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## Case Report

# External auditory canal involvement by nasopharyngeal carcinoma via eustachian tube spread: A case report <sup>☆,☆☆,★</sup>

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## ABSTRACT

We present the imaging findings of a 44-year-old female patient who was diagnosed with nasopharyngeal carcinoma (NPC) extending from the nasopharynx to the external auditory canal (EAC) through the Eustachian tube (ET). The patient presented with a left neck submandibular lump on initial presentation that showed NPC upon fine needle aspiration, leading to chemoradiotherapy. Despite treatment, the patient experienced multiple relapses and later presented with aural symptoms, including left ear pain, foul-smelling drainage, and trismus on recurrence, and was subsequently diagnosed through biopsy. CT, MRI, and PET-CT scans revealed an extensive infiltrative nasopharyngeal mass extending into the left ET, involving the EAC. This rare case highlights the importance of considering the extension of NPC into the EAC as a potential etiology in patients who present with aural symptoms.

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<sup>☆☆</sup> External presentation of a nasopharyngeal carcinoma meandering through the Eustachian tube, middle ear and into the external auditory canal.

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## Introduction

Nasopharyngeal carcinoma (NPC) is a malignant tumor that arises from the epithelial lining of the nasopharynx. NPC is a relatively uncommon cancer worldwide, with incidence rates of less than 1 case per 100,000 cancer cases [1]. However, it is more prevalent in specific regions, such as South-east China, and notably in Hong Kong [2,3]. Most patients with NPC present with a neck lump (75%-85%) [4]. Other manifestations may include aural symptoms such as ear fullness, hearing loss, ear pain; nasal symptoms such as discharge, bleeding, and obstruction [4]; as well as head pain, weight loss, or diplopia [5]. NPC usually originates from the lateral wall of the nasopharynx, which includes the fossa of Rosenmüller, and does not usually present with external auditory canal (EAC) and middle ear involvement. The only previously reported cases of rare spread via the Eustachian tube (ET) to the middle and external ear were associated with recurrence after radical treatment or advanced skull base erosion [6–8]. We present a patient who presented with auditory symptoms and trismus and received antibiotic treatment but whose symptoms remained unresolved. The patient was then diagnosed with an NPC extending from the nasopharynx to the EAC via the ET without any skull base erosion. EAC involvement was demonstrated using magnetic resonance imaging (MRI) and positron emission tomography-computed tomography (PET-CT), and was biopsy proven.

## Case presentation

In 1999, at the age of 44 years, a never-smoker and never-drinker female patient presented with a left neck submandibular lump. The patient had no past medical history, surgical history, or family history. Physical examination was unremarkable, with no evidence of thyromegaly or lymphadenopathy. Fine needle aspiration (FNA) biopsy of the lump showed nodal spread of NPC, and the patient was treated with cisplatin-based chemotherapy and radiation. At the age of 49 years, the patient re-presented with right neck pain and underwent a modified right neck dissection, with pathology revealing nodal and soft tissue involvement by poorly differentiated squamous cell carcinoma. She completed postoperative chemotherapy and was followed up by annual CT scans and nasopharyngolaryngoscopy, without evidence of recurrence. Four years later she developed a left neck mass and was re-treated with chemoradiation.

She remained recurrence free for another 5 years, but then developed left ear pain and drainage, and was noted to have a large left nasopharyngeal mass on endoscopy. Biopsy showed keratinizing verrucoid papillary well-differentiated squamous cell carcinoma. A CT scan confirmed a 3.6 cm left nasopharyngeal mass with obliteration of the parapharyngeal fat on the left side, extending to the left glenoid fossa and into the Eustachian tube opening, and left neck level IA and IIA enlarged lymph nodes. There was no clival bone invasion. She continued to have left ear pain, drainage, and worsening trismus. The patient underwent an audiology examination, which re-

vealed moderately severe to profound mixed hearing loss with a conductive component in the left ear. Tumor was visualized grossly on physical exam extending into the left external auditory canal.

The patient then had MRI and PET-CT scans with concern for residual or recurrent tumor. On MRI there was a large, extensive infiltrative nasopharyngeal mass with significant involvement of the left parapharyngeal, parotid, and, to a lesser extent, the masticator spaces, with direct extension into the left Eustachian tube, nasopharynx, superior oropharynx, and involvement of left V3 and the skull base, including the clivus, left greater wing of the sphenoid, and left pterygoid plate (Fig. 1). Cervical lymphadenopathy was again noted. PET-CT revealed intense FDG uptake of the mass extending to the prestyloid space and periarticular region and enlarged nodal metastases (Fig. 2).

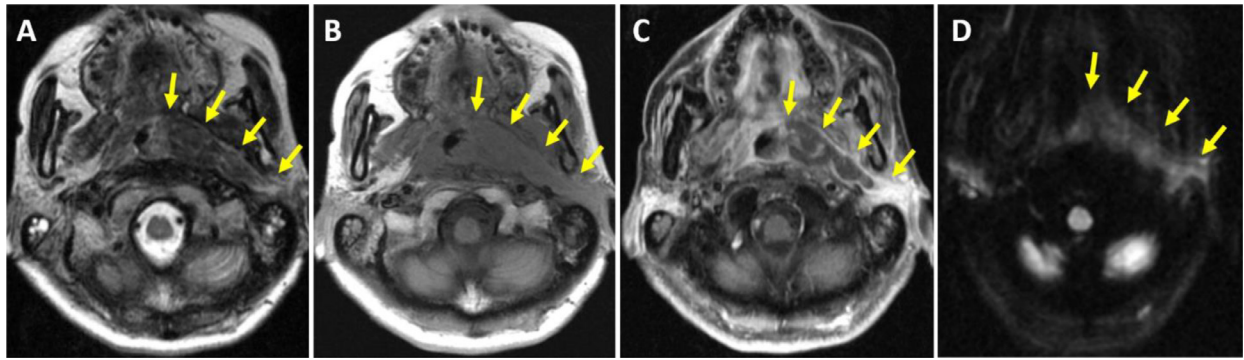
At this stage the patient was not a candidate for repeat radiation therapy as she previously had definitive radiation therapy with evidence of significant postradiation fibrosis in her neck, indicating that further radiation might cause significant toxicity. The patient was therefore started on 6 cycles of induction chemotherapy with a 3-drug regimen (carboplatin, paclitaxel, and cetuximab). Two weeks after starting the treatment, the patient showed improvement in symptoms and physical exam, with some disease in the left palatine tonsillar area and mucosal abnormality that had improved. Clinically, there was decreased swelling in the left external auditory canal with the ruptured tympanic membrane now visible, and less trismus.

Two months later, the patient had a contrast CT scan, revealing ill-defined soft tissue thickening within the posterior left nasopharynx corresponding to the known NPC with extension to the left parapharyngeal, prestyloid, and masticator spaces. It appeared the amount of soft tissue bulk might have slightly decreased in size.

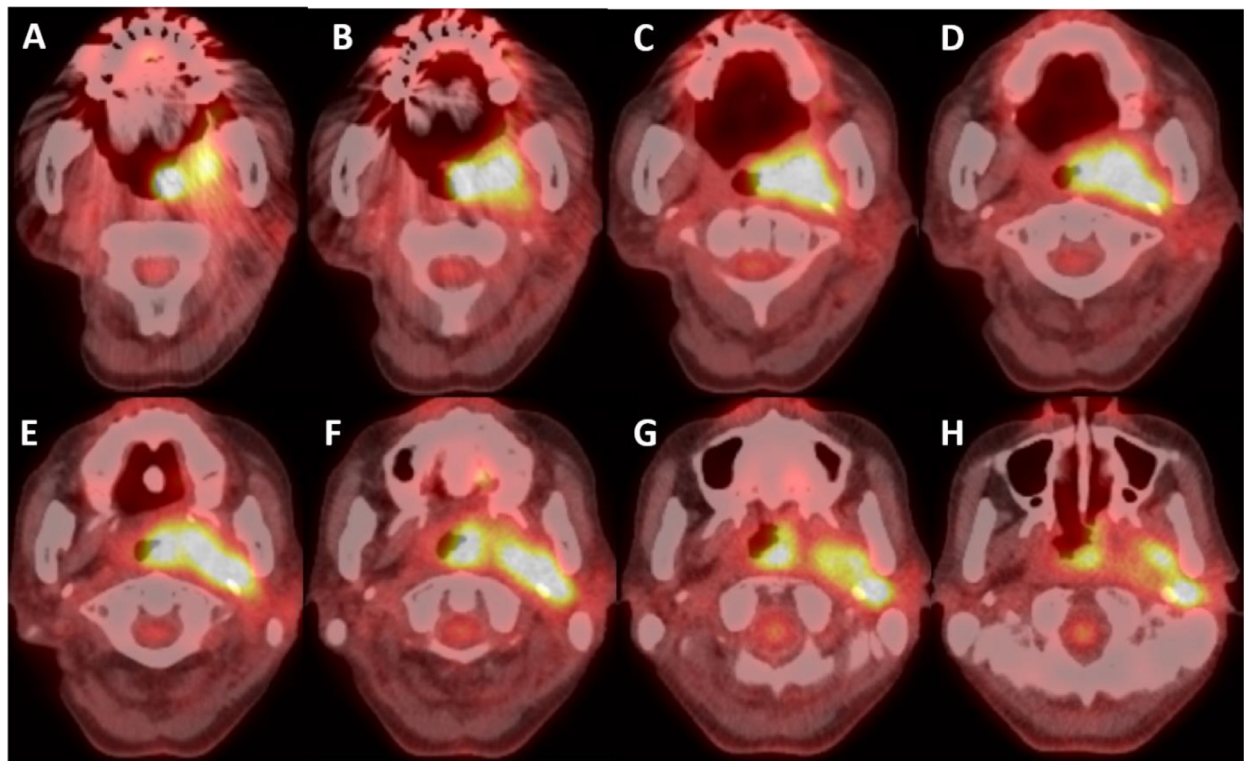
Now at the age of 59 years, the patient finished 12 cycles of the 3-drug regimen. Later on, she had debridement of crusts from the tumor area, and was started on maintenance cetuximab every 2 weeks following a good response to the 3-drug regimen for recurrent disease.

At the age of 62 years, she returned and had a surgical debridement of the NPC area. The biopsy showed only inflammatory tissue and no evidence of residual or recurrent carcinoma in the left external auditory canal. However, PET-CT showed hypermetabolic activity within the left posterior nasopharynx and Eustachian tube (Fig. 3), and multiple other cervical lymph nodes were grossly stable. There was also increased hyperactivity in the right posterior nasopharynx and increased right posterior larynx compared to previous PET-CT imaging, which was concerning for progressive disease. On MRI, there was subtle ill-defined submucosal enhancement at the level of the right true vocal cord, possibly corresponding to the area of FDG uptake on the PET-CT. On endoscopy, there were 2 new small tumor nodules on the epiglottis. Hence, the patient was restarted on systemic chemotherapy with cetuximab, paclitaxel, and carboplatin.

Further MRI and CT scans of the temporal bones were obtained 5 months later. On MRI, there was an enhancing infiltrative lesion in the left nasopharynx contiguously extending along the left Eustachian tube to the left middle ear and external auditory canal (Fig. 4). There was mild asymmetric thick-



**Fig. 1** – Representative axial T2-weighted (A), T1-weighted (B), postcontrast T1-weighted (C), and diffusion weighted (D) MR images show extensive infiltrative left nasopharyngeal mass (arrows) that slightly cross the midline and on multiple images is seen to involve the left oropharynx, and left parapharyngeal, parotid, and masticator spaces. There is also involvement of left V3 nerve and the skull base, including the clivus, left greater wing of the sphenoid, and left pterygoid plate (not shown here).



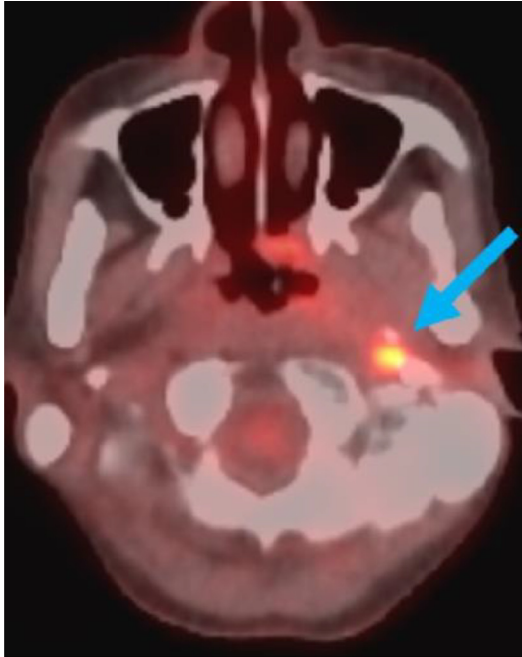
**Fig. 2** – Axial PET-CT (sequential inferior to superior slices: A to H) of the head and neck shows intense FDG uptake of the left nasopharyngeal mass in a similar distribution to MRI findings in [Fig. 1](#).

ening and enhancement of V3 on the left, raising concern for possible perineural spread. On CT of the temporal bones, there was near complete opacification of the left mastoid, middle ear cavity, and external auditory canal ([Fig. 5](#)). There was no appreciable bony erosion of middle ear ossicles or the external auditory canal, and minimal destruction of the scutum.

Another nasal endoscopy with debridement was done 3 months later, revealing choanal stenosis on both sides, left greater than right. There was significant crusting of the nasopharynx on both sides, which was debrided. The patient passed away a year later at the age of 65 years.

## Discussion

Direct extension of NPC into the middle ear or EAC via the ET has been previously reported but is a rare metastatic route of spread [9,10]. The exact cause for this rarity remains unclear, but it is likely related to the relatively resistant nature of cartilage to neoplastic growth [11]. In an MRI series involving 102 cases of NPC, only 13 cases showed NPC invasion of the main body of the cartilaginous ET, and none showed invasion into the lumen of the bony ET, middle ear, or inner ear [9]. Among



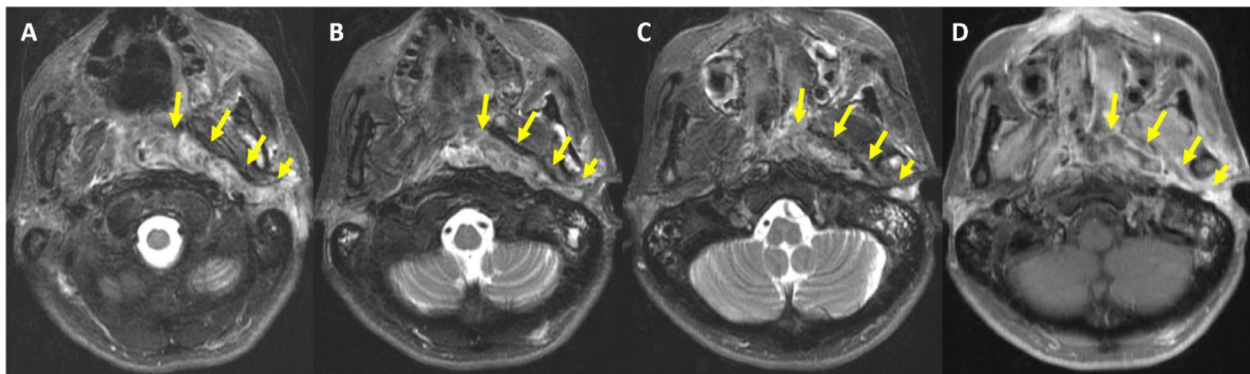
**Fig. 3 – Axial PET-CT shows hypermetabolic activity within the left posterior nasopharynx and Eustachian tube (arrow).**

the cases reported in the English literature, 6 cases showed NPC invasion into the middle ear or EAC, and they were mostly recurrences following primary treatment with radical chemoradiotherapy [6,7,12–14]. Beyond the English literature, a case series written in Chinese included 9 NPC patients with tumor growth in the EAC, with 3 cases identified at initial diagnosis and 6 occurring during recurrence [15]. Moreover, 2 NPC cases with middle and external ear involvements through the ET have been reported by Satar et al. [16] in Turkish, and a case series of 3 patients among 214 having NPC with middle ear invasion via the ET was reported by Çuhruk et al. also in Turkey [17].

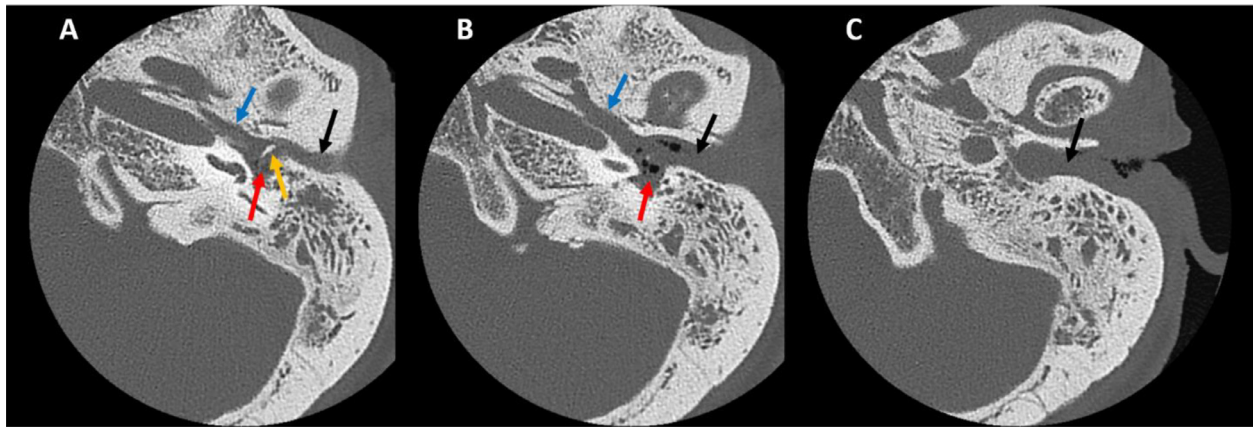
NPC tends to invade adjacent structures and can spread anteriorly, laterally, posteriorly, superiorly, and inferiorly. An-

teriorly, NPC can extend into the nasal cavity and paranasal sinuses, leading to nasal symptoms such as obstruction, epistaxis, and sinusitis. It can result in erosion of the nasal and infratemporal walls of the maxillary sinus and potentially infiltrate the pterygopalatine fossa via the sphenopalatine foramen. From there, it may progress into the middle cranial fossa through structures such as the inferior orbital fissure, optic canal, and superior orbital fissure, eventually reaching as far as the cavernous sinus. Additionally, it can invade the anterior cranial fossa through the ethmoid sinus and cribriform plate. Laterally, there can be an effacement of the fat-filled parapharyngeal space with further spread into the masticator space, as the pharyngeal wall around the ET offers little resistance. Infiltration of medial and lateral pterygoid muscles results in trismus [6,18]. Lateral spread can cause the sensation of ear blockage, serous otitis media, and hearing loss, as well as tinnitus. Posteriorly, it can involve the prevertebral muscles, especially the longus colli. Superiorly, it can spread to the base of the skull and cause skull base erosion and destruction. NPC can spread through foramen lacerum, subsequently invading the skull base and middle cranial fossa or entering the middle cranial fossa through foramen ovale. It may invade the posterior cranial fossa through the jugular fossa, and may cause cranial nerve palsies [6]. Inferiorly, it can spread along the pharyngeal muscles, extending to the oropharynx, and may be responsible for trismus or causing dysphagia and regurgitation.

The route of NPC invasion into the middle ear and EAC via the ET can be detected by CT and MRI. The spread is usually mucosal or submucosal along the ET, which can also manifest as erosion of the anterior wall of the EAC on CT, as the tumor bypasses the middle ear. A case of an NPC with left ET, middle ear, and EAC involvements has been documented using MRI [8]. A CT scan showed a little erosion of the surrounding temporal bone, suggesting the likelihood of true mucosal or submucosal invasion along the ET rather than a locally advanced NPC invading the ET, middle ear, and externally following extensive skull bone involvement. It was suspected that the tumor might have extended further into the mastoid air cells, which are connected to the middle ear through the tympanic antrum. In our patient, the path of invasion into the middle ear was discerned by CT, MRI, and PET-CT images.



**Fig. 4 – Axial T2-weighted (sequential inferior to superior slices: A-C) and postcontrast T1-weighted (D) MR images show a recurrent mass in the left nasopharynx extends along the left Eustachian tube to the left middle ear and external auditory canal (arrows).**



**Fig. 5** – Thin-slice axial CT images of the left temporal bone using bone algorithm and viewed in bone windows (sequential superior to inferior slices: A-C). There is a widened bony segment of the Eustachian tube (blue arrow), near-complete opacification of the left middle ear cavity (red arrow), likely disruption of middle ear ossicles (orange arrow), and external auditory canal opacification (black arrow).

CT scans showed a widened bony Eustachian tube, near complete opacification of the left middle ear cavity and external auditory canal with associated bony destruction of the scutum, and questionable adjacent erosive changes of the distal tympanic segment of the facial nerve canal, which may be related to tumor involvement or superimposed infection related to the obstruction. There was also near complete opacification of the left mastoid air cells. MRI scans showed the enhancing infiltrative lesion in the left nasopharynx contiguously extending along the left ET to the left middle ear and EAC.

The most typical presentation of NPC is cervical lymphadenopathy [4]. NPC spreads via blood and lymphatics commonly. The lymphatic drainage system associated with the nasopharynx is extensive, primarily draining through 3 distinct pathways: the internal jugular vein, the posterior cervical chain, and the retropharyngeal chain [9]. Because of the deep anatomical position of the nasopharynx, NPC is frequently diagnosed in advanced stages when the cancer has often already metastasized to the lymph nodes, resulting in the common observation of cervical lymphadenopathy at diagnosis. Tumors that are confined solely to the nasopharynx and do not show lymph node involvement are rare, comprising approximately 9% of all cases [19].

Clinical suspicion of NPC should arise when patients experience otologic symptoms such as tinnitus, deafness, pain, or discharge, and nasal symptoms such as discharge, bleeding, or obstruction. Our patient presented with left-sided deafness, pain, and discharge but no nasal symptoms. Rarely, an otoscopic examination can reveal a polypoid soft tissue mass in the EAC, but there was no such mass in our patient in both the left and right ear, at least initially at presentation. Another notable manifestation is a facial nerve palsy of the lower motor neuron type, but the cranial nerve examination showed nerves II–XII grossly intact in our patient. In other reports, patients with recurrences mostly did not have recurrent tumors in the nasopharynx, but a significant number eventually developed distant metastases despite treatments such as local salvage treatments, radiotherapy, and chemotherapy [6,13,15]. However, our patient had a recurrence after treatment with

combined modality chemoradiation therapy, and the recurrent tumor was located in the left nasopharynx, which extended to the middle ear and EAC. There were no distant metastases in the thorax, liver, bones, or lymph nodes.

## Conclusion

We report a patient who demonstrated a rare extension of NPC into the middle ear and EAC via the ET. This tumor can present in patients with ordinary auditory symptoms, and therefore raises the need for awareness and vigilance for this mode of spread in NPC patients.

## IRB approval

I confirm that Stanford's Institutional Review Board (IRB) determined that this case report of 1 person is not Human Subjects Research (HSR); hence, no IRB review is required.

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