



Metastatic Papillary Thyroid Carcinoma to the Frontal Bone



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Abstract

Calvarial metastasis of papillary thyroid carcinoma is rare, especially as an initial presentation of this disease. The patient in this case study is a 37-year-old male presenting with a persistent mass on the left forehead following a blunt injury to the site. Imaging was performed to show an osteolytic mass in the left frontal bone, which was surgically resected with surrounding bone six weeks later for pathologic examination. The mass was diagnosed as a metastasis of papillary thyroid carcinoma, follicular variant, to the left frontal bone. A follow-up total thyroidectomy and bilateral neck resection was performed, showing extensive extrathyroidal extension into surrounding tissues, and the papillary thyroid carcinoma was staged as pT4aN1bM1. Due to the rarity of calvarial metastasis by papillary thyroid carcinoma, it can easily be mischaracterized as other osteolytic neoplasms with similar clinical presentations and radiographic morphologies, notably meningiomas. Because of the frequency of this mischaracterization, a comparison of morphologies between metastatic papillary thyroid carcinomas and meningiomas is discussed to aid the pathologists' assistant in tailoring their macroscopic examination to contribute to an efficient, accurate differential diagnosis and treatment plan for the patient.

Keywords: Frontal bone metastasis, papillary thyroid carcinoma, blunt injury, osteolytic

Background

Thyroid carcinomas are relatively uncommon in the United States, making up about 1.5% of cancers in women and 0.5% of cancers in men.¹ Papillary thyroid carcinomas are the most common type, constituting over 85% of cases. Several histological variants exist in this type, the most common being the follicular variant. This variant behaves similarly to the more aggressive follicular thyroid carcinoma; it spreads through hematogenous metastasis, and is more prone to angioinvasion and distant bony metastasis than other papillary thyroid carcinomas.² Even with this predisposition, bone metastasis only occurs in 1-5% of papillary and follicular thyroid carcinomas.^{1,3} Metastasis to the frontal bone or any calvarial site is quite a rare occurrence. Bone metastases often spread to the ribs, vertebrae, or sternum, and when they do occur in the skull, most are located in the base and occipital area.¹ Papillary thyroid carcinoma metastasis to the calvarium typically presents with a palpable scalp tumor, with osteolytic lesions on imaging, and can easily be mischaracterized as meningioma clinically. Metastatic calvarial masses can be the initial presentation of the underlying thyroid carcinoma, as is the case for the following patient.

Clinical History and Presentation

The patient, a 37-year-old male with a history of diabetes mellitus, initially presented for physical examination of a frontal bone mass. He reported falling on a mat while practicing jiu-jitsu three months prior and expressed concern over the persistence of a lump which appeared on his forehead the following day. He denied experiencing headaches, nausea, difficulty sleeping, or any other symptoms after the fall. Palpation of the mass proved painless to the patient, and the mass itself was described as soft and palpable with an apparent lack of underlying bone. Performed computer tomography (CT) scans of the head showed a 2.2 x 2.2 cm lytic lesion suspicious for neoplasm in the left frontal bone with intra and extracranial extension. Treatment and management options were discussed with the patient, and surgical resection with intraoperative consultation was chosen as the next step. It is worth noting that seven months prior to this the patient presented to a clinician for concerns over extreme fatigue, and the cause was diagnosed as diabetic ketoacidosis. During this visit, palpation of the thyroid gland showed no tenderness or nodules, and no distension of the jugular vein. Thyroid stimulating hormone (TSH), thyroxine (T4), and triiodothyronine (T3) blood serum levels were within normal ranges.

Pathologic Findings

Six weeks after the physical exam, magnetic resonance imaging (MRI) was taken of the patient's head (Figure 1), followed by a resection of the segment of left frontal bone containing the mass (Figures 2 and 3). A preliminary diagnosis of metastatic thyroid carcinoma was obtained through intraoperative consultation utilizing frozen sections and smear preparations of the soft extraosseous aspects of the mass. The remaining specimen was grossly examined and a diagnosis of invasive papillary thyroid carcinoma, follicular variant, was confirmed by microscopic examination of the permanent sections.

The following month, the patient underwent a total thyroidectomy and lateral neck resections, bilaterally, with the right side modified to include level VI. The gross examination of the specimen showed grossly apparent extrathyroidal extension into surrounding tissues, but not into the prevertebral fascia, carotid artery, or mediastinal vessels, as well as local metastasis to bilateral cervical lymph nodes. Combined with the distant metastasis to the left frontal bone shown in the original specimen, the AJCC stage was determined to be pT4aN1bM1.³ No further information on the patient's treatment decisions or health status are available at this time.

Results

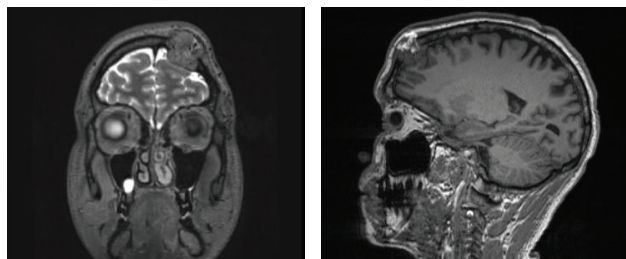


Figure 1: T2 MRI scans showing coronal and sagittal views of the well-defined left frontal bone mass. Intra and extracranial protrusion with compression of underlying brain tissue can be seen.

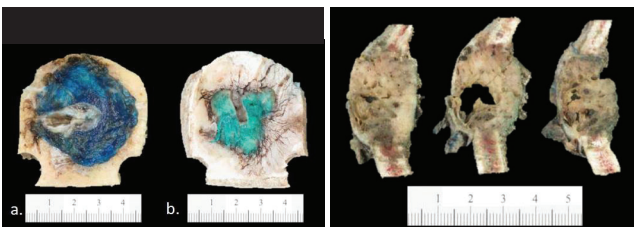


Figure 2: (Left frontal bone - metastatic papillary thyroid carcinoma, follicular variant) a. External view with outer surface of mass inked blue. b. Internal view with outer surface of mass inked green.

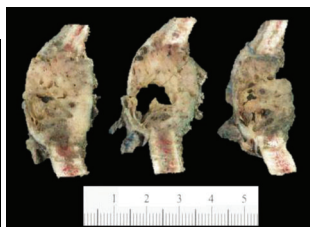


Figure 3: (Left frontal bone - metastatic papillary thyroid carcinoma, follicular variant) Serial sections of the specimen, showing a solitary, osteolytic mass with a variegated, tan-grey to brown, solid and cystic cut surface with minimal papillary excrescences.

The skull fragment, 5.9 x 5.3 x 1.0 cm in thickness, displayed a solitary, rubbery to firm, well-defined mass, 4.4 x 4.0 x 2.5 cm (Figure 2). The mass was 0.2 cm from the nearest margin on the external surface, 1.0 cm from the nearest margin on the internal surface, and less than 0.1 cm from the nearest deep margin. The mass protruded 1.5 cm deep intracranially. Sectioning revealed a centrally friable, variegated tan-grey to brown, solid and cystic cut surface with minimal papillary excrescences (Figure 3). A total of twelve cassettes were submitted for histologic processing, with sections including:

- Decalcified complete circumferential bony margins (with perpendicular sections taken at the nearest margin).
- A decalcified full-face section of the mass with transition to bone.
- Additional sections of mass without decalcification.

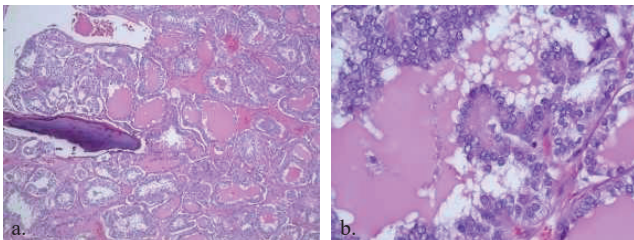


Figure 4: (Metastatic papillary thyroid carcinoma interfacing with bone) a. Note the multiple thyroid follicles and papillary architecture surrounding the bone (b). b. Orphan Amie-eye nuclei, pseudo-inclusions occurring from invaginations in the cytoplasm, and intranuclear grooves can be seen, and are diagnostic cytologic features of papillary thyroid carcinoma.²

Morphological Comparison

The distant metastasis of papillary thyroid carcinomas to calvarial sites is an infrequent occurrence, and the metastasis as the sole patient complaint is even less likely. Often, this rarity combined with similar clinical presentation and radiological appearances to more common lytic lesions of the bone and meninges leads to an initial erroneous impression (most commonly of meningioma) leading up to receipt of these malignant masses in the surgical pathology laboratory.^{4,5} This confusion poses an additional challenge to the surgical pathology team in achieving an accurate and rapid diagnosis of metastatic papillary thyroid carcinoma, which the patient depends on for improved prognosis and treatment efficacy. Because of this added diagnostic challenge, it is worth comparing the gross morphology of metastatic skull papillary thyroid carcinomas and meningiomas occurring in the calvarium, to highlight overlap between the neoplasms and unique descriptors for each to aid in the differential diagnosis. This is done below in Table 1.

Morphological Feature	Metastatic Papillary Thyroid Carcinoma	Meningioma
Solitary or multifocal, well-defined masses	Yes	Yes
Appearance on imaging	More often moth-eaten, follicular variant can have more solid appearance	More often solid, can be moth-eaten
Intracranial compression of underlying brain	Yes	Yes
Basal attachment to dura	Often	Yes
Encapsulation by thin/roughened membrane	Often	Often
★ En plaque growth along the intracranial surface	No	Yes
★ Necrosis or hemorrhage	Yes (friable necrosis)	No
★ Solid and cystic cut surface and/or papillary excrescences	Yes	No
Internal calcifications forming psammoma bodies	Can be present	Can be present (psammomatous type)

Table 1: A Comparison of Typical Morphological Features Between Metastatic Papillary Thyroid Carcinomas and Meningiomas in the Calvarium.^{2,4,6} The unique features are starred.

There are multiple histological variants of meningiomas and papillary thyroid carcinomas, leading to a spectrum of macroscopic presentations on the cut surfaces of these masses, but generally en plaque growth along the intracranial surface of the calvarial bone along with a lack of necrosis or hemorrhage is indicative of meningioma, and a solid and cystic cut surface containing papillary excrescences or friable central necrosis points toward metastatic papillary thyroid carcinoma.²

Lymphoma has a distinctly different cut surface morphology, but it deserves a brief mention as it can present similarly to both meningiomas and the metastatic papillary thyroid carcinoma observed in the current patient – showing a mild to asymptomatic presentation with a localized swelling on the head, and an intra and extracranial osteolytic lesion with a moth-eaten appearance which compresses the underlying brain on imaging.^{7,8} Both lymphomas and metastatic papillary thyroid carcinomas often require cleaner handling (for touch or smear preparations, or special studies) and more extensive tissue sampling with cautious use of decalcifier for IHC stains to obtain an accurate diagnosis and treatment plan for the patient. When receiving a specimen with the clinical impression of a meningioma, the pathologists' assistant should be prepared for the possibility of switching to lymphoma or thyroid protocol and they will be better prepared to do so by using clean technique from the initial cut into the mass onward.

Conclusion

The frontal bone is a highly unusual site for papillary thyroid carcinoma, and receipt of its resection for initial diagnosis by the surgical pathology lab is even more strange; however, we can see from this case study that it does occur. It is important to be aware of these rare cases and keep their existence in mind even when informed of a benign clinical impression and no history of cancer. A detailed macroscopic description of the morphology including details on papillary excrescences, central necrosis, and the growth pattern of the mass on the intracranial surface aid in reaching an accurate differential diagnosis to pinpoint the best treatment options for the patient.

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