrifuged cell free lymph. We have also reinfused lymph after lymphocyte destruction by refrigeration.

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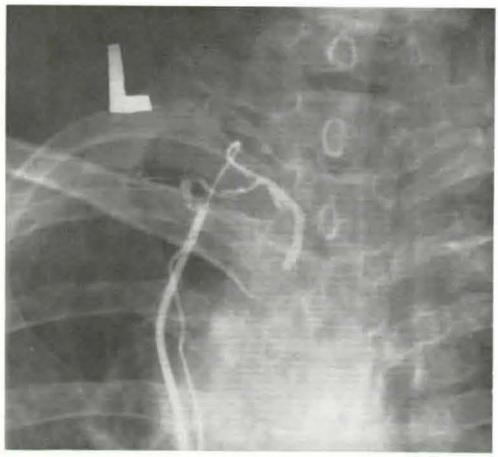

Fig. 2 Collateral lymphovenous communication developing during the course of thoracic duct drainage, demonstrated by retrograde lymphaniography through the thoracic duct cannula

Local wound sepsis is suprisingly infrequent, even in the face of profound immunosuppression. Skin exit sites of the cannulae are carefully dressed after daily application of antimicrobial ointment. Prophylactic systemic antibiotics are not used.

2. Coagulation

Occasionally during the course of other surgical manipulations in the course of thoracic duct drainage; e.g. biopsies, or renal transplantation, the lymph may become sanguinous in character and an increased tendency for clot formation is noted. When these episodes are recognized heparin infusion should be increased. Other factors may accelerate lymph clotting and strands of fibrin may be identified in the lymph outflow track. When this problem is noted, and lymph output ceases rather abruptly, retrograde instillation of Fibrinolysin via the heparin line, with concomitant clamping of the lymph outflow line for approximately 20 to 30 minutes, will generally restore lymph outflow.

3. Collateral Development

The slow but progressive decline of lymph output generally noted at the third to fifth week of drainage is most commonly due to development of new collateral lymphovenous communications. This is prevented by maintaining the outflow cannula free of unnecessary resistance. Intermittent kinking of the outflow line, or narrow gauge collection tubing, causes an increase in resistance which will hasten the development of these lymphovenous collateral channels. If angiographic contrast dye is infused via the heparin line, while temporarily obstructing lymph outflow, retrograde lymphangiography can be accomplished and the lymphovenous collateral channels identified. These collateral channels are best controlled by re-operation and ligation. The volume of lymph immediately increases and is usually sustained (Fig. 2).

Occasionally fibrin deposition or intimal proliferation at the tip of the indwelling thoracic duct cannula will lead to progressive reduction of lymph outflow. This can be corrected by reinsertion of the cannula to a deeper position. When this problem occurs the fistula is generally well established and the tract well formed. Often the soft silastic cannula can be removed under local anesthesia and a firmer teflon catheter can be inserted through the same tract but to a deeper position in the upper thoracic mediastinum.

Conclusion

The development of immunosuppression with thoracic duct lymph fistulas requires long-term drainage from one to three months. Manipulation of the immune system during profound lymphocyte depletion, unadulterated by the protean effects of pharmacologic agents offers a unique opportunity to study and treat autoimmune disease, as well as organ rejection phenomenon. Attention to a few pertinent details of cannulation, and recognition of several common pitfalls, should facilitate maintenance of long-term thoracic duct fistulas in man.

References

1 *Fish, J.C., H.E. Sarles, A.R. Remmers et al.:* Circulating Lymphocyte Depletion in Preparation for Renal Allotransplantation. Surg. Gynecol. Obstet. 128 (1969) 777–787

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2 *Tilney, N.L., J.C Atkinson, J.E. Murray:* The Immunosuppressive Effect of Thoracic Duct Drainage in Human Kidney Transplantation. Ann. Intern. Med. 72 (1970) 59–64
3 *Paulus, H.E., H.I. Machleder, P.J. Clements et al.:* Prolonged Thoracic Duct Drainage in Rheumatoid Arthritis and Systemic Lupus Erythematosis. West. J. Med. 130 (1979) 309–324
4 *Machleder, H.I., H. Paulus:* Clinical and Immunological Alterations Observed in Patients. Undergoing Long-term Thoracic Duct Drainage. Surgery 84 (1978) 157–165

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