Case Series

# Imaging Findings in Acute Neck Infection due to Pyriform Sinus Fistula

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## Abstract

**Introduction: Pyriform sinus fistula is a congenital branchial pouch abnormality that is often overlooked as a cause of acute neck infection in children. Our aim is to demonstrate the value of various imaging modalities (ultrasound, computed tomography [CT], barium oesophagraphy) in its diagnosis. Materials and Methods: The preoperative imaging findings of 5 patients with surgically proven pyriform sinus fistula who presented with acute neck infection between September 2001 and March 2003 were retrospectively reviewed. CT was performed in all patients, 4 patients had barium oesophagraphy and 3 had an ultrasound scan. Results: All 5 patients suffered from upper respiratory tract infection within a week of developing a tender swelling on the left side of the neck. Four patients had a history of recurrent neck infections. CT depicted inflammation of the left perithyroid soft tissue and adjacent left thyroid lobe in every case. In 2 cases, CT demonstrated the presence of a pyriform sinus fistula. Ultrasound, performed in 3 patients, correlated strongly with the CT findings. It also showed gas within a fistula in 1 case. Barium oesophagraphy clearly delineated the fistula in 3 out of 4 cases. Conclusion: Ultrasound and CT accurately showed the presence of acute neck infection and could demonstrate the pyriform sinus fistula. Barium oesophagraphy most clearly depicted the presence and course of the fistula. Recurrent left-sided neck infection in a child should alert the physician to the possibility of an underlying pyriform sinus fistula and imaging should be performed to confirm its presence.**


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**Key words: Abscess, Barium sulphate, Branchial region, Infection, Thyroiditis**

## Introduction

Pyriform sinus fistula is a developmental abnormality of the 3rd or 4th branchial pouch. It usually presents in childhood as acute inflammatory swelling of the neck and frequently involves the thyroid gland. Prompt surgical treatment of pyriform sinus fistula is essential so that recurrent infections can be prevented. Barium oesophagraphy, ultrasound and computed tomography (CT) are commonly utilised to attain the diagnosis.

We present the preoperative imaging findings of 5 cases of pyriform sinus fistula complicated by acute infection that were treated at KK Women's and Children's Hospital, Singapore.

## Materials and Methods

Patients treated for acute inflammation of the neck at KK Women's and Children's Hospital who had surgically proven pyriform sinus fistula between September 2001 and March 2003 were included. Relevant clinical details were also obtained. There were 5 patients, 3 male and 2 female, whose ages ranged from 8 to 12 years.

Ultrasound was performed in 3 patients with a 10 MHz linear transducer (ATL HDI 3000 Bothwell, Washington, WA). All 5 patients had a helical CT scan (PQ 5000; Picker International, Cleveland, Ohio) of which 2 patients ingested dilute barium sulphate (EZ–HD; E-Z–Em, Westbury, NY) prior to the study. Barium oesophagraphy was performed in 4 patients.

The preoperative hardcopy images were retrospectively evaluated by 2 radiologists in consensus. The features that were assessed on ultrasound include: hypoechoic appearance of the soft tissue due to inflammation, effacement of the plane between the thyroid gland and perithyroid soft tissue representing thyroid gland

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inflammation, hypoechoic collection with thick wall due to abscess formation and the presence of gas pockets delineating the fistula. For CT images, the following imaging features were recorded: side of the lesion, the presence of soft tissue enhancement due to inflammation, the presence of a low-density fluid collection with peripheral enhancement representing an abscess, depiction of the fistula by gas pockets or barium (where applicable), distortion of the pyriform sinus, involvement of the thyroid gland as evidenced by reduction in the intrinsic high thyroid gland density and tracheal narrowing. On barium oesophagraphy, the presence of a fistula arising from the pyriform sinus, its origin in relation to the pyriform sinus and its course in the neck were evaluated.

## Results

All patients presented with fever, left-sided neck pain, skin erythema and swelling. They all had symptoms of upper respiratory tract infection ranging from 2 to 7 days prior to presentation and 4 patients had bouts of left-sided neck swelling in the past. Three patients complained of odynaphagia and 2 had hoarseness of voice. None had difficulty in breathing.

The imaging findings are summarised in Table 1.

Ultrasound of the neck, obtained in 3 patients, revealed hypoechoic appearance of the left perithyroid soft tissue and effacement of the intervening plane with the adjacent left thyroid lobe in all cases. Frank abscess was identified in 2 patients, 1 in the upper and 1 in the lower pole of the left thyroid lobe (Fig. 1). These findings were confirmed on subsequent CT. One study did not show a discrete abscess, although air pockets in a linear distribution were detected within the fistula (Fig. 2).

Table 1. Appearance of Neck Infection due to Pyriform Sinus Fistula

| Imaging findings | No. |
|---|---|
| Ultrasound | n = 3 |
| Perithyroid soft tissue inflammation | 3 |
| Effacement of plane between perithyroid soft tissue and thyroid gland | 3 |
| Abscess | 2 |
| Fistula demonstrated | 1 |
| Computed tomography | n = 5 |
| Left-sided lesion | 5 |
| Soft tissue enhancement | 5 |
| Reduced density of thyroid gland | 5 |
| Abscess | 4 |
| Pyriform sinus deformity | 4 |
| Fistula demonstrated | 2 |
| Tracheal narrowing | 0 |
| Barium oesophagraphy | n = 4 |
| Fistula demonstrated | 3 |

CT scan was performed in all 5 patients. In all cases, there was left perithyroid soft tissue swelling and increase enhancement together with reduced definition and loss of the normal high density of the adjacent left thyroid lobe (Fig. 3). Four patients had abscess that involved both the left thyroid lobe and surrounding perithyroid soft tissue (Fig. 4). Gas pockets were detected in 3 patients, which in 1 case, had a linear distribution and communicated with the left pyriform sinus (Fig. 5). The CT findings in this particular case were deemed diagnostic of a pyriform sinus fistula and the patient was not given a barium oesophagram. The fistula was successfully delineated in 1 of the 2 patients who swallowed barium sulphate prior to the scan (Fig. 6). The left pyriform sinus was deformed and the trachea deviated to the right in 4 patients. None had significant tracheal narrowing.

Barium oesophagraphy was performed in 4 patients. A linear, antero-inferiorly oriented tract arising from the apex of the left pyriform sinus was demonstrated in 3 patients (Fig. 7). In the 4th patient, the fistula was not visualised despite the procedure being performed 2 weeks after the initial episode, when the neck swelling had resolved.

All patient were treated with antibiotics. Ligation of the fistula was performed in 2 patients and resections in 3 patients. Surgical treatment was performed within 5 days of admission in 3 cases. Elective surgery was performed in the remaining 2 patients at 6 and 15 weeks after the acute infection.

## Discussion

Acute neck infection due to pyriform sinus fistula commonly occurs in children with a male to female ratio of 10 to 7.[1] The fistula originates from the pyriform sinus, courses antero-inferiorly and ends blindly in the parenchyma of the thyroid gland or in the perithyroid soft tissue.[2] It tends to become infected after a bout of upper respiratory tract infection which is attributed to the accumulation of contaminated secretions in the pharynx and fistulous tract. Suppurative thyroiditis or neck abscesses can develop depending on the course of the sinus tract.[3,4] Gas pockets occurring within the soft tissue inflammation have several possible sources. The gas may originate from the pyriform sinus via the fistula, from an external cutaneous drainage or from gas-forming bacilli.

Embryologically, the 3rd and 4th pharyngeal pouches form the pyriform sinus. The dorsal component of the 3rd pouch forms the inferior parathyroid gland while the ventral component becomes the thymus. The thymus becomes attached to the aortic arch, which migrates caudally with the developing heart. This accounts for the 3rd pouch parathyroid gland lying inferior to its partner derived from the 4th pouch. In addition, the 4th pouch fuses with the

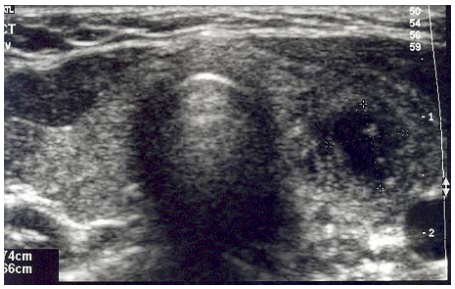

Fig. 1. Transverse ultrasound image of the thyroid gland shows abscess involving the left lobe and adjacent perithyroid soft tissue.

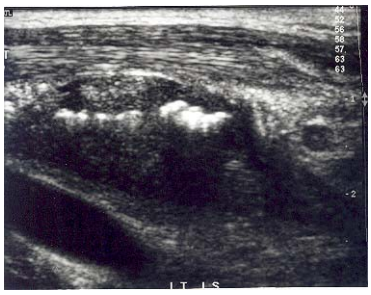

Fig. 2. Sagittal ultrasound image of the left perithyroid region shows hyperechoic gas pockets within the pyriform sinus fistula.

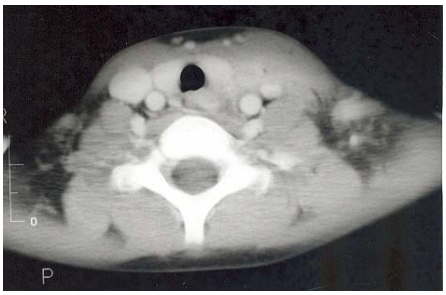

Fig. 3. Contrast enhanced axial computed tomographic image scan shows increased enhancement and swelling of the left perithyroid soft tissue, together with loss of the normal high attenuation and ill definition of the adjacent left thyroid lobe.

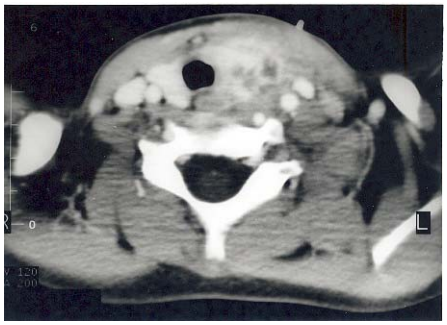

Fig. 4. Contrast enhanced axial computed tomographic image shows abscesses involving the left thyroid lobe and adjacent perithyroid soft tissue. There is deviation of the trachea to the right.

Fig. 5a.

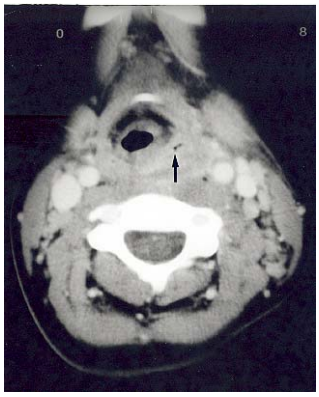

Fig. 5b.

Fig. 5. Contrast enhanced axial computed tomographic images of gas in the left pyriform sinus fistula.
Fig. 5a. A tract is shown arising from the left pyriform sinus.
Fig. 5b. Section inferior to Figure 5a shows gas within the pyriform sinus fistula.

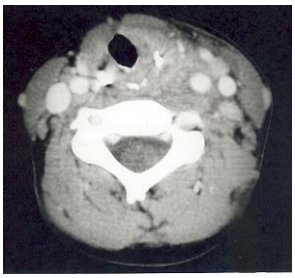

Fig. 6a.

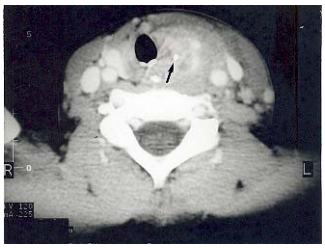

Fig. 6b.

Fig. 6. Contrast enhanced axial computed tomographic images after swallowing dilute barium sulphate.
Fig. 6a. Contrast present in both pyriform sinuses with associated streak artifacts. There is a small amount of contrast in the trachea due to mild aspiration.
Fig. 6b. Section inferior to Figure 6a shows contrast in the left pyriform sinus fistula. There is a left perithyroid abscess present.

Fig. 7a.

Fig. 7b.

Fig. 7. Barium oesophagraphy appearance of left pyriform sinus fistula.
Fig. 7a. Single contrast oblique image shows fistula arising from the left pyriform sinus, directed antero-inferiorly.
Fig. 7b. Double contrast oblique image confirms fistula arising from the apex of the left pyriform sinus.

corresponding lobe of the thyroid gland, preventing caudal migration of the 4th pouch structures. The 2 pouches are connected to the pharynx via a pharyngo-branchial duct that ruptures during development and rarely persists. Both ducts drain into the pyriform sinus and the persistence of a duct results in the formation of a fistula. A fistula originating from the 3rd pouch courses superior to the superior laryngeal nerve and posterior to the common carotid artery, draining anterior to the fold formed by the internal laryngeal nerve. A fistula originating from the 4th pouch passes between the superior and recurrent laryngeal nerves, draining posterior to the fold formed by the internal laryngeal nerve.[5] The left 4th branchial arch forms part of the aortic arch and the right one forms the right subclavian artery. It is postulated that the asymmetrical development of the 4th branchial arches accounts for the abnormality being predominantly left-sided.[6]

Patients with this condition often have a history of repeated upper respiratory tract infection and sore throat. Pain and tenderness of the thyroid gland with or without suppuration is common. The whole thyroid gland may be firm and tender but the primary focus of infection is often the left lobe. With suppuration and enlargement of the mass, the skin becomes erythematous and warm. Hoarseness of the voice is frequently present but significant airway obstruction is uncommon. Swallowing may be painful with the head held preferentially in extension and the patient is typically euthyroid.[7] Differential diagnoses include lymphadenitis, cystic hygroma, atypical thyroglossal duct remnant, thymic cyst, ectopic thyroid, lymphoma, haemangioma and carotid body tumour.[8]

The thyroid gland is resistant to infection due to its rich blood supply, abundant lymphatic drainage, fibrous capsule and high iodine content.[9] Therefore, the finding of acute suppurative thyroiditis, particularly if recurrent and left-sided, should prompt a search for an underlying pyriform sinus fistula.

Ultrasound is often the initial modality used in the assessment of a neck mass in children. An abscess is seen as an ill-defined, hypoechoic, heterogeneous mass with internal debris. Internal septae and gas pockets may also be present. If the thyroid gland is involved, the plane between the gland and the adjacent soft tissue is obliterated. Adjacent inflammatory lymph nodes may also be identified.[10] Identification of the fistulous tract has been demonstrated on ultrasound, using the trumpet manoeuvre. This entails getting the patient to exhale against pursed lips in order to distend the pyriform sinus. Ultrasound of the neck is simultaneously performed, looking for gas bubbles coursing through the sinus tract into the abscess cavity.[6]

CT shows abnormal soft tissue swelling with enhancement along the course of the tract, deformation of the pyriform fossa due to adjacent soft tissue swelling, cutaneous opening in the neck, frank abscess and gas along the course of inflammation. Involvement of the thyroid gland manifests as swelling, poor definition of its margins and loss of the intrinsically high attenuation of the affected lobe. MRI has been used in the imaging of this condition but CT is considered sufficient. In addition, CT better detects gas in the tract and has better resolution compared to MRI.[9]

Various methods have been used to delineate the anomalous tract on CT. An air pharyngogram technique has been employed and requires the patient to drink a carbonated beverage prior to the scan. When the patient lies supine during the procedure, gas in the pharynx enters the tract and courses anteroinferiorly from the apex of the pyriform sinus towards the thyroid gland.[2] A similar result may be obtained by utilising the trumpet manoeuvre at the time of scanning, but this is difficult to perform in children.[11] A 3rd method involves drinking barium prior to the scan to outline the tract.[12] We attempted the 3rd method in 2 patients and were successful in delineating the tract in 1 case.

The anomalous tract is most clearly depicted by barium oesophagraphy. However, false negatives can occur due to soft tissue oedema in the acute phase. The oedema causes closure of the tract, precluding its opacification with contrast material. In such a situation, a repeat barium oesophagram should be performed after resolution of the acute infection.[7]

## Conclusion

The differential diagnosis of a child with acute neck swelling is varied and the presence of an underlying pyriform sinus fistula is often overlooked, resulting in recurrent infections. A history of preceding upper respiratory tract infection and recurrent left-sided neck infection should alert the physician to its presence. Ultrasound and CT demonstrate neck infections well and can depict the presence of a fistula. Barium oesophagraphy helps to confirm the presence of the pyriform sinus fistula and delineates its extent prior to surgical treatment.

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