

## Case Report

# Squamous cell carcinoma of the middle ear: report of three cases

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**Abstract:** Squamous cell carcinoma of the middle ear (SCCME) accounts for 1.5% of malignant tumors in the ear. Because of the low incidence and infrequent reports of SCCME, the extent of concordance between CT and MRI results, surgical findings, and pathology reports are not well-characterized. In the present study, we reported CT and MRI images in three SCCME cases, and assessed the relationship between these results and those of surgery and the pathological report. Middle ear carcinoma is frequently misdiagnosed before surgery. In three cases of middle ear carcinoma, CT revealed the following: 1) soft tissue density lesions centered around the middle tympanum, exhibiting increased density, with external auditory canal involvement; 2) damage and absorption in the mastoid area, ossicles, and facial nerve canal, characterized by an irregular, worm-eaten appearance, without sclerotic margins; and 3) lesion infiltration of the surrounding bony substance of the middle ear, temporal squama, temporomandibular joint, anterior wall of the sigmoid sinus, and horizontal segment of the canalis caroticus (in one case lesion invasion into the intracranial cavity occurred through sigmoid sinus walls; no signs of intracranial invasion were seen in the other two cases). Enhanced lesion imaging revealed partial heterogeneous enhancement. In one patient MRI revealed a defined mass in the mastoid area of the middle ear. Signals in the lesion were partially heterogeneous and similar to brain tissue in T1- and T2-weighted images. The lesion was significantly enhanced following application of a contrast agent, while the adjacent meninges also exhibited linear enhancement. No abnormal signals were detected in the brain parenchyma. The destruction of adjacent bone plates was poorly defined. The CT and MRI results were consistent with the invasive features of middle ear cancer documented in the post-surgery pathology report.

**Keywords:** Middle ear carcinoma, computed tomography, magnetic resonance imaging

### Introduction

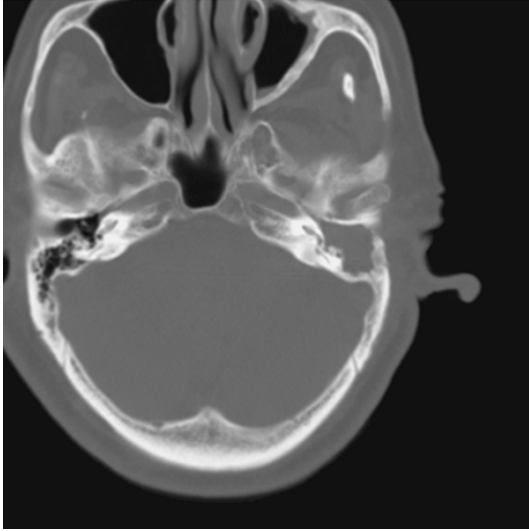
Squamous cell carcinoma is one of the most common malignant tumors, but rarely occurs in the middle ear [1]. Squamous cell carcinoma of the middle ear (SCCME) accounts for 1.5% of malignant tumors in the ear [1, 2]. Early manifestations of SCCME are similar to chronic suppurative otitis media, rendering early diagnosis difficult [1-4]. Because of the low incidence and infrequent reports of SCCME, the extent of concordance between CT and MRI results, surgical findings, and pathology reports are not well-characterized [5-8]. Preoperatively estimating extent of invasion, and evaluating important anatomic structures such as the facial nerve canal, carotid bony canal, jugular bulb, and sigmoid sinus, is important in guiding the surgical

process [5-8]. This report retrospectively analyzed CT and MRI images in three SCCME cases, and assessed the relationship between these results and those of surgery and the pathological report.

### Case series

#### Case 1

A 73-year-old male patient was admitted to our hospital, with left ear pain and bloody discharge during the previous 2 months, in addition to purulent discharge and intermittent bleeding from the left ear for > 40 years. Biopsy of the neoplasm of the left external auditory meatus had already been undertaken at a local hospital, with the pathological results indicating "inflammatory granulomatous tissue with kera-



**Figure 1.** CT of Case 1 revealed no significant expansion, abnormal wall changes, or suspicious soft tissue shadow in the bilateral auditory canals.

tosis". The primary diagnosis upon admission was of "chronic purulent otitis media of the left ear (cholesteatoma type)". Otological examination revealed purulent bloody fluid in the left external auditory canal, granulomatous tissue in the tympanic cavity, which bled easily when touched, and skin ulceration together with residue-like secretions in the mastoid area behind the ear.

CT scans indicated that the right mastoid was well-developed, and further that mastoid air cells were pneumatic. Imaging of the left side revealed mastoid bone destruction and air cell loss, with bone resorption in certain areas of the temporal squama replaced by a larger soft tissue density shadow, significant middle ear bone destruction and destroyed ossicles. CT revealed no significant expansion, abnormal wall changes, or suspicious soft tissue shadow in the bilateral auditory canals (**Figure 1**).

MRI revealed a defined mass ( $2.9 \times 2.6 \times 2.4$  cm) in the mastoid process of the left middle ear. Signals in the lesion were partially heterogeneous and similar to brain tissue in T1- and T2-weighted images. The lesion was significantly enhanced after application of a contrast agent, with the adjacent meninges also exhibiting linear enhancement. No abnormal signals were observed in the brain parenchyma. The destruction of adjacent bone plates was poorly defined. Left semicircular canals of the inner ear and auditory nerve were well-defined, with

no indication of aberrant morphology or an abnormal signal. The right mastoid was well-developed. The route, shape, and signals of the auditory nerve were normal (**Figure 2**).

An extended radical tumorectomy of the right mastoid was performed under general anesthesia, revealing a defect in the lateral bony wall of the mastoid process. The mastoid cavity was filled with crispy, tumor-like tissue, which bled easily and was confirmed as squamous cell carcinoma during the subsequent frozen pathology report. The lateral wall of the mastoid process was then removed by a rongeur to fully expose the tumor, which had grown upwards destroying the mastoid and tympanic canopy, and infiltrating the dura of the middle cranial fossa. In a backward direction, the tumor had destroyed the bone structure of the sigmoid sinus, but had not infiltrated into soft tissues. In a forward direction, the tumor had destroyed the anterior wall of the external auditory canal, and the posterior wall of the tympanic cavity, but the facial nerve bony canal and labyrinth medial to the tumor were intact.

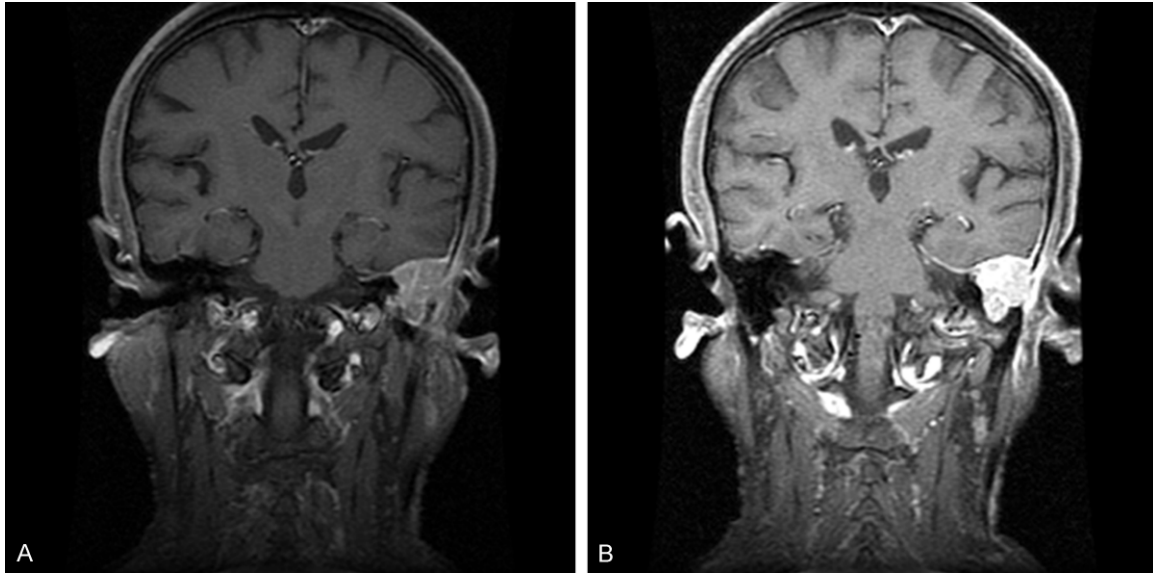
General observation of the tumor revealed a gray and crispy mass. Examination under a microscope revealed diffuse tumor cell growth with marked cellular atypia, manifesting as a large and hyperchromatic nucleus with visible nucleoli and mitotic figures. The final pathological diagnosis was of poorly to moderately differentiated squamous cell carcinoma of the left middle ear.

The patient received postoperative radiotherapy, with a  $^{60}\text{Co}$  dose of 60 Gy. No recurrence or metastasis was observed at the 17-month follow-up.

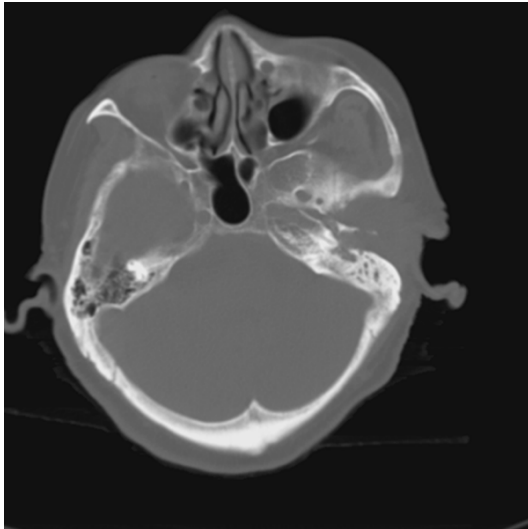
#### Case 2

A 63-year-old female was admitted with intermittent purulent discharge from the right ear, hearing loss for > 60 years, dizziness for > 4 months, and facial paralysis for > 2 months. Two months previously, her right-side frontal facial lines had disappeared, her right eyelid failed to achieve complete closure, and the corner of her mouth appeared to be askew. These symptoms were accompanied by a headache. The patient visited a local hospital and was diagnosed with cholesteatomatous otitis media of the right ear following a CT scan. In April 2004, she was referred to our hospital and

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**Figure 2.** MRI of Case 1 revealed a defined mass ( $2.9 \times 2.6 \times 2.4$  cm) in the mastoid process of the left middle ear. Signals in the lesion were partially heterogeneous and similar to brain tissue in T1- and T2-weighted images (A). The lesion was significantly enhanced after application of a contrast agent, with the adjacent meninges also exhibiting linear enhancement (B).



**Figure 3.** CT image of Case 2 showed the ossicles were intact but their structure could not be distinguished clearly. The right external auditory canal was filled with soft tissue shadow.

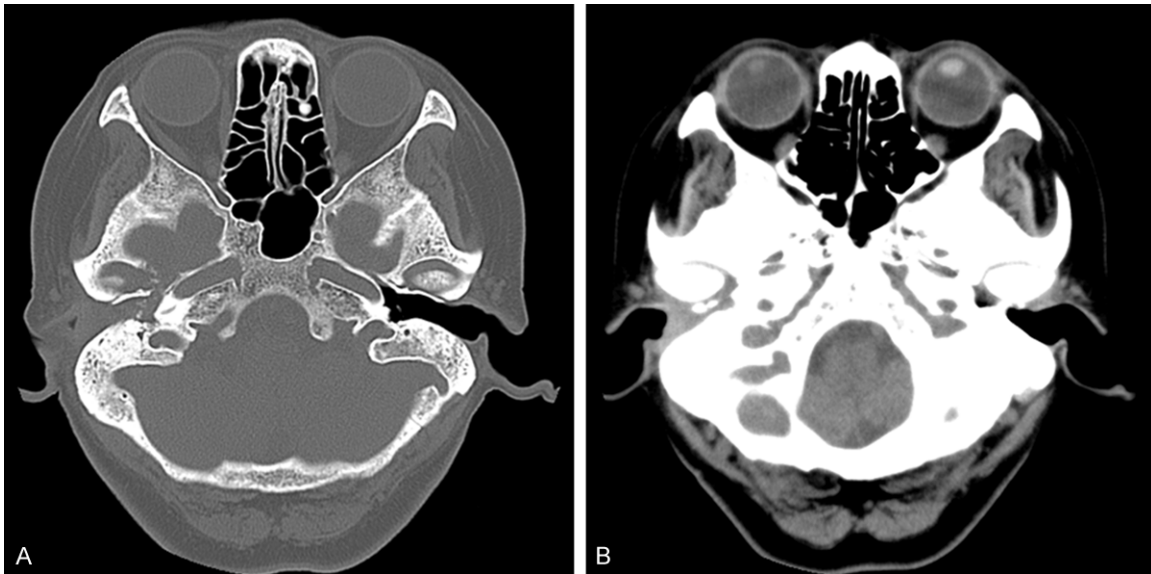
admitted with “chronic purulent otitis media of the right ear (cholesteatoma type)”. Otological examination revealed that granulomatous tissues, mixed with matrices of cholesteatoma, filled the right external auditory canal.

Repeated CT scans revealed a bilateral, poorly developed mastoid process, with soft tissue density lesions in the right tympanic cavity, epi-

tympanic recess, entrance to the tympanic antrum, and tympanic antrum. Bone destruction was observed in the mastoid dividers, the upper and anterior wall of the tympanic antrum, and the right temporomandibular articular surface. No obvious abnormality was indicated in the adjacent brain parenchyma of temporal lobe. The ossicles were intact but their structure could not be distinguished clearly. The right external auditory canal was filled with soft tissue shadow (**Figure 3**).

The diagnosis following specimen biopsy was of moderately differentiated squamous cell carcinoma. A partial right temporal bone resection was performed under general anesthesia. The right external auditory canal was filled with pink granulation tissue, with the right tympanic membrane exhibiting a large perforation. The lateral bony wall of the upper tympanic cavity had been partially absorbed, and the tympanic antrum, and tympanic and mastoid cavities, were filled with tumor tissue. The tympanic canopy had been destroyed. The tumor was pushing upward against the dura, but the dura remained intact. The facial nerve bony canal had been partially destroyed, and the facial nerve had been infiltrated by the tumor. A facial nerve resection was then performed.

General observation of the pathological specimen revealed a gray and crispy mass, present-



**Figure 4.** CT imaging of Case 3 indicated abnormal soft tissue density shadows in the right external auditory canal, tympanic cavity, and tympanic antrum (A). The lesions were characterized by partially heterogeneous enhancement (B).

ing with grey sections. Examination under a microscope revealed diffuse tumor cell growth with marked cellular atypia, manifesting in a large and hyperchromatic nucleus with visible nucleoli and mitotic figures. The final pathological diagnosis was of poorly to moderately differentiated squamous cell carcinoma of the left middle ear.

The patient received postoperative radiotherapy, with a  $^{60}\text{Co}$  dose of 70 Gy. No recurrence or metastasis was observed at the 16-month follow-up.

#### Case 3

A 72-year-old female was admitted with recurrent purulent discharge from the right ear accompanied by hearing loss for > 50 years, and facial paralysis of the right side for > 1 month. Otological examination upon admission revealed purulent secretion from the right external auditory canal, with a granulomatous tissue blockage in the deep right external auditory canal. No obvious swelling or tenderness was observed in the mastoid area. Further examination revealed complete peripheral facial paralysis of the right side. The diagnosis upon admission was of “chronic suppurative otitis media mastoiditis of the right ear (carius type) with complete peripheral facial paralysis”.

CT imaging indicated abnormal soft tissue density shadows in the right external auditory canal, tympanic cavity, and tympanic antrum. The tumor had infiltrated the brain through a continuously interrupted sigmoid sinus wall. The right tympanic cavity and tympanic antrum had clearly expanded, with reduced gassy spaces. The right external auditory canal was occluded, and the ossicles had been destroyed. The lateral bony wall of the horizontal segment of the carotid canal, and the facial nerve canal wall, was also damaged. The lesions were characterized by partially heterogeneous enhancement (**Figure 4**).

A radical left mastoidectomy was performed under general anesthesia. Intraoperative frozen sections revealed moderately differentiated squamous cell carcinoma. A cauliflower-like neoplasm was observed in the right external auditory canal, tympanic cavity and tympanic sinus, accompanied by bloody exudate. The malleus, incus and horizontal segment of the facial nerve were completely destroyed. The tumor had also enveloped the vertical segment and knee area. The posterior bony wall of the tympanic cavity was destroyed, and the tumor had infiltrated the brain through the sigmoid sinus wall. A partial temporal bone resection was performed.

The postoperative pathological report documented moderately differentiated squamous



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cell carcinoma. The tumor cells were distributed in a nest-like bulk, with marked cellular atypia and an infiltrative growth pattern.

The patient received radiotherapy 2 weeks after surgery, with a total  $^{60}\text{Co}$  dose of 70 Gy. At the 6-month follow-up, the patient had died from intracranial metastasis.

### Discussion

Malignant tumors originating in the middle ear are rare, accounting for only 0.25% of the malignant tumors occurring in this region, and with a low incidence rate of approximately 0.03% [1]. The etiological factors in primary middle ear carcinoma are unknown, but one possible cause is chronic otitis media [3, 4]. Between 75%-85% of primary middle ear carcinomas are secondary to chronic suppurative otitis media [1-5], which may be due to metaplasia of the middle ear mucosa caused by chronic inflammation. In our study, all three patients had a history of chronic suppurative otitis media of > 40 years.

The early symptoms of SCCME are atypical and clinical signs are obscure, frequently leading to neglect and misdiagnosis [6]. These lesions always invade surrounding tissue, but typically late diagnosis and close proximity to vital organs render treatment problematic [5-8]. Preoperative diagnosis of the three cases described herein were all of chronic purulent otitis media with cholesteatoma. Per our experience with patients, the following situations should be afforded particular attention: 1) history of an intermittently bloody discharging ear; 2) rapid-growing polypoid or granulomatous masses in the middle ear or external auditory canal (particularly when bleeding occurs easily in response to touching); 3) severe nocturnal earache; 4) peripheral facial paralysis upon physical examination; and 5) painless skin ulceration in the mastoid area. When clinicians encounter any of these situations, a differential diagnosis of SCCME should be made. CT, MRI and histopathological examinations are helpful and can assist diagnosis when required. In cases where malignancy is highly suspected, but without positive histopathological evidence, close follow-up and repeated biopsies should be considered.

Preoperative CT imaging of the three cases revealed the following: 1) soft tissue density

lesions centered around the middle tympanum, exhibiting increased density, with external auditory canal involvement; 2) destroyed mastoid process and ossicles (with a damaged facial nerve canal, characterized by an irregular and worm-eaten appearance without sclerotic margins in two cases); 3) lesions may invade the surrounding bony substance of the middle ear, with damage and absorption of the temporal squama ( $n = 1$ ) temporomandibular joint ( $n = 1$ ), anterior wall of the sigmoid sinus ( $n = 2$ ), or horizontal segment of the canalis caroticus ( $n = 1$ ). In one case the lesion had infiltrated into the intracranial cavity through the sigmoid sinus walls (no signs of intracranial invasion were observed in the other two cases); and 4) enhanced imaging of lesions revealed partially heterogeneous enhancement.

In one patient, MRI imaging revealed the following: 1) a defined mass in the mastoid area of the middle ear, exhibiting partially heterogeneous signals; 2) similar signals in the lesion to brain tissue in T1- and T2-weighted images; 3) significant lesion enhancement following application of a contrast agent, with the adjacent meninges also exhibiting linear enhancement; and 4) poorly defined destruction of adjacent bone plates.

According to the clinical staging criteria for middle ear cancer proposed by Stell in 1985 [9], one of our patients was in stage T2, with the other two in stage T3. CT and MRI results were confirmed by surgery, indicating that preoperative CT and MRI imaging can identify the correct T-stage for middle ear cancer. All three cases were characterized by poorly to moderately differentiated squamous cell carcinoma, based on the pathology report. Irregular and multi-point moth-eaten destruction, and non-sclerotic margins of the middle ear bone, were revealed by both CT and MRI, reflecting the diffuse and invasive biological growth of poorly to moderately differentiated squamous cell carcinoma. Therefore, preoperative CT and MRI imaging can facilitate correct staging and identification of the pathological features of primary middle ear carcinoma. Non-enhanced CT scans are insufficiently accurate to define the extent of tumor invasion. Enhanced imaging can differentiate enhanced tumor tissue and non-enhanced effusion, thereby contributing to high concordance between imaging and intraoperative findings. Enhanced MRI images can provide a marked contrast between tumor tissue

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and inflammatory effusion, and are superior to CT in identifying the invasive range of a tumor [5].

Surgery, together with radiation, is the main treatment approach to middle ear cancer [10-12]. Preoperative CT can reveal the extent of tumor infiltration into the carotid bony canal, jugular bulb and sigmoid sinus. Improper operations on the carotid canal may lead to rupture of the internal carotid artery, resulting in serious surgical complications or even death [5]. Therefore, preoperative evaluation of the carotid canal is of vital importance. The CT images in our study clearly demonstrated destruction of the sigmoid sinus wall in two cases, one of which was accompanied by damage to the horizontal segment of the carotid canal. No signs of a damaged jugular bulb were observed in any of the patients.

With the assistance of neurosurgeons, a radical mastoidectomy was performed on the patient in stage T2. Partial temporal bone resections were performed on the two T3-stage patients. No serious complications were observed [10-12]. All three patients received radiotherapy after surgery. The facial nerve is always involved in middle ear cancer. CT images can clearly distinguish each segment of the facial nerve canal, and accurately quantify the extent of tumor invasion. In two of our patients facial nerves were extensively infiltrated, according to CT imaging, which was confirmed during the surgical process: a local excision was therefore performed.

### Disclosure of conflict of interest

None.

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