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SURGICAL TECHNIQUES AND INNOVATIONS

# Indocyanine Green Fluorescent Thoracic Duct Lymphography by Inguinal Nodal Injection Approach for Identifying Thoracic Duct and Chyle Leak: a Case Report

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**Abstract**
Near-infrared (NIR) fluorescence imaging by indocyanine green (ICG) is a promising tool to provide a high-resolution, real-time intraoperative imaging of the thoracic duct. We presume inguinal intranodal injection of ICG is the ideal approach to perform real-time fluorescent thoracic duct lymphography. Here, we describe the successful utilization of NIR fluorescence imaging with ICG for identification and clipping of thoracic duct in a case of traumatic chylothorax persistent after a failed neck exploration.

**Keywords** Chyle leak · ICG Florescence · Inguinal nodal injection · Thoracoscopy

## Case Presentation

A 29-year gentleman developed hoarseness of voice and breathlessness with heaviness on the left side of his chest following a stab injury with a sharp object to the left side of his neck (Fig. 1A). There was subcutaneous emphysema in left side of neck and adjacent part of chest wall and reduced air entry on the left side of the thorax at presentation. He underwent left chest tube placement at a local hospital after a CT neck and chest showed massive left pleural effusion (Fig. 1B). Video laryngoscopy revealed left vocal paralysis. Initial serosanguinous chest drain output about 1 L/day, turned to chylous nature, 3 L/day after patient resumed oral feeds. Fluid triglycerides level was 197 mg/dl. A planned lymphangiography was abandoned as the patient developed a reaction to dye during the procedure. Initial conservative and dietary management with medium-chain triglycerides yielded no significant clinical improvement.

The patient had a persistent chyle leak, for which a neck exploration and ligation of the thoracic duct (TD) was attempted, but the chylous output did not come down. He was referred to our hospital for further management. After anesthesia induction and 20 min before the start of surgery, 2.5 mg indocyanine green (ICG) dye was injected into inguinal nodes bilaterally under sonographic guidance (Fig. 1C, D). The patient was then placed in semi-prone position. Right thoracoscopic ports were placed, and the fluorescent thoracic duct was visualized with SPY ENV and overlay modes using Stryker's high definition 1688 advanced imaging modalities (AIM) 4 K Platform (Fig. 2). Three cm above the esophageal hiatus, the thoracic duct was dissected between the azygous vein and aorta, and a 10 mm Liga clip was applied to it (Fig. 2). A successful clipping was demonstrated by distal collapse and proximal ballooning of the duct. The left thoracoscopy was done in the supine position; the chylous fluid was stained in green fluorescence. A thorough lavage and aspiration were done with bilaterally chest tube placement. The left chest tube output declined dramatically to 50 ml serous the next day. He was allowed on a regular diet, chest tubes were removed on day 4, and the patient was discharged uneventfully on day 5.

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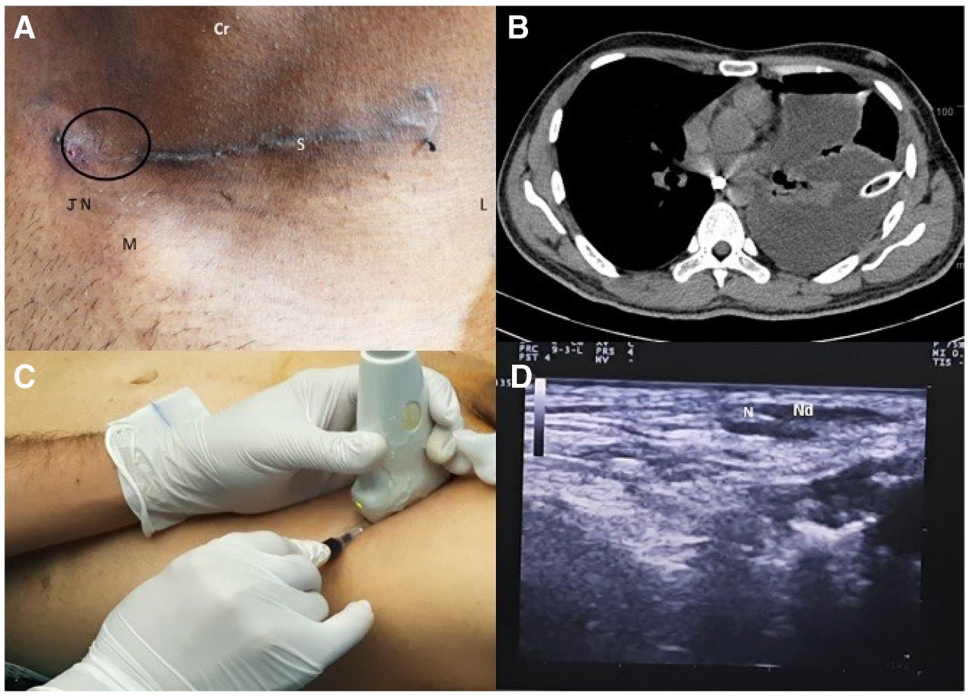


**Fig. 1** **A** Clinical photograph of left side of neck. Black circle indicates the site of penetration of sharp object in the neck just above jugular notch (JN), S and M represents the scar of previous surgery and medial end of left clavicle. Cr and L denote cranial and left side of the patient. **B** Axial cut section of plain CT chest demonstrating left side chylothorax with intercostal chest tube insitu, with compressive collapse of left lung. **C** Injection of ICG in inguinal node under sonographic guidance. **D** Sonographic image revealing needle tip (N) inside the inguinal node (Nd)

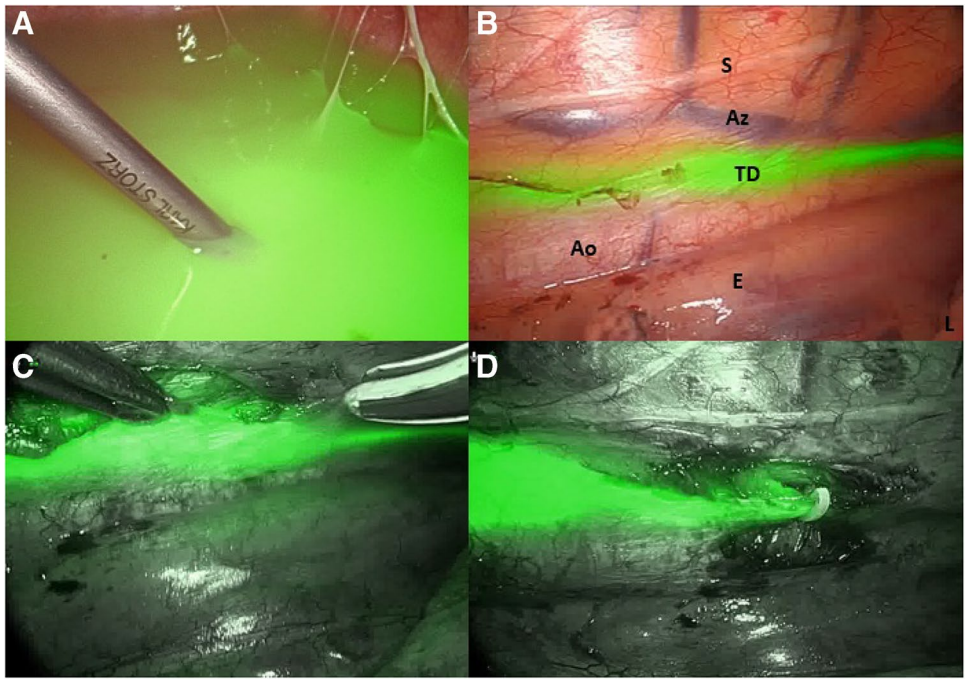


**Fig. 2** **A** Left thoracoscopic image in spy overlay mode with Stryker's 1688 AIM HD system showing fluorescent tinged chyle in the left thoracic cavity following a traumatic apical pleural membrane breach. **B** Right thoracoscopic pictures in overlay mode with the patient in semi-prone position depicting thoracic duct (TD) enhanced in green fluorescence and lying between Azygous vein (Az) and Descending aorta (Ao). Also seen here are the Thoracic Sympathetic Trunk (S), Esophagus (E), and Right Lung (L). **C** Real-time dissection of the thoracic duct for clipping in spy ENV mode. **D** Post clipping (In spy ENV mode) note the dilatation of proximal part of thoracic duct and collapse of its distal part

## Discussion

The NIR-ICG technology for the management of chylothorax is relatively new and evolving. Chang et al. used NIR fluorescence imaging with ICG to visualize and treat a chylous fistula in an unusual location in a 3-month-old infant with congenital heart disease with postoperative chylothorax [1]. Kaburagi et al. described the successful management of post-esophagectomy chylothorax by injecting ICG into the mesentery [2]. Few authors have used groin nodes to inject ICG under sonographic guidance, with TD successfully identified, even after repeat and failed surgeries [3, 4]. In comparison, bilateral subcutaneous groin and mesenteric injection were employed with varying success [5, 6].

NIR fluorescence imaging with ICG was used to identify and clip the thoracic duct in the case reported here. The intense fluorescence in the thoracic duct helped in identifying and clipping of duct. Also, ICG deposition in inguinal nodes provided a continuous fluorescence source for TD lymphography, at least for the initial few hours. ICG can quickly be injected in inguinal lymph nodes under ultrasound guidance with little training to master the technique. Usually, if ICG is injected at the time of induction of anesthesia, 10 to 20 min (taken for scrubbing, draping, and positioning the patient) will be sufficient for the dye to appear in the thoracic duct for TD lymphography. Surgeons need not wait for extra time for fluorescence to appear.

A special note is made of Fluorescein, a commonly used, low-priced fluorescent dye with wide applications in ophthalmology [7] and neurosurgical practices [8]. It has also been successfully utilized for sentinel node mapping in colorectal and breast malignancies [9, 10]. Early results from a randomized trial by Srivastava et al. showed similar detection rates for Fluorescein combined with methylene blue dye compared with the standard combination technique (radioisotope and methylene blue dye) in early breast cancer [11]. It is an attractive option for developing countries because of its low cost, easy availability, and established safety with low adverse reactions like ICG. It is directly visible to eyes with an ultraviolet blue light source needed to excite fluorescence. No special imaging systems are needed. However, there are few published papers on the subject, and further studies are needed to demonstrate its effectiveness and reproducibility and standardize the procedure.

## Conclusion

NIR fluorescence thoracic duct lymphography by inguinal nodal injection of ICG provides excellent, bright real-time intraoperative visualization of the thoracic duct. It is particularly beneficial in cases where recognizing the thoracic duct or chylous fistulous site is challenging, including redo surgeries, post-radiation cases, and pediatric procedures. The fluorescence usually lasts throughout the surgery.

### Declarations

**Ethics Approval and Consent to Participate** The study was approved by the ethics committee of the Basavatarakam Indo American Cancer Hospital and Research Institute and conformed to the provisions of the Declaration of Helsinki in 1995. Informed consent was obtained from the subject, and patients' anonymity is preserved.

**Conflict of Interest** The authors declare no competing interests.

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