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Research Article

Management of Intra-operative Chyle Leak during Neck Dissection: Recognition and Control

Abstract

Chyle fistula (CF) is a rare complication of neck dissection. The extravasation of chyle can result in potentially devastating metabolic, nutritional and immunologic sequelae.

We report the efficacy a protocol for treatment of intraoperative (CF).

Hospital length of stay, time to oral alimentation, and type of diet were analyzed.

There were 19 patients with thoracic duct injury development following neck dissection (0.08%) The mean age was 62 years and the majority were male with squamous cell carcinoma of the oral cavity. The TDI's were identified on the left side in 16 patients and on the right side in 3 patients. In all cases TDI were identified intraoperatively, packed with micro-fibrillar collagen and oversewn with monofilament nylon. In one patient required re-exploration and placement of a muscle flap. The mean number of days NPO was 2.5 (range 1 to 13 days, SD \pm 2.8). The mean LOS was 4 days (range 2 to 14 days, SD \pm 2.7). Only patient number 5 and 12 required MCT administration for 14 and 12 days and no patients required parenteral nutrition.

Prompt recognition and definitive intraoperative management of TDI can result in reduced post-operative complications and early return to acceptable oral alimentation.

Introduction

Chyle fistula is a rare but serious complication following neck dissection with an incidence ranging from 1% to 2.5% [1]. This uncontrolled extravasation of chyle arise from damage to the thoracic duct, which transports triglycerides and cholesterol from intestinal lymphatics into the venous system [2]. Beginning at the cisterna chyli, the thoracic duct ascends through the aortic hiatus of the diaphragm. It enters the neck to form a loop that courses between the internal jugular vein and anterior scalene muscle [3], where it terminates into the venous system. Due to the integral role of this lymphatic structure in fluid balance, metabolism, and immunity, unresolved chyle leaks can cause extreme morbidity secondary to the loss of fluids, electrolytes, and other proteinaceous nutrients. These losses can lead to severe dehydration, electrolyte disturbances, and lymphopenia ultimately delaying wound healing, causing skin-flap necrosis and infection, and substantially prolonging the duration of hospitalization [3].

The management of chyle fistula is multi-faceted and contingent upon timing of the recognition of thoracic duct injury (TDI). If identified during surgery, operative

management by over-sewing and ligating the TDI is indicated. However, if unrecognized during the index operation, a chyle leak will usually manifest after resuming enteral feeding through the appearance of milky fluid from neck drainage contents. Findings on physical examination include a ballotable subcutaneous mass the medial neck or supraclavicular fossa, and associated induration, edema, and erythema of the overlying skin [4,5]. Management of a chyle leak includes dietary modification consisting of total parenteral nutrition (TPN) or the implementation of a medium-chain triglyceride (MTC) diet as to bypass the remnant thoracic duct and prevent intestinal peristalsis and lymph flow. Adjunctive treatments include the administration of octreotide to decrease triglyceride absorption and inhibit splanchnic circulation [6], elevation of the head of the bed, and application of compressive dressings [7-10]. Delayed surgical management is indicated for cases in which medical treatment has failed to decrease the amount of chyle drainage by half, or for high-output fistulas (>1000 ml/day for 5-7 days), or when there are serious complications such as chylothorax with respiratory insufficiency and severe malnutrition/electrolyte disturbances [11]. In these instances, the neck is re-explored and thoracic duct is ligated.

Herein we describe an approach to the treatment of thoracic duct injuries, focusing on early intraoperative recognition and immediate repair. The aim of this study is to demonstrate the efficacy of Avitene, a microfibrillar collagen hemostat, and post-operative adherence to a low fat, low carbohydrate diet as an adjunct to the standard intraoperative management of a chyle fistula.

Materials and Methods

Between 1995 and 2015, 1736 patients underwent 2381 neck dissections or node biopsies by the senior author (GJP). After eliminating sentinel node biopsies (96) and Zone 1,2,3 selective neck dissections (1100), there were 1185 necks at risk for TDI having undergone either comprehensive neck (161), modified neck (995), zones 4 node dissection (1) or Zone 6-para-tracheal node (28) dissections. Of the 1185 at risk necks, a total of 19 thoracic duct injuries were identified intraoperatively (Figure 1). Data was collected from a password protected database of deidentified patient surgical records maintained by the senior author.

In all cases, the TDI was identified intraoperatively, oversewn with 4-0 mono-filament non-absorbable suture, packed with Avitene microfibrillar collagen hemostatic material and a medially directed suction drain was placed. Patients remained *nil per os* for 24 to 48 hours then began a high protein, low-fat, low-carbohydrate diet.

Demographic information was collected regarding patient age, gender, primary cancer, primary tumor site, and TDI sidedness. The primary outcome was the presence or absence of a delayed chyle leak, and secondary outcomes evaluated were length of hospital stay, days NPO, and need for MCT and/or TPN. Statistical analysis of data was performed using the SPSS statistical package XXX. Chi-squared and Fisher exact tests were used to compare percentages.

Results

There were 19 patients with thoracic duct injury development following neck dissection with an overall incidence of 0.80%.

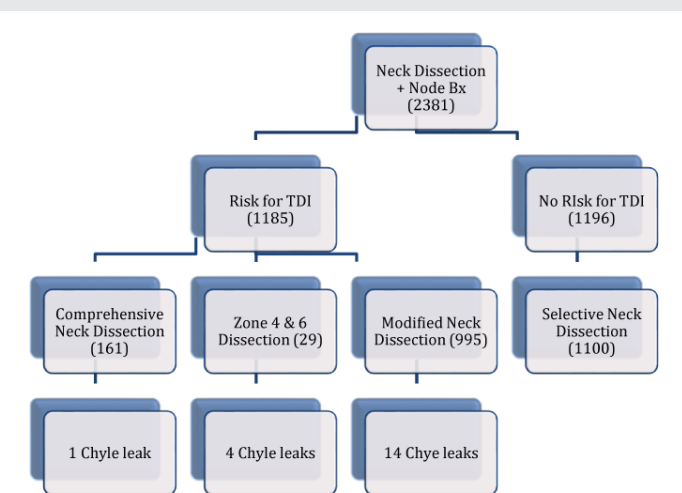


Figure 1: Distribution of types of neck dissections performed and associated thoracic duct injuries in 1185 patients.

Among the 19 patients, the mean age was 62 years, and the majority was male with a diagnosis of squamous cell carcinoma of the oral cavity (Table 1). In the patient population who suffered TDIs, 14 underwent modified radical neck dissections, 4 underwent selective neck dissections, and 1 underwent a radical neck dissection. The procedures were performed on the left side in 16 patients and on the right side in 3 patients (Table 2). Specifically, the incidence of TDI following a right-sided neck dissection was 0.24% and the incidence following a left-sided neck dissection was higher at 1.42%.

In one patient intraoperative management was not successful and he required a return to the operating room for re-exploration and placement of a sternocleidomastoid muscle flap. The mean number of days NPO was 2.5, ranging from 1 to 13 days (SD ± 2.8). The mean duration of hospitalization was

Table 1: Histopathology obtained from neck dissections.

Pathology	Primary site	Total n = 19
Squamous Cell Carcinoma	Oropharynx	3
	Tongue	3
	Tonsil	1
	Hypopharynx	1
	Neck	1
	Larynx (transglottic)	1
	Oral cavity	1
	Supraglottis	1
Melanoma	Skin (neck)	2
Papillary Carcinoma	Thyroid	2
Yolk Sac Tumor	Testicle	1
Medullary Carcinoma	Thyroid	1
Lymphoma	Neck	1

Table 2: Demographic and perioperative data.

Patient	Gender	Age (y)	Procedure	Side	Days NPO (d)	Duration of Hospitalization (d)	MCT Use (Y/N)
1	M	42	MRND-2	L	1	2	N
2	M	46	SND	L	1	2	N
3	M	38	MRND-2	L	1	2	N
4	M	62	MRND-3 & Zone 6	L	2	4	N
5	M	67	MRND-2	L	6	14	Y
6	M	77	MRND-3	L	2	4	N
7	M	64	MRND-3 & Zone 6	L	2	5	N
8	M	88	SND	L	1	3	N
9	F	76	MRND-3	L	3	5	N
10	M	63	RND	R	1	3	N
11	F	81	MRND-3	L	2	3	N
12	F	74	MRND-3	L	13	6	Y
13	M	71	MRND-1	L	2	4	N
14	M	42	MRND-3	L	3	5	N
15	M	55	MRND-3	R	2	4	N
16	F	55	Zone 6	L	1	3	N
17	F	43	MRND-3 & Zone 6	L	2	4	N
18	M	57	MRND-3	L	1	2	N
19	F	76	Zone 6	R	1	2	N
Average	--	61.9 ± 14.9	--	--	2.5 ± 2.8	4.0 ± 2.7	--

M = male; F = female; L = left; R = right; MRND = modified radical neck dissection; SND = selective neck dissection; NPO = nil per os (nothing by mouth); MCT = medium-chain triglycerides.

4 days with a range from 2 to 14 days (SD \pm 2.7). Only patient number 5 and 12 required MCT administration for 14 and 12 days, respectively, and no patients required TPN (Table 2).

Discussion

The best method for prevention of a chyle fistula is prompt recognition of the index thoracic duct injury. In addition to standard practice of direct suture repair and drain placement, we advocate for the use of intraoperative Avitene and post-operative compliance with a low-carbohydrate low-fat diet. As a result, we encountered no delayed chyle leaks. Avitene is a microfibrillar collagen hemostat (MCH) that accelerates platelet and protein aggregation, resulting in a fibrin plug. It is naturally derived, lacks antigenicity, and is insoluble in water. These properties have made it a popular choice for hemostasis in neurosurgical, urological, and endoscopic surgery, and recent literature has shown that MCH's structure can increase surface area for cell adhesion as well as provide a lasting scaffolding for new cartilage synthesis [12]. Santaolalla also described the use of fibrin, polyglactin, or collagen application to intra-operatively detected TDIs, and reported an incidence of 1.31% (4/304) post-operative chylous fistula [2]. Gregor et al., also utilized fibrin glue for management of chylous fistula, both early and delayed, and his study cited an incidence of 5.8% [5]. It is possible that our lack of post-operative chyle fistula was due not only to our use of a more suitable product, but also because of our pre-emptive application of the MCH at the index operation.

Also unique to our study was that all patients adhered to a low-fat low-carbohydrate diet post-operatively. This nutrition regimen seeks to minimize fat digestion and subsequent lymphatic transit, which ultimately slows the flow of lymph through the thoracic duct. Additionally, this diet promotes ketosis, which new research has shown to inhibit the NLRP3 inflammasome from activating IL-1 β and IL-18 generation, thereby dampening the inflammatory process [13]. Of our 19 patients, 17 responded to this diet while the remaining 2 patients required supplementation with MCT. Both of these patients had left-sided MRNDs for squamous cell carcinoma, were older than the average age of our cohort, and had longer lengths of hospitalization.

Nevertheless, we still sustained injuries to the thoracic duct during neck dissections in this series. We describe an overall incidence of 0.80% for injury, which is much lower than the cited literature values. There are numerous anatomic variations of the duct that may contribute to the occurrence of ductal injury following surgery, such as the existence of multiple tributaries as opposed to one duct or termination into the subclavian vein, innominate vein, and the external jugular vein [10]. Consequently, chyle fistula occur more commonly following radical neck dissections and are typically left-sided, specifically at the base of the neck lateral to the carotid sheath [3]. Not surprisingly, the most common procedure in our series associated with a TDI was a left-sided, modified radical neck dissection.

Unfortunately, there are no exact objective signs of chyle fistula to aid in immediate diagnosis during the postoperative

period. A leak of up to 1 L/day can be tolerated for 1 to 2 days before causing any electrolyte abnormalities [14]. Once identified, medical management is the first line of treatment for delayed chyle fistulas and is aimed at measures that promote closure by reducing chyle flow [15,16]. If these attempts fail, a minimally invasive surgical repair can be undertaken by percutaneous lymphangiography-guided cannulation with embolization of the thoracic duct [17] or through thoroscopic ligation. Finally, re-exploration of the neck with local muscle flaps and adjuvant fibrin glue or cyanoacrylate tissue glue are recommended as a last resort¹⁴ due to the delicacy of the already damaged thoracic ductal system. Thus, it behooves one to meticulously inspect the wound at the index operation, especially after hyperinflating the lungs to increase intrathoracic pressure in order to identify the source of the leak [10]. Once localized, prompt suture repair, placement of hemostatic material (Avitene) and a suction drain, as well as post-operative adherence to a diet that decreases lymph flow and inflammation are instrumental to success.

Conclusion

The management of chylous fistula is multi-faceted and depends on the timing of identification. We believe that microfibrillar collagen hemostat (Avitene) effectively seals a thoracic duct injury and prevents post-operative chyle fistula. Adjuvant diet modification to low-fat low-carbohydrate enhances the efficacy of the repair.

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