CASE REPORT

Yellow nail syndrome with chylothorax after coronary artery bypass grafting

Sarah Waliany 1, Julia Chandler 2, David Hovsepian 3, Jack Boyd 4 and Natalie Lui 4,5 *

Abstract

Background: Yellow nail syndrome is a rare condition considered secondary to functional anomalies of lymphatic drainage. Yellow nail syndrome is diagnosed through the triad of intrathoracic findings (30% being pleural effusions), nail discoloration, and lymphedema, with any two features sufficient for diagnosis. We report the second case of post-operative yellow nail syndrome.

Case presentation: After coronary artery bypass grafting, our patient presented with chylothorax on post-operative day 13 and yellow toenail discoloration on post-operative day 28, diagnosing yellow nail syndrome. Initial conservative management with pigtail catheter drainage and low-fat diet with medium-chain triglycerides reduced chylous drainage from 350 mL/day on post-operative day 14 to <100 mL/day on post-operative day 17. However, by post-operative day 18, drainage returned to 350 mL/day that persisted despite attempts to readjust the catheter position, replacement of catheter with chest tube, and transition to total parenteral nutrition and octreotide while nil per os. Lymphangiogram on post-operative day 32 did not identify the thoracic duct or cisterna chyli, precluding embolization. Talc and doxycycline pleurodeses performed on post-operative days 33 and 38, respectively, resolved his chylothorax and nail discoloration.

Conclusions: Both yellow nail syndrome and chylothorax as a complication of coronary artery bypass grafting are rare entities. The proposed mechanism of post-operative chylothorax is iatrogenic injury to thoracic duct or collateral lymphatic vessels. Diagnosing yellow nail syndrome in patients with post-operative chylothorax (through co-existing yellow nail discoloration and/or lymphedema) may suggest predisposition to impaired lymphatic drainage, portending a difficult recovery and potentially indicating need for surgical management.

Keywords: Yellow nail syndrome, Coronary artery bypass grafting complications, Post-operative chylothorax

Background

Yellow nail syndrome (YNS) is a rare condition of unclear etiology considered secondary to functional anomalies of lymphatic drainage. YNS is characterized by the triad of nail changes, intrathoracic findings (30% being pleural effusions), and lymphedema, with only two of the triad elements required for diagnosis (typically nail discoloration with one of the other findings) [1]. Most cases of YNS have been associated with malignancies, especially lymphoma; autoimmune disorders; immunodeficiencies; endocrine diseases; and others. We report the second case, to our knowledge, of YNS associated with surgery; the first reported case of post-operative YNS was also diagnosed after coronary artery bypass grafting (CABG). We also review the literature on the 41 prior reported cases of chylothorax diagnosed after CABG.

Case presentation

A 62-year-old man with coronary artery disease underwent four-vessel CABG including left internal thoracic artery (ITA) to left anterior descending artery. The patient was discharged on postoperative day (POD) 6 after an uneventful postoperative course with low chest tube output and trace pleural effusions.

On POD 13, the patient was readmitted after four days of moderate chest pain and exertional dyspnea. Diminished respiratory sounds were noted over the full left
lung field. Chest radiograph confirmed a large left pleural effusion (Fig. 1). A left pigtail catheter drained 2.3 l of milky fluid with a triglyceride level of 1604 mg/dL, diagnosing chylothorax.

Conservative management was attempted with continued catheter drainage and initiation of a low-fat diet with medium-chain triglycerides on POD 14. Drainage gradually decreased over the next three days to < 100 ml/day, but by POD 18, drainage increased to 350 mL/day that continued for two days despite attempts to readjust the catheter position. On POD 20, the pigtail catheter was replaced with a chest tube, and the patient was transitioned to total parenteral nutrition (TPN) and octreotide while nil per os, but chest tube drainage persisted at 200–360 ml/day. On POD 28, the patient noted new, bilateral yellow toenail discoloration (Fig. 2). The yellow nail discoloration was not associated with any disfiguring features such as nail thickening or separation from nail bed. No lymphedema was found. Presence of yellow nails and chylothorax resulted in diagnosis of YNS.

Lymphangiogram on POD 32 noted well-opacified pelvic lymphatic channels, but cisterna chyli and thoracic duct were not identified (Fig. 3), precluding embolization. Tiny droplets of lipiodol were present in the left pleural space, but the leak location could not be identified.

On POD 33, thoracoscopic left pleurodesis was performed using aerosolized talc (4 g). Prior to talc administration, half-and-half (300 mL) was administered via nasogastric tube, but no chyle leak was found on thoracoscopic examination after two hours. Since lymphangiogram did not identify a thoracic duct, thoracic duct ligation was not attempted. Five days after pleurodesis, since chest tube output remained high (> 200–300 mL/day), doxycycline pleurodesis was performed via existing chest tube. Output subsequently decreased, allowing transition to low-fat diet seven days later and discharge home two days after that.

At 2- and 8-week follow-ups, chest radiograph showed trace pleural effusion with no recurrence of chylothorax. Although still on a low-fat diet at both visits, the patient was gradually increasing fat intake. Yellow toenail discoloration had resolved by the 8-week follow-up.

**Discussion**

YNS is diagnosed clinically through the triad of characteristic nail changes, intrathoracic findings (30% being pleural effusions), and lymphedema. Presence of any two features (typically nail discoloration with another finding) is sufficient for diagnosis [1], with the full triad observed in one-third of cases [2]. About 30% of YNS-associated pleural effusions are chylothoraces [3].

Since the first report in 1964 [4], fewer than 400 cases of YNS have been described in the literature. The etiology remains unknown, with prior associations including malignancies (especially lymphoma), immunodeficiency disorders, tuberculosis, diabetes mellitus, thyroid dysfunction, Guillan-Barré syndrome, and others. This is the second report of YNS associated
with surgery; the first reported case was also diagnosed after CABG [5].

Although debated, the pathophysiology of YNS is attributed to functional lymphatic defects, with lymphangiogram and lymphoscintigraphy findings of hypoplastic lymphatic vessels [4] and reduced lymphatic drainage in extremities [6]. Nail discoloration results from lipofuscin pigment from oxidation of lipid precursors in soft tissue lymph collections. The conditions associated with YNS are considered to be second insults causing functionally anomalous lymphatics to present clinically through intrathoracic findings, nail changes, and/or edema.

Our report indicates that traumatic disruption of lymphatic vessels may be another trigger causing functionally anomalous lymphatics to manifest clinically as YNS. Intra-operative damage to thoracic duct or other lymphatic tributaries may have overwhelmed the lymphatic network, causing accumulation of chyle in the pleural space as chylothorax and in lower extremity soft tissues manifesting as yellow nails. Although our patient did not have visible lymphedema, a previous study showed that patients with YNS without edema still had significantly reduced lymphatic drainage in lower extremities on lymphoscintigraphy compared with control patients [6]; this suggests that our patient’s lymph collection may have been sufficient to cause lipofuscin accumulation but not edema.

Post-CABG chylothorax is also rare, with 41 other reported cases (Table 1). The proposed mechanism is iatrogenic injury to the thoracic duct or collateral lymphatic vessels. A strong association exists with left ITA harvesting (involving 81.0% of the 42 cases including ours) due to close proximity between the left ITA origin and thoracic duct. Another risk factor is use of electrocautery during harvesting; due to low protein in lymph (compared with blood), electrocautery of lymphatics increases risk of leakage rather than achieving lymphostasis [7].

Management of post-operative chylothorax starts with conservative measures, including chest tube for effusion drainage. Efforts to decrease chyle production include a trial of low-fat diet with medium-chain triglycerides (absorbed directly into portal system) with transition to TPN and somatostatin or octreotide if output remains high [8]. Conservative management has failed if output exceeds 1 L/day for five days; drainage persists for more than fourteen days; or nutritional status declines. Of the 41 prior cases with post-CABG chylothorax, 26 (63.4%) succeeded with conservative management with all but one resolving in less than 30 days; the other 15 (36.6%) underwent surgery after a median (range) of 14 (3–78) days. In our patient’s case, conservative measures with pigtail catheter drainage and low-fat diet were initially successful at reducing chylous drainage during the first four days of management; however, drainage increased by the fifth day of management likely due to a malfunction of the catheter. Additional conservative measures (chest tube drainage, total parenteral nutrition, and octreotide while nil per os) were continued for an additional 14 days before attempting lymphangiogram; of the 26 reported post-CABG chylothoraces that resolved without surgical intervention, 14 (53.8%) required 14–28 days of conservative management before resolving (see Table 1).

When conservative management fails, thoracoscopic or open thoracic duct ligation with chemical pleurodesis can be done [9]. In chylothorax management at our medical center, it is institutional practice to start with lymphangiogram and minimally-invasive thoracic duct embolization before attempting surgical thoracic duct ligation as our Department of Interventional Radiology has a history of success with the less invasive procedure; in the event that duct embolization fails, lymphangiogram may guide future
| Reference          | Year | Sex | Age | Procedure       | L ITA | R ITA | Chylothorax site | POD | Outcome with conservative tx | Octreotide? | Surgical tx                               |
|--------------------|------|-----|-----|-----------------|-------|-------|------------------|-----|-----------------------------|-------------|------------------------------------------|
| Weber [10]         | 1981 | M   | 55  | CABG            | Yes   | No    | L & M            | 2   | Resolved after 12d          | No          | None                                     |
| Zakhour [11]       | 1981 | M   | 73  | CABG            | Yes   | No    | L                | 90  | Resolved after 21d          | No          | None                                     |
| Zakhour [11]       | 1981 | M   | 59  | CABG            | No    | No    | L & M            | 2   | Resolved after 5d           | No          | None                                     |
| Kshettry [12]      | 1981 | M   | 51  | CABG            | No    | No    | L                | 30  | Resolved after 4d           | No          | None                                     |
| Teba [13]          | 1985 | F   | 51  | CABG/MVR        | No    | No    | L                | 7   | Resolved after 17d          | No          | None                                     |
| Di Lello [14]      | 1987 | M   | 53  | CABG            | Yes   | No    | L                | 9   | Failed after 31d            | No          | L thoracotomy-fibrin glue               |
| Czarnecki [15]     | 1988 | F   | 61  | CABG            | Yes   | Yes   | R                | 42  | Failed after 10d            | No          | R thoracotomy-ligation at diaphragm     |
| Chaiyaroji [16]    | 1991 | F   | 69  | CABG            | Yes   | No    | L                | 6   | Failed after 18d            | No          | L thoracotomy-ligation at injury        |
| Inderbitzi [17]    | 1992 | M   | 69  | CABG/Redo UK    | Yes   | No    | UK & L           | 2   | Failed after 21d            | No          | Left VATS - fibrin glue                |
| Rogers [18]        | 1993 | M   | 41  | CABG            | Yes   | No    | L                | 1   | Failed after 35d            | No          | L thoracotomy-ligation at injury        |
| Janssen [19]       | 1994 | M   | 58  | CABG            | Yes   | No    | L                | 35  | Failed after 14d            | No          | L VATS-ligation at injury               |
| Davies [20]        | 1994 | M   | 48  | CABG            | Yes   | No    | L                | 21  | Resolved after 28d          | No          | None                                     |
| Wood [21]          | 1994 | M   | 69  | CABG            | Yes   | No    | L                | 3   | Failed after 7d             | No          | L VATS-ligation at injury               |
| Smith [22]         | 1994 | M   | 60  | CABG            | Yes   | No    | L                | 14  | Resolved after 15d          | No          | None                                     |
| Smith [22]         | 1994 | M   | 47  | CABG            | Yes   | No    | L                | 7   | Resolved after 14d          | No          | None                                     |
| Zaidenstein [23]   | 1996 | F   | 70  | CABG            | Yes   | No    | L                | 42  | Resolved after 16d          | No          | None                                     |
| Felz [24]          | 1997 | F   | 50  | CABG            | Yes   | No    | L                | 56  | Resolved after 59d          | No          | None                                     |
| Mohanty [25]       | 1998 | M   | 56  | CABG            | Yes   | No    | L                | 8   | Resolved after 22d          | No          | Attempted wiring of dehisced sternum on day 9 after diagnosis |
| Sharpe [26]        | 1999 | F   | 63  | CABG            | No    | No    | L & M            | 11  | Resolved after 14d          | No          | None                                     |
| Perez [27]         | 1999 | M   | 68  | CABG/AVR UK    | Yes   | No    | UK & L           | 10  | Resolved after 10d          | No          | None                                     |
| Pego-Fernandez [28]| 1999 | M   | 38  | CABG            | Yes   | No    | L                | 90  | Resolved after 17d          | No          | None                                     |
| Kelly [29]         | 2000 | M   | 77  | CABG            | Yes   | No    | L                | 18  | Resolved after 14d          | Yes         | None                                     |
| Fahimi [30]        | 2001 | M   | 49  | CABG            | Yes   | No    | L                | Yes | Failed after 14d            | No          | L VATS-fibrin glue                      |
| Fahimi [30]        | 2001 | M   | 51  | CABG            | Yes   | No    | L                | Yes | Failed after 14d            | No          | None                                     |
| Brancaccio [31]    | 2001 | M   | 64  | CABG            | Yes   | No    | L                | 6   | Resolved after 11d          | No          | None                                     |
| Abid [32]          | 2003 | M   | 58  | CABG            | Yes   | No    | L                | 3   | Failed after 8d             | No          | Talc slurry pleurodesis                 |
| Riquet [33]        | 2004 | F   | 59  | CABG            | Yes   | No    | L                | UK  | Failed after 78d            | No          | L thoracotomy-ligation at injury        |
| Gabbieri [34]      | 2004 | F   | 67  | CABG            | Yes   | No    | L                | 10  | Resolved after 28d          | No          | None                                     |
| Kilic [35]         | 2005 | F   | 66  | CABG            | Yes   | No    | L                | 12  | Resolved after 10d          | No          | None                                     |
| Falode [36]        | 2005 | F   | 68  | CABG/ASD        | Yes   | No    | L                | 3   | Failed after 60d            | No          | L VATS-dry talc pleurodesis            |
| Barbatakis [37]    | 2005 | M   | 78  | CABG            | Yes   | No    | L                | 27  | Resolved after 13d          | Yes         | None                                     |
| Halladorsson [38]  | 2006 | F   | 47  | CABG            | No    | No    | R                | 10  | Resolved after 10d          | No          | None                                     |
| Choong [39]        | 2006 | M   | 63  | CABG            | Yes   | No    | L                | 2   | Failed after 35d            | No          | R thoracotomy-ligation at diaphragm     |
| Narayan [40]       | 2007 | F   | 65  | CABG/MVR        | Yes   | No    | UK               | 1   | Failed after 3d             | Yes         | Median sternotomy-ligation at injury    |
An updated adaptation from Halldorsson [38] and Deguchi [43] ASD = Atrial Septal Defect repair, caused YNS to manifest clinically.

Although diagnosing YNS does not alter management, we propose that concurrence of chylothorax with yellow nails and/or lymphedema may suggest predisposition to impaired lymphatic drainage and serve as a marker of degree of lymphatic leakage, portending a difficult recovery course and potentially indicating the need for surgical intervention. As our patient’s case, the lymphangiogram guided the surgical team to attempt pleurodesis without thoracic duct ligation since the thoracic duct was not identified.

Although this is the second report, to our knowledge, of post-CABG yellow nail syndrome, it is possible that the other YNS features (yellow nails and lymphedema) have previously been missed in patients with post-CABG chylothorax since the findings are subtle. Other cases may have been misdiagnosed as fungal infections. In our patient’s case, the close temporal association between the development of chylothorax and appearance of yellow nail discoloration and the temporal proximity of their resolution were more consistent with YNS. Furthermore, the appearance of his nails was less consistent with onychomycosis. Other than yellow discoloration, his nails had no disfiguring features such as thickening, chipping, or separation from the nail bed; his nails also demonstrated a uniform yellow discoloration without black debris. Overall, the appearance of his nails was not consistent with any of the major subtypes of onychomycosis (such as distal and lateral subungual; proximal subungual; endonyx subungual; superficial; or total dystrophic onychomycosis) [10].

Although diagnosing YNS does not alter management, we propose that concurrence of chylothorax with yellow nails and/or lymphedema may suggest predisposition to impaired lymphatic drainage and serve as a marker of degree of lymphatic leakage, portending a difficult recovery course and potentially indicating need for surgical intervention. As our patient’s recovery was challenging (failing conservative treatment and requiring both talc and doxycycline pleurodeses), it is possible that he had a lymphatic aberrancy predisposing to YNS, with intraoperative thoracic duct injury serving as the second insult that caused YNS to manifest clinically.

### Table 1
Reported cases of chylothorax diagnosed after coronary artery bypass grafting (Continued)

| Reference     | Year | Sex | Age | Procedure | L ITA | R ITA | Chylothorax site | POD | Outcome with conservative tx | Octreotide? | Surgical tx                  |
|---------------|------|-----|-----|-----------|-------|-------|------------------|-----|-----------------------------|-------------|----------------------------|
| Paul [41]     | 2009 | M   | 65  | CABG      | UK    | UK    | L                | UK | Failed after 14d            |             | Thoracotomy-thoracic duct ligation |
| Karimi [42]   | 2010 | M   | 53  | CABG      | Yes   | No    | L                | 2  | Resolved after 27d          |             | None                          |
| Deguchi [43]  | 2013 | F   | 78  | CABG      | Yes   | Yes   | R                | 3  | Failed after 10d            |             | Median sternotomy-ligation at injury |
| Altun [44]    | 2015 | M   | 60  | CABG      | Yes   | No    | UK               | 2  | Resolved after 13d          |             | None                          |
| Altun [44]    | 2015 | M   | 46  | CABG      | Yes   | No    | UK               | 3  | Resolved after 14d          |             | None                          |
| Owais [45]    | 2015 | F   | 76  | CABG      | Yes   | No    | L                | 15 | Resolved after 7d           |             | None                          |
| Sabzi [7]     | 2017 | M   | 43  | CABG      | Yes   | No    | L                | 0  | Resolved after 10d          |             | None                          |

**Abbreviations:** M = Male, F = Female, ITA = internal thoracic artery, L = Left, R = Right, M = Mediastinum, UK = Unknown, POD = “post-operative day” when chylothorax was diagnosed, d = days, tx = treatment, CABG = coronary artery bypass graft, MVR = mitral valve replacement, AVR = Aortic Valve Replacement, ASD = Atrial Septal Defect repair, VATS = video-assisted thoracoscopic surgery

surgical measures. In our patient’s case, the lymphangiogram guided the surgical team to attempt pleurodesis without thoracic duct ligation since the thoracic duct was not identified.

Although this is the second report, to our knowledge, of post-CABG yellow nail syndrome, it is possible that the other YNS features (yellow nails and lymphedema) have previously been missed in patients with post-CABG chylothorax since the findings are subtle. Other cases may have been misdiagnosed as fungal infections. In our patient’s case, the close temporal association between the development of chylothorax and appearance of yellow nail discoloration and the temporal proximity of their resolution were more consistent with YNS. Furthermore, the appearance of his nails was less consistent with onychomycosis. Other than yellow discoloration, his nails had no disfiguring features such as thickening, chipping, or separation from the nail bed; his nails also demonstrated a uniform yellow discoloration without black debris. Overall, the appearance of his nails was not consistent with any of the major subtypes of onychomycosis (such as distal and lateral subungual; proximal subungual; endonyx subungual; superficial; or total dystrophic onychomycosis) [10].

Although diagnosing YNS does not alter management, we propose that concurrence of chylothorax with yellow nails and/or lymphedema may suggest predisposition to impaired lymphatic drainage and serve as a marker of degree of lymphatic leakage, portending a difficult recovery course and potentially indicating need for surgical intervention. As our patient’s recovery was challenging (failing conservative treatment and requiring both talc and doxycycline pleurodeses), it is possible that he had a lymphatic aberrancy predisposing to YNS, with intraoperative thoracic duct injury serving as the second insult that caused YNS to manifest clinically.

### Conclusions
Chylothorax as a complication of coronary artery bypass grafting is rare, with the most likely mechanism being iatrogenic injury to the thoracic duct or collateral lymphatic vessels. During management of post-operative chylothorax, diagnosis of yellow nail syndrome (through concurrent presence of yellow nail discoloration and/or lymphedema) may suggest a predisposition to impaired lymphatic drainage, potentially indicating the need for surgical management.

**Abbreviations**
CABG: Coronary artery bypass grafting; ITA: Internal thoracic artery; POD: Post-operative day; TPN: Total parenteral nutrition; YNS: Yellow nail syndrome

**Authors’ contributions**
All authors were involved in patient care. SW, JC, and NL participated in manuscript preparation. All authors participated in manuscript revisions and approved the final manuscript.

**Ethics approval and consent to participate**
Not applicable.

**Consent for publication**
We have obtained written consent from the patient to publish the medical data in this case report.

**Competing interests**
The authors declare that they have no competing interests.

**Publisher’s Note**
Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

**Author details**
1Stanford University School of Medicine, Stanford, CA, USA. 2Department of Surgery, Stanford University School of Medicine, Stanford, CA, USA. 3Department of Interventional Radiology, Stanford University School of Medicine, Stanford, CA, USA. 4Department of Cardiothoracic Surgery, Stanford University School of Medicine, Stanford, CA, USA. 5Department of Cardiothoracic Surgery, Division of Thoracic Surgery, Stanford University School of Medicine, Stanford, CA, USA.
References
1. Hiller E, Rosenow EC, Olsen AM. Pulmonary manifestations of the yellow nail syndrome. Chest. 1972;61(5):452–8.
2. Emser PA. Yellow nails, lymphoedema, and pleural effusions. Thorax. 1966;21(3):247–53.
3. Maldonado F, Toczalaar HD, Wang CW, Ryu JH. Yellow nail syndrome: analysis of 41 consecutive patients. Chest. 2008;134(2):375–81.
4. Samman PD, White WF. The "yellow nail" syndrome. Br J Dermatol. 1964;76:153–7.

Received: 11 June 2018  Accepted: 30 August 2018
Published online: 11 September 2018