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Original research

Thoracic duct lesions in thyroid surgery: An update on diagnosis, treatment and prevention based on a cohort study

Andrea Polistena [a, *], Jacopo Vannucci [b], Massimo Monacelli [b], Roberta Lucchini [a], Alessandro Sanguinetti [a], Stefano Avenia [a], Stefano Santoprete [b], Roberta Triola [a], Roberto Cirocchi [a], Francesco Puma [b], Nicola Avenia [a]

[a] Endocrine Surgery Unit, Medical School University of Perugia, Italy
[b] Thoracic Surgery Unit, Medical School University of Perugia, Italy

HIGHLIGHTS

- Thoracic duct injury at cervical level is a rare complication following thyroid surgery.
- Thoracic duct injury is associated to lateral neck dissection and thyroidectomy for mediastinal goiter.
- Conservative treatment is the first option with parenteral nutrition and wound dressing.
- High flow fistula, chyloma, cutaneous inflammation and necrosis, chylothorax are indications to surgery.
- Duct ligation after unsuccessful conservative treatment is the only resolutive treatment of cervical chylous fistula.

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ABSTRACT

Introduction: Thoracic duct fistula at the cervical level is a severe but rare complication following thyroid surgery, particularly associated to lateral dissection of the neck and to mediastinal goiter.
Methods: we retrospectively analyzed chylous fistulas observed in a cohort of 13.224 patients underwent surgery for thyroid disease since 1986 to 2014, in the Unit of Endocrine Surgery, S. Maria University Hospital, Terni, Italy.
Results: We observed 20 cases of chylous fistula. Thirteen patients underwent primary surgery in our institution while the remaining 7 cases had been referred to our Department from other hospitals for an already diagnosed lymphatic leak. Surgical procedures carried out included total thyroidectomy for mediastinal goiter in 4 patients, total thyroidectomy for cancer in 2 patients, unilateral functional lymphadenectomy in 11 patients and bilateral in 3. Intraoperative repair was carried out in 4 cases. Of the remaining 16 cases, 4 of the 6 fistulas with low flow leakage healed in about 30 days of conservative treatment, 2 cases instead required surgical repair. All 10 patients with "high-flow" fistula underwent surgery.
Despite surgery was performed later, postoperative course in patients with late surgical repair is similar to what observed in those patients with early surgical repair. Both groups underwent cervical drainage removal in post-operative day 4.
Conclusion: Healing of a cervical chylous fistula can be achieved by conservative medical therapy (nutritional and pharmacological) but in case of therapeutic failure with rapid decrease of general condition, the surgical approach is necessary. In our experience, duct ligation after unsuccessful conservative treatment, is the only resolutive treatment.

1. Introduction

Thoracic duct injury is a rare but severe complication following cervical surgery. Lymphatic duct injuries are more commonly observed during laryngeal and esophageal surgery, nodal biopsy,

* Corresponding author. UOC Chirurgia Generale e Specialità Chirurgiche, S. Maria University Hospital, via Tristano di Joannuccio 1, Terni, 05100, Italy.
E-mail addresses: apolis74@yahoo.it (A. Polistena), jacopo.vannucci@gmail.com (J. Vannucci), massimo.monacelli@gmail.com (M. Monacelli), robertalucchini@alice.it (R. Lucchini), alessandrosanguinetti@gmail.com (A. Sanguinetti), stefano_avenia@libero.it (S. Avenia), stefanosantoprete@alice.it (S. Santoprete), triolaroberta@gmail.com (R. Triola), roberto.cirocchi@unipg.it (R. Cirocchi), francesco.puma@unipg.it (F. Puma), nicolaavenia@libero.it (N. Avenia).

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subclavian catheterization, radical or functional neck dissection [1].

Considering the anatomy of the thoracic duct, accurate dissection must be used during lateral neck lymphadenectomy or during thyroidectomy especially for mediastinal goiters.

Chylous fistulas can occur after a thoracic duct lesion following neck surgery at the level of omoclavicular triangle, which contains other important anatomical structures such as lymph-nodes, brachial plexus, transverse cervical and suprascapular veins and arteries, subclavian artery, the terminal part of the external jugular vein and the phrenic nerve [2]. Chyle leak is known to lead to prolonged hospitalization. Clinical management of chylous fistulas may be difficult and it is complicated by local inflammation and systemic failure. Thoracic duct lesions can be recognized intraoperatively by direct visualization of the damaged duct or after surgery when macroscopic changes of drainage features occurs with "milky white" fluid. However, in patients who are nil by mouth or on a fat-free diet, it may present as a leakage of clear fluid and diagnosis can be confirmed by laboratory assessment with triglycerides dosage over 100 mg/dL. In most cases, the finding of a cervical lymphatic fistula is not immediate but it appears during the second postoperative day in most of the cases. Conservative treatment is recommended as first approach but when complicated or high flow fistula are observed surgical treatment by duct's ligation is the only resolutive approach to this potentially severe complication. Persistent chyle loss leads to electrolyte disturbance, hypovolemia, hypoalbuminemia, coagulopathy, immunosuppression, chylothorax, peripheral oedema, wound infection with increased mortality.

Aim of this study was to focus on diagnosis and therapeutic approaches in patients with cervical injury of the thoracic duct, analyzing the personal experience in the treatment of this rare event.

2. Materials and methods

We retrospectively analyzed a population of 13.224 patients admitted for thyroid disease over a period of 28 years, since 1986 to 2014, in the Unit of Endocrine Surgery, S. Maria University Hospital, Terni, University of Perugia. This retrospective cohort study was designed according to the STROBE criteria [3].

Data available in the observational period were collected from our database and analyzed.

In all operated patients drainages were used, one in the thyroid space after total thyroidectomy with or without central neck dissection and one along the carotid artery when a lateral neck dissection was carried out. Three drainages were used in case of bilateral lymphadenectomy plus total thyroidectomy with or without central neck dissection.

When a chylous fistula is suspected postoperatively after macroscopic changes of drained fluids, diagnosis was confirmed by laboratory assessment with triglycerides dosage over 100 mg/dL. We classified chyle leaks considering the daily volume of the drainage and we defined low-flow and high-flow fistulas respectively with volume less and more than 500 mL/die.

The different approach to the chylous leak included intraoperative ligation, post-operative conservative treatment and reoperation.

3. Results

We observed twenty patients with chylous fistula due to cervical injury of the thoracic duct following surgery. Thirteen patients (0.01% out of 13.224) underwent primary surgery in our institution while the remaining 7 cases had been referred to our Department from other hospitals for an already diagnosed lymphatic injury after neck surgery. Surgical procedures performed included total thyroidectomy for mediastinal goiter in 4 patients, total thyroidectomy for cancer in 2 patients and total thyroidectomy associated to left unilateral and bilateral functional lymphadenectomy respectively in 11 and in 3 patients (70% out of 20).

The intraoperative finding of anomalous lymphatic leakage allowed prompt suture with a consequent regular post-operative course in 4 cases.

The remaining 16 cases showed the lymphatic leak during the post-operative period with no evidence of chylothorax; 6 leaks were low-flow (<500 mL/die) and 10 highflow (>500 mL/die).

Four cases of the 6 fistulas with low flow leakage, healed in about 30 days of conservative treatment (drainage, starving, total parenteral nutrition, compressive dressing of surgical incision, somatostatin 6 mg per day intravenously), 2 case instead required surgical repair. All 10 patients with "high-flow" fistula underwent surgery: 6 were submitted to surgery during the first postoperative week, 1 after 2 weeks and 3 after a period of 30 days of conservative therapy and failed medical support (Table 1). Duct ligation was performed once by videothoracoscopy.

In the 6 patients who underwent early surgical repair, postoperative course was regular, drainage was removed in postoperative day 4 after oral feeding resumption in all cases; all the 3 patients, submitted to surgery after 30 days from diagnosis of fistula, had previously unsuccessfully been treated by conservative therapy.

Despite surgery was performed later, postoperative course in patients with late surgical repair is similar to what observed in those patients with early surgical repair.

4. Discussion

The occurrence of a thoracic duct injury during neck surgery is strictly related to the anatomy of the lymphatic trunks at the cervico-thoracic level.

The thoracic duct originates from Paquet's cisterna chyli which receives, at the level the second lumbar vertebra, the right and left lumbar lymphatic trunks and the intestinal lymphatic trunk. Then the duct runs through the retroperitoneum and the mediastinum for a length of 38–45 cm, having its caudal course in proximity to the left side of the esophagus and then arising posteriorly in the mediastinum towards the carotid artery and the internal jugular vein. It consequently bends with inferior concavity following an anterior-lateral direction to the jugular subclavian confluence. At cervical level, the thoracic duct receives the left jugular lymphatic trunk, the subclavian trunk and sometimes the broncho-mediastinal affluence. The last one can separately flow into the jugular-subclavian confluence. At that level an anatomical variability can be observed (single duct with simple junction, delta-shaped junction, wide dilation with multiple terminal branches) [2].

Incidence of lymphatic fistula becomes particularly considerable, with variable rate (1–2.5%) in those patients undergoing radical and functional neck dissection [4,5].

Neck dissection has been recognized as an integral part of the surgical treatment of head and neck cancer since the 19th century and many technical changes were standardized in order to preserve loco-regional structures, to conserve function and to prevent dysmorphism without reducing the oncologic efficacy of the procedure [6].

Latero-cervical lymphadenectomy is classified in radical, modified radical and selective. Selective lymphectomy is additionally divided in: supraomohyoid dissection, postero-lateral, lateral and anterior dissection. The omoclavicular triangle shows the following borders: posterior margin of sternocleidomastoideus

Table 1
Cohort of patients: MG (mediastinal goiter), DTC (differentiated thyroid carcinoma), TT (total thyroidectomy), LND (lateral neck dissection), BLND (bilateral neck dissection), LF (low flow), HF (high flow).

Patient	Diagnosis	Previous surgery	Intraoperative detection	Flow of fistula at postoperative detection	Treatment	Outcome
1	**MG**	TT	NO	**LF**	**conservative**	healing
2	DTC	TT	NO	HF	duct ligation	healing
3	DTC	*TT + LND*	NO	HF	duct ligation	healing
4	DTC	*TT + LND*	**YES**	/	duct ligation	healing
5	**MG**	TT	NO	**LF**	duct ligation	healing
6	DTC	**TT + BLND**	NO	HF	duct ligation	healing
7	**MG**	TT	**YES**	/	duct ligation	healing
8	DTC	TT	NO	**LF**	**conservative**	healing
9	DTC	*TT + LND*	NO	HF	duct ligation	healing
10	DTC	*TT + LND*	NO	HF	duct ligation	healing
11	DTC	TT	NO	HF	duct ligation	healing
12	DTC	*TT + LND*	**YES**	/	duct ligation	healing
13	**MG**	TT	NO	**LF**	**conservative**	healing
14	DTC	*TT + LND*	NO	HF	duct ligation	healing
15	DTC	*TT + LND*	NO	**LF**	duct ligation	healing
16	DTC	**TT + BLND**	NO	HF	duct ligation	healing
17	DTC	*TT + LND*	NO	HF	duct ligation	healing
18	DTC	**TT + BLND**	**YES**	/	duct ligation	healing
19	DTC	TT	NO	**LF**	**conservative**	healing
20	DTC	*TT + LND*	NO	HF	duct ligation	healing

muscle anteriorly, inferior margin of omohyoideus muscle superiorly and superior margin of the clavicle inferiorly. Furthermore, omoclavicular triangle and occipital triangle together determine the posterior triangle that is also recognized as fifth level.

In the omoclavicular triangle, several anatomical structures are found: thoracic duct, lymph-nodes, brachial plexus, transverse cervical and suprascapular veins and arteries, subclavian artery, the terminal part of the external jugular vein and the phrenic nerve [2].

For these anatomical reasons cervical lymphadenectomy, as an advanced demolitive procedure, may lead to significant morbidity for potential damage to critical loco-regional structures [7–11].

In a multicentric study, Rosato reports an incidence of lymphatic fistula of 0.03% analyzing 14.934 surgical procedures for thyroid disease [12].

Moley describes an incidence up to 8.9% of chylous fistula after surgery for thyroid carcinoma in patients operated after previous neck radiotherapy [13]. It was observed that higher rate of duct damage followed radical dissection than functional dissection on the left side [13].

We observed a chyle fistula only in 13 cases out of 13.224 (0.01%) patients underwent surgery in our institution. Other 7 cases, referred to our institution from other hospital, were as well included in the study since received the same therapeutic approach, with identical criteria of treatment. In our experience functional neck dissection was the procedure most associated to lymphatic fistula. Radical dissection was not performed in the examined cases.

The lymphatic lesion usually occurs at the junction of the left jugular and subclavian vein at the level of confluence with the thoracic duct. In most cases, the injury occurs to small lymphatic routes and a minimal chylous leak is observed. Generally it spontaneously heals in few days or a collateral vicarious draining system can develop with no symptoms. The lack of collateral pathways or functional insufficiency of the remaining regional lymphatic net lead instead to an evident chylous fistula [14].

Even rare, the occurrence of chylous fistula is also described in the right side as reported in some series [15–17].

The favoring conditions for the post-operative occurrence of a lymphatic fistula after thoracic duct injury are associated with higher frequency to locally advanced thyroid malignancy, cervico-mediastinal goiter and left cervical lymphadenectomy.

Chyle leak lesion evident at surgery must be treated, at the same time, by suture ligation with non-absorbable material as we experienced in 4 patients.

When a chyle fistula is demonstrated postoperatively a conservative treatment with starving and artificial nutrition or a fat free diet and pressure dressing is suggested [14,18]. The chylous flow is in fact strictly dependent on quantity and quality of diet, it markedly increases after meals especially if they have an high rate of long chain fatty acid. This approach is successful in almost all patients. As local conservative treatment, negative-pressure wound therapy demonstrated successful results [18].

If conservative treatment is not effective a reoperation must be tempted with local administration of biological sealant as Tissucol™, or sclerosing agents application such tetracycline or iodoform packing or with attempt to direct suture and ligation, even by a videothoracoscopic approach as we did in 1 case.

The first thoracic duct ligation at cervical level was reported by Cushing in 1898 [19] and since that there is no doubt concerning the appropriateness of an immediate duct ligation with non-absorbable material in case of intraoperative finding of duct rupture. Surgeons must face the evidence that the delayed procedure can be demanding considering the sclero-inflammatory background due to previous surgery and effects of lymphatic leak, especially in long standing fistula. Persistently prolonged conservative treatment in fact gives no advantages and may add additional local and systemic complication to an already complex surgical procedure.

Nevertheless there is no general agreement on timing and operative steps for the surgical approach to thoracic duct injury, which remains subjective as attesting the different times of reoperation chosen in our experience, according to the different clinical conditions observed in our patients.

The decision for an operative approach can be supported by some conditions including chyloma not reducible with compressive dressing, cutaneous inflammation and necrosis, chylothorax. Other alternative methods are reported such as muscle flap with pectoralis major or lymphography with duct catheterization and selective embolization [1,14,17,20–23]. Excision and imbrication of leaking lymphatics, chylous fistula surgical/microsurgical repair, video-assisted thoracoscopic surgery, thoracotomy, pleurodesis and decortication, pericardial “window”, and pleura-

venous/pleura-peritoneal shunts were described as surgical alternative options to duct ligation. In addition, single or preferably, multiple lymphovenous anastomoses may be taken into account [24].

Nutritional deficiency, hypovolemia, hyponatremia, hypochloremia, fatty acids and protein loss, immunosuppression, proximal vessels compression and respiratory insufficiency retard the fistula healing.

In this context, mortality can arise to 50% if this condition is not adequately managed although conservative or surgical treatment have been performed [25–27].

5. Conclusions

Thoracic duct injury at the cervical level following thyroid surgery represents a rare but severe complication and it is particularly associated to latero-cervical lymphadenectomy, invasive cancer and large mediastinal goiter.

Healing of a cervical chylous fistula can be achieved by conservative medical therapy (with nutritional and pharmacological approach) but in case of therapeutic failure, rapid decrease of general condition, or systemic inefficiency, the surgical approach is necessary.

In our experience, surgical approach to chylous fistula by duct ligation after unsuccessful conservative treatment is the only resolutive treatment of this clinical condition.

Competing interests

The authors declare to have no competing interests.

Ethical approval

Not required.

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Author contribution

Andrea Polistena: Participated substantially in conception, design, and execution of the study and in the analysis and interpretation of data; also the drafted and editing of the manuscript.

Jacopo Vannucci: Participated substantially in conception, design, and execution of the study and in the analysis and interpretation of data.

Massimo Monacelli: Participated substantially in conception, design, and execution of the study and in the analysis and interpretation of data.

Roberta Lucchini: Participated substantially in execution of the study and in the analysis and interpretation of data.

Alessandro Sanguinetti: Participated substantially in execution of the study and in the analysis and interpretation of data.

Stefano Avenia: Participated substantially in execution of the study.

Stefano Santoprete: Participated substantially in execution of the study.

Roberta Triola: Participated substantially in execution of the study.

Roberto Cirocchi: Participated substantially in execution of the study and in the analysis and interpretation of data.

Francesco Puma: Participated substantially in conception, design, and execution of the study and in the analysis and interpretation of data; also participated substantially in the drafting and editing of the manuscript.

Nicola Avenia: Participated substantially in conception, design, and execution of the study and in the analysis and interpretation of data; also participated substantially in the drafting and editing of the manuscript.

Conflicts of interest

All Authors have no conflict of interests.

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