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Original Research Paper

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THORACIC DUCT INJURY IN NECK DISSECTION SURGERY: ANALYSING FREQUENCY AND ITS MANAGEMENT TECHNIQUES

Dr. Kavin Prajesh Rawal	Senior Resident, SAIMS, Indore
Dr. Vinod Dhakad	Professor, SAIMS, Indore
Dr. Himanshu Patidar	Associate Professor, SAIMS, Indore
Dr. Mayank Pancholi	Head And Professor, SAIMS, Indore
Dr. Vaibhav Gupta*	Senior Resident, SAIMS, Indore *Corresponding Author

ABSTRACT

Background: Chyle leak is an uncommon yet potentially serious complication following neck dissection, particularly in procedures involving the left side and level IV lymph node clearance. It can result in significant postoperative morbidity, including malnutrition, electrolyte imbalance, and extended hospitalization. Despite its clinical importance, there is limited consensus on standardized management approaches, especially in stratifying conservative versus surgical interventions. **Methods:** This prospective cross-sectional observational study was conducted in the Department of Surgical Oncology at Sri Aurobindo Institute of Medical Sciences (SAIMS), Indore, between January and December 2024. A total of 200 patients with head and neck malignancies undergoing left-sided neck dissection were enrolled. All patients were monitored for intraoperative and postoperative chyle leak. Leaks were categorized based on daily output as low-output (<500 mL/day) or high-output (>500 mL/day). Management strategies included conservative treatment (dietary modifications, total parenteral nutrition, pressure dressings, and octreotide) or surgical re-exploration as indicated. Statistical analysis was performed using SPSS version 25.0. **Results:** Chyle leak occurred in 12 patients (6%), while 11 (5.5%) had intraoperative chyle duct injury, all managed successfully with ligation. A statistically significant association was noted between chyle leak and the type of neck dissection ($p=0.0028$), level IV nodal metastasis ($p<0.0001$), and prior chemoradiotherapy ($p=0.0002$). Conservative management succeeded in 8 patients (66.6%), whereas 3 of 4 patients with high-output leaks required surgical intervention and achieved resolution within 48 hours. **Conclusion:** Chyle leak remains a clinically relevant complication following neck dissection. Risk-based stratification and early intraoperative recognition allow for effective conservative or surgical management, optimizing outcomes and reducing morbidity.

KEYWORDS : Chyle leak, Neck dissection, Thoracic duct injury, Level IV lymph nodes, Conservative management

INTRODUCTION

Thoracic duct injury, though rare, is a noteworthy and potentially serious complication associated with neck dissection procedures performed for head and neck malignancies. As the largest lymphatic channel in the human body, the thoracic duct typically terminates at the left venous angle, making it particularly susceptible to iatrogenic damage during dissections involving lower cervical levels—specifically level IV and V lymph nodes. The anatomical variability and fragile structure of the duct further contribute to its vulnerability during surgery [1].

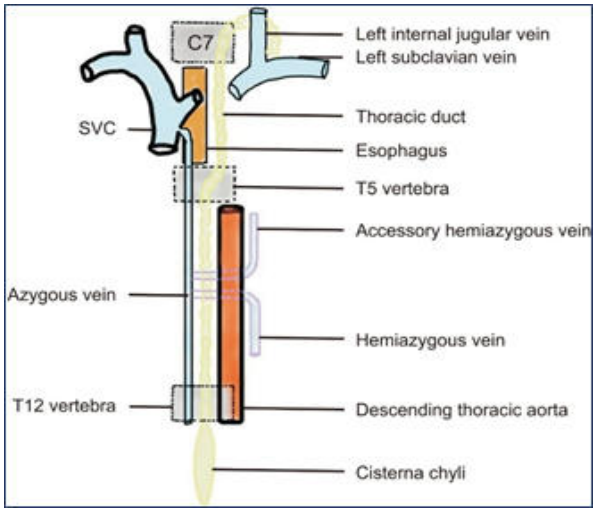

Fig. 1. Anatomy of thoracic duct. (SVC: superior vena cava)

Figure 2. Left neck dissection showing exposed Thoracic duct postero-lateral to Left IJV

Chyle leak is a distinctive form of lymphatic leakage occurring primarily following left-sided neck dissections. While right-sided lymphatic injuries usually present as clear fluid drainage, injury to the thoracic duct results in the loss of milky, lipid-rich chyle. This can be identified clinically by the sudden appearance of creamy or milky fluid in surgical drains, particularly after the initiation of oral or enteral nutrition. The incidence of iatrogenic lymphatic injury in head and neck surgeries ranges between 2% and 8%, with thoracic duct

involvement accounting for up to 75–92% of cases. In contrast, procedures such as thyroidectomy report much lower incidence rates of 0.5–1.4% [2,3].

The consequences of a chyle leak extend beyond fluid loss. Patients may develop significant metabolic disturbances, electrolyte imbalance, hypoalbuminemia, immunosuppression, malnutrition, wound dehiscence, infection, and prolonged hospitalization. In some cases, chyle accumulation may lead to chylothorax or skin necrosis if left untreated [4]. Diagnosis can be confirmed intraoperatively by direct visualization or postoperatively by biochemical analysis showing elevated triglyceride levels (>110 mg/dL) in the drainage fluid [5].

Management approaches are guided by the daily volume of chyle output. Low-output leaks (<500 mL/day) generally respond to conservative treatment, including fat-restricted or MCT-rich diets, pressure dressings, bowel rest, and administration of octreotide. Persistent or high-output leaks may require surgical re-intervention, thoracic duct ligation, or minimally invasive procedures such as image-guided embolization [6,7].

Given the variability in clinical practice and the lack of robust comparative data, this study aims to evaluate the incidence, risk factors, and outcomes associated with thoracic duct injury in neck dissection, while also reviewing the effectiveness of various treatment strategies in a tertiary care center.

MATERIAL AND METHODS

This was a single-center, cross-sectional observational study conducted in the Department of Surgical Oncology at Sri Aurobindo Institute of Medical Sciences (SAIMS), Indore, after obtaining approval from the Institutional Ethics Committee. The study was carried out over a 12-month period from January 2024 to December 2024 and included a total of 200 patients diagnosed with head and neck cancers undergoing left-sided neck dissection as part of definitive surgical treatment.

All patients were assessed preoperatively through detailed clinical history and physical examination. Written informed consent was obtained from all participants prior to inclusion in the study. Only patients undergoing Modified Radical Neck Dissection (MRND) or Radical Neck Dissection (RND) on the left side were included. Patients undergoing Selective Neck Dissection (SOHND) or right-sided dissection only were excluded from the study.

Inclusion Criteria

- All head and neck cancer patients undergoing left-sided neck dissection.
- Patients medically fit for surgery and giving informed consent.
- Patients with resectable disease.
- Patients who had received radiation or chemotherapy as neoadjuvant or definitive treatment.

Exclusion Criteria

- Patients undergoing only **SOHND**.
- Patients undergoing right-sided neck dissection only.
- Patients who refused to provide informed consent.

Surgical Protocol

All surgical procedures were performed by a team of six experienced surgeons. After completion of neck dissection, Valsalva maneuver was performed intraoperatively to detect any evidence of chyle leak. If intraoperative chyle leak was observed (characterized by clear or milky fluid), it was managed immediately using intraoperative clipping or suture ligation, often with the aid of microscope or magnification loupes when needed.

Postoperative Monitoring And Management

Following surgery, all patients were carefully observed for evidence of chyle leak until the fifth postoperative day (POD 5). Enteral feeding was initiated via a Ryle's tube on postoperative day one (POD 1) for all patients, and drain outputs were closely monitored thereafter. Chyle leak was clinically suspected in patients who exhibited a sudden increase in drainage volume following the initiation of enteral feeding or in cases where the drainage fluid appeared milky, white, or creamy in consistency. Additional signs included localized fluctuant swelling in the neck with overlying erythema.

Once a chyle leak was suspected, an initial conservative approach was adopted. This included instituting a low-fat diet enriched with medium-chain triglycerides (MCTs), continued enteral feeding through a Ryle's tube, and application of pressure over the left supraclavicular fossa to reduce lymphatic flow. In patients with persistent chyle output, nil per oral (NPO) status was initiated, and total parenteral nutrition (TPN) was started to minimize lymph production. Central venous catheterization was considered in patients requiring prolonged TPN.

The decision for surgical intervention was based on the volume and duration of chyle leak. Patients with high-output chyle leak, defined as more than 500 mL/day, were managed conservatively for up to five days. If the output remained elevated beyond this period, re-exploration was planned. Conversely, patients with low-output chyle leak (<500 mL/day) were managed conservatively for up to fifteen days, and only if leakage persisted beyond this time frame, surgical repair was undertaken. During surgical re-exploration, the chyle duct was identified, typically located posterior to the internal jugular vein (IJV), and was secured using suture ligation or clipping. Microsurgical magnification or loupes were employed as necessary to aid in accurate duct localization and secure closure.

Statistical Analysis

All data were analyzed using IBM SPSS Statistics for Windows, Version 25.0 (IBM Corp., Armonk, NY, USA). Descriptive statistics were used to summarize demographic and clinical characteristics. Continuous variables such as age were expressed as mean ± standard deviation, while categorical variables (e.g., type of malignancy, type of neck dissection, presence or absence of chyle leak) were summarized as frequencies and percentages. Associations between the development of chyle leak and factors such as type of dissection, presence of level IV nodal metastasis, and prior treatment (neoadjuvant chemotherapy or chemoradiotherapy) were assessed using the Chi-square test or Fisher's exact test where appropriate. A p-value < 0.05 was considered statistically significant.

RESULTS

In this prospective observational study, a total of 200 patients diagnosed with head and neck cancers who underwent left-sided neck dissection were included between January 2024 and December 2024. The mean age of the participants was 46 years, ranging from 24 to 66 years. The most common primary tumor site was the oral cavity, observed in 174 patients (87%), followed by thyroid malignancies in 18 patients (9%), parotid tumors in 6 patients (3%), and laryngeal carcinoma in 2 patients (1%). [Table 1]

Table 1: Distribution Of Primary Malignancy

Primary Malignancy	Number of Patients (%)	Percentage (%)
Oral cavity	174	87%
Thyroid	18	9%
Parotid	6	3%

Larynx	2	1%

Regarding surgical approach, Modified Radical Neck Dissection (MRND) was the most commonly performed procedure (172 patients; 86%), followed by Radical Neck Dissection (RND) in 5 patients (2.5%), and Lateral/Extended Supraomohyoid Neck Dissection (SOHND) in 23 patients (11.5%). [Table 2]

Table 2: Type Of Neck Dissection Performed

Type of Neck Dissection	Number of Patients	Percentage (%)
Modified Radical Neck Dissection (MRND)	172	86.0%
Radical Neck Dissection (RND)	5	2.5%
Lateral/Extended SOHND	23	11.5%
Total	200	100%

During surgery, intraoperative chyle duct injury was encountered in 11 patients (5.5%), all of whom were managed immediately with microvascular clipping under magnification loupes. Importantly, none of these patients developed postoperative chyle leak, highlighting the effectiveness of intraoperative detection and repair. However, postoperative chyle leak was observed in 12 patients (6%). Among these, 10 had undergone MRND and 2 had undergone RND, whereas none of the patients who underwent Lateral/Extended SOHND developed a chyle leak. There is a statistically significant association between the type of neck dissection and the occurrence of postoperative chyle leak (Table 3). MRND and RND were significantly more associated with postoperative leaks. [Table 3]

Table 3: Association Between Postoperative Chyle Leak and Type of Neck Dissection

Type of Neck Dissection	Chyle Leak	No Chyle Leak	Total
Modified Neck Dissection	10	162	172
Radical Neck Dissection	2	3	5
Lateral/Extended SOHND	0	23	23

Statistical Test: Chi-square; **p-value:** 0.0028

Furthermore, it was observed that **all 12 patients** who developed postoperative chyle leak had **metastatic level IV lymph nodes**, while **none** of the patients without level IV metastasis developed a chyle leak. Presence of metastatic level IV lymph nodes is significantly associated with the development of postoperative chyle leak. **[Table 4]**

Table 4: Association Between Level IV Node Metastasis and Chyle Leak

Metastatic Level IV Node	Chyle Leak	No Chyle Leak
Present	12	11
Absent	0	177

Statistical Test: Fisher's exact test; **p-value:** < 0.0001

Looking at preoperative treatment history among the 12 patients who developed chyle leak: **7 patients (58.3%)** had received **definitive chemoradiotherapy**, **3 (25%)** had undergone **neoadjuvant chemotherapy (NACT)**, and **2 (16.6%)** had not received any preoperative treatment. Preoperative treatment modality is significantly associated with the risk of developing postoperative chyle leak **(Table 4)**, with chemoradiotherapy and NACT being risk-enhancing factors. [Table 5]

Table 5: Association Between Preoperative Treatment And Chyle Leak

Preoperative Treatment	Chyle Leak	No Chyle Leak	Total
Definitive Chemoradiotherapy	7	33	40
Neoadjuvant Chemotherapy	3	17	20
No Treatment	2	138	140

Statistical Test: Chi-square; **p-value:** 0.0002

Among the 12 patients with chyle leak, **8 (66.6%) had low-output leak** (<500 mL/day) and were successfully treated conservatively using a combination of **NPO**, **TPN**, **low-fat/MCT-rich diet**, and **supraclavicular compression**. These patients achieved complete resolution within **10 days**. The remaining **4 patients (33.3%)** had **high-output leaks (>500 mL/day)**; 1 of them with **900 mL/day output** recovered with conservative treatment, while the other **3 patients** (output between **1–1.4 L/day**) required **surgical re-exploration and clipping of the thoracic duct**, leading to resolution within **24–48 hours**. [Table 6]

Table 6: Output And Management Of Postoperative Chyle Leak

Leak Output Type	Number of Patients	Management Strategy	Resolution Time
Low-output (<500 mL/day)	8	Conservative (NPO, TPN, MCT, compression)	<10 days
High-output (>500 mL/day)	1	Conservative (responded)	8 days
High-output (>1 L/day)	3	Surgical re-exploration and duct clipping	24–48 hours

DISCUSSION

Chyle leak remains a relatively uncommon yet clinically significant complication following neck dissection, with an incidence reported between 2% and 8% in the literature depending on surgical technique, tumor characteristics, and patient-related factors [3,4]. In our prospective observational study involving 200 patients who underwent left-sided neck dissection for head and neck malignancies, we observed an incidence of 6% for postoperative chyle leaks, consistent with earlier data and reinforcing the relevance of this complication in contemporary surgical oncology.

Chyle leak typically results from thoracic duct injury during dissection of lower cervical lymph nodes, particularly at level IV. The duct's anatomical variability and its close relationship with the internal jugular and subclavian veins increase its vulnerability, especially during left-sided neck dissection. In our study, a significant correlation was observed between the type of neck dissection and chyle leak incidence. Patients undergoing Modified Radical Neck Dissection (MRND) and Radical Neck Dissection (RND) showed a higher risk, while no cases were reported in Lateral or Extended Supraomohyoid Neck Dissection (SOHND) ($p = 0.0028$), consistent with earlier literature [4,8].

One of the most striking observations in our analysis was the association between level IV nodal metastasis and postoperative chyle leak. All 12 patients who developed postoperative chyle leak had histopathologically confirmed metastatic involvement at level IV, while no leaks were recorded in patients without such nodal metastasis ($p < 0.0001$; Table 4). This emphasizes the thoracic duct's anatomical vulnerability and suggests that aggressive dissection in this region, particularly in the presence of nodal disease, increases the risk of lymphatic disruption. Similar correlations have been documented by other studies, which have identified level IV dissection as an independent predictor of chyle leak [4,9].

The role of preoperative treatment in chyle leak development also warrants consideration. In our cohort, 58.3% of patients with chyle leak had undergone definitive chemoradiotherapy, 25% had received neoadjuvant chemotherapy (NACT), and only 16.6% had not received any prior treatment. This

difference was statistically significant (p = 0.0002; Table 5), indicating that tissue fibrosis and anatomical distortion resulting from prior therapy may increase the risk of thoracic duct injury during dissection. Although the literature remains sparse on this specific association, our findings support the hypothesis that pretreated tissues are more susceptible to surgical trauma due to altered vascularity and loss of tissue planes.

Intraoperative detection and management of chyle duct injury can significantly mitigate postoperative complications. In our study, 11 patients (5.5%) had intraoperative chyle duct injuries, all of which were promptly managed with clipping under magnification loupes. None of these patients went on to develop postoperative chyle leaks, highlighting the importance of intraoperative vigilance. The Valsalva maneuver was routinely employed to detect chyle extravasation during surgery. Early recognition and precise intraoperative repair are vital, as corroborated by Leović et al. and Ganesan A et al., who emphasized that intraoperative control of lymphatic injury significantly reduces the incidence of persistent postoperative leakage and associated morbidity [4,10].

Postoperatively, the clinical diagnosis of chyle leak was based on classical signs such as a sudden increase in neck drain output following initiation of enteral feeding and the appearance of turbid, milky fluid. In uncertain cases, biochemical confirmation through fluid triglyceride levels >100 mg/dL or demonstration of chylomicrons was considered, aligning with established diagnostic protocols [3].

Regarding management, a tiered approach was adopted based on the severity of chyle output. Of the 12 patients with postoperative chyle leak, two-thirds (8/12) had low-output leaks (<500 mL/day) and were successfully managed using conservative measures such as nil per oral status, total parenteral nutrition (TPN), medium-chain triglyceride-rich diets, and supraclavicular pressure dressings. All patients in this subgroup experienced resolution of the leak within 10 days, reinforcing existing evidence that conservative therapy is effective in low-output cases [3,4]. However, 4 patients had high-output leaks (>500 mL/day), and only one of these responded to conservative management. The remaining three, with daily outputs ranging from 1 to 1.4 liters, required surgical re-exploration and direct clipping of the thoracic duct. Postoperative resolution was observed within 24 to 48 hours in all three cases. These outcomes are in agreement with several previous studies that advocate early surgical intervention in high-output chyle leaks to prevent complications such as malnutrition, electrolyte imbalance, wound dehiscence, and immunosuppression [3,4].

A wide range of surgical and non-surgical approaches have been reported in the literature for the management of chyle leaks. Conservative measures such as total parenteral nutrition (TPN), medium-chain triglyceride (MCT)-based diets, somatostatin analogs like octreotide, and local compressive dressings are typically employed as first-line interventions, particularly for low-output leaks [7,8]. In cases where these methods fail or in high-output leaks, escalation to surgical intervention becomes necessary. Surgical strategies include direct thoracic duct ligation, application of fibrin sealants, and reinforcement using local myofascial flaps such as the omohyoid or pectoralis major [7,9]. Additionally, minimally invasive procedures—such as video-assisted thoracoscopic surgery (VATS) and image-guided percutaneous duct embolization—have gained traction in recent years as effective alternatives in refractory cases [9]. Our findings support this stepwise, algorithmic approach, emphasizing individualized escalation based on daily chyle output and the response to initial conservative management.

It is essential to highlight that the risk of chyle leak should not compromise the oncological intent of surgery. The presence of risk factors such as bulky level IV nodes, prior chemoradiotherapy, or low BMI should prompt greater intraoperative caution, but not deter surgeons from performing adequate neck dissections. Instead, these findings emphasize the necessity of enhanced anatomical understanding and meticulous dissection techniques to prevent inadvertent injury to the thoracic duct and its tributaries.

The strength of our study lies in its prospective design and rigorous assessment of surgical, anatomical, and therapeutic variables influencing chyle leak incidence. However, the study's limitation includes its single-institutional setting and focus solely on left-sided neck dissections, thereby limiting broader generalizability.

CONCLUSION

In conclusion, chyle leak continues to be a clinically relevant complication in neck dissection surgeries. Our study reinforces the importance of factors such as the type of neck dissection, presence of level IV nodal metastasis, and history of preoperative chemoradiotherapy in predicting the risk of chyle leak. Prompt intraoperative identification, especially using Valsalva maneuver and meticulous clipping, can effectively prevent postoperative leaks. While conservative management remains the cornerstone for low-output leaks, early surgical intervention is vital in high-output or refractory cases. The development of structured, evidence-based protocols for early risk stratification and stepwise management could further reduce patient morbidity and improve surgical outcomes.

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