Skull metastasis of thyroid carcinoma

Study of 12 cases

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Over the past 33 years the authors have treated 12 cases of skull metastasis from thyroid carcinoma, accounting for 2.5% of a total of 473 cases of thyroid cancer. A study of these 12 cases revealed the following characteristics. 1) The mean age of the patients was 60.4 years and the predominant incidence was in the seventh decade of life. 2) The incidence of skull metastasis from thyroid cancer was higher among women than among men. 3) The primary sign was a soft hemispheric tumor resting on the skull. 4) The tumors were rich in vascularity with osteolytic changes in the skull. 5) The average period from diagnosis of the thyroid tumor until thyroidectomy was 14.3 years, and until discovery of the skull metastasis was 23.3 years. The clinical course was thus very long. 6) The most frequent histopathological presentation was follicular adenocarcinoma. Such lesions were morphologically well differentiated, with little pleomorphism and atypism, but detailed examination showed infiltration into the vascular lumen or capsule. 7) The mean survival time in these patients was 4.5 years from the time of diagnosis. The prognosis in this lesion was relatively poor, considering its long clinical course.

KEY WORDS • skull metastasis • thyroid carcinoma • metastasis

Bone metastasis from thyroid carcinoma is not uncommon, but there have been few reports of skull metastasis. Over the past 33 years, we have examined 12 patients with skull metastasis from thyroid carcinoma. Eleven of these tumors were hemispheric in shape and arose on the convexity of the skull. These skull tumors presented characteristic pathological findings.

Summary of Cases

During the 33 years from 1950 to 1982, 473 cases of thyroid cancer were seen at the Second Department of Surgery of Tohoku University and the Division of Neurosurgery, Institute of Brain Diseases. Skull metastasis was found in 12 (2.5%) of the 473 thyroid cancer cases (Table 1).

Clinical Features

Eleven of the 12 patients were women. The ages of the patients at the time of admission ranged from 36 to 77 years (mean 60.4 years); one patient was aged in the 30's, one in the 40's, one in the 50's, seven in the 60's, and two in the 70's.

The symptoms and signs were palpable scalp tumors (11 cases), exophthalmos (one case), disturbance of consciousness and hemiparesis (one case), and headache (one case). A palpable tumor of the scalp was the principal physical sign, while cranial nerve dysfunction, focal brain symptoms, or symptoms due to increased intracranial pressure were uncommon.

Ten of the 12 patients had palpable thyroid tumors on admission, and five of them were unaware of the tumor. Six of the patients with goiter had previously undergone thyroidectomy, but only one case was diagnosed as having thyroid cancer. The period from diagnosis of the thyroid tumor until thyroidectomy in these six cases ranged from 2 months to 27 years (mean 14.3 years). The period from diagnosis of the thyroid tumor until discovery of the skull metastasis ranged from 4 to 52 years (mean 23.3 years). These lengthy periods from onset to metastasis are clearly different from the time scale of metastasis in most other forms of cancer.
### Skull metastasis of thyroid carcinoma

**TABLE 1**

*Summary of 12 cases of skull metastasis from thyroid carcinoma*

<table>
<thead>
<tr>
<th>Case No.</th>
<th>Age (yrs) &amp; Sex</th>
<th>Signs &amp; Symptoms</th>
<th>Neurological Findings</th>
<th>Medical History</th>
<th>Goiter</th>
<th>Scinti-</th>
<th>Thyroidectomy</th>
<th>Metastasis</th>
<th>Other Therapy</th>
<th>Pathology</th>
<th>Other Metas-</th>
<th>Survival Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>36, F</td>
<td>head tumor, headache</td>
<td>—</td>
<td>yes</td>
<td>yes</td>
<td>—</td>
<td>lt PO goose egg</td>
<td>subtotal</td>
<td>—</td>
<td>follicular</td>
<td>no</td>
<td>3 yrs</td>
</tr>
<tr>
<td>2</td>
<td>42, F</td>
<td>head tumor</td>
<td>—</td>
<td>nodular goiter op, head injury</td>
<td>yes</td>
<td>—</td>
<td>lt O fist</td>
<td>subtotal</td>
<td>—</td>
<td>mixed</td>
<td>no</td>
<td>17 yrs</td>
</tr>
<tr>
<td>3</td>
<td>61, F</td>
<td>head tumor, headache</td>
<td>Basedow's disease, op</td>
<td>no</td>
<td>no</td>
<td>rt O</td>
<td>walnut biopsy</td>
<td>—</td>
<td>follicular</td>
<td>no</td>
<td>5 mos</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>56, F</td>
<td>head tumor</td>
<td>—</td>
<td>yes</td>
<td>yes</td>
<td>rt F</td>
<td>child's head biopsy</td>
<td>—</td>
<td>follicular</td>
<td>yes</td>
<td>5 yrs</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>63, F</td>
<td>head tumor</td>
<td>—</td>
<td>yes</td>
<td>cold</td>
<td>yes</td>
<td>lt O apple</td>
<td>total</td>
<td>60Co, endoxan</td>
<td>follicular</td>
<td>yes</td>
<td>5 yrs</td>
</tr>
<tr>
<td>6</td>
<td>67, F</td>
<td>head tumor</td>
<td>—</td>
<td>goiter op</td>
<td>no</td>
<td>cold</td>
<td>no midline O large fist</td>
<td>—</td>
<td>60Co</td>
<td>follicular</td>
<td>yes</td>
<td>7 mos</td>
</tr>
<tr>
<td>7</td>
<td>63, F</td>
<td>neck &amp; head tumor</td>
<td>—</td>
<td>goiter op</td>
<td>yes</td>
<td>cold</td>
<td>yes</td>
<td>lt O goose egg</td>
<td>total</td>
<td>60Co</td>
<td>mixed</td>
<td>yes</td>
</tr>
<tr>
<td>8</td>
<td>64, F</td>
<td>head tumor</td>
<td>—</td>
<td>yes</td>
<td>cold</td>
<td>yes</td>
<td>lt FP fist</td>
<td>total</td>
<td>—</td>
<td>follicular</td>
<td>no</td>
<td>2 yrs</td>
</tr>
<tr>
<td>9</td>
<td>65, F</td>
<td>visual disturbance, exophthalmos</td>
<td>optic atrophy, ophthalmoplegia</td>
<td>—</td>
<td>yes</td>
<td>rt hemiparesis, semicoma, papilledema</td>
<td>yes hot</td>
<td>yes lt PO fist</td>
<td>total</td>
<td>60Co, 131I</td>
<td>follicular</td>
<td>no</td>
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<tr>
<td>10</td>
<td>62, F</td>
<td>head tumor, consciousness disturbance, rt hemiparesis</td>
<td>malignant goiter op</td>
<td>—</td>
<td>yes</td>
<td>hot</td>
<td>yes lt PO fist</td>
<td>total</td>
<td>60Co, 131I</td>
<td>follicular</td>
<td>yes</td>
<td>7 yrs</td>
</tr>
<tr>
<td>11</td>
<td>71, M</td>
<td>head tumor</td>
<td>—</td>
<td>goiter op</td>
<td>yes</td>
<td>cold</td>
<td>no lt P &amp; rt T goose egg</td>
<td>total</td>
<td>—</td>
<td>131I papillary</td>
<td>yes</td>
<td>1 1/2 yrs</td>
</tr>
<tr>
<td>12</td>
<td>77, F</td>
<td>head tumor</td>
<td>—</td>
<td>head injury</td>
<td>yes</td>
<td>warm</td>
<td>yes</td>
<td>lt PO fist</td>
<td>total</td>
<td>AVQ, emboli-</td>
<td>follicular</td>
<td>no</td>
</tr>
</tbody>
</table>

* = none; AVQ = Adriamycin, vincristine, carboquone; F = frontal; FP = frontoparietal; O = occipital; P = parietal; PO = parieto-occipital; T = temporal.

Eleven of the 12 cases had palpable tumors, all of which were hemispheric in shape and appeared characteristically as small inverted bowls placed on the head (Fig. 1). Ten of these 11 tumors had smooth surfaces, and one (Case 10) had a slight indentation in the center of the swelling. Eight tumors were soft, and three were elastic (Cases 1, 2, and 3); seven showed pseudofluctuation\(^8\) (Cases 1, 2, 4, 7, 8, 11, and 12). All 12 tumors had abundant vascular supply, although only five were pulsatile. The tumors ranged from walnut-size to the size of a child's head; most were the size of a goose egg or of a large fist. Five tumors were located over the occipital region, three over the parieto-occipital region, and one each over the frontoparietal, parietal, and frontal regions — the majority being posterior in location. Eight were found on the left, two on the right, one was bilateral, and one was in the midline. One of the tumors was painful (Case 4), one was slightly tender (Case 7), and nine were without sensation.

**Radiological Features**

On plain skull x-ray film, all 12 cases of skull metas-

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**Fig. 1.** Photograph of the tumor in Case 12. A hemispheric growth is seen over the left parieto-occipital region.
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FIG. 2. Plain skull x-ray film in Case 11. A bone defect is seen in the parietal region.

tasis showed osteolytic lesions, with no signs of osteoblastic changes. Oval or round-shaped bone defects with clear boundaries were found in the region of the skull tumor. The internal structure was translucent (Fig. 2), sometimes with small pieces of bone remaining, and the margin was jagged. There were no indications of bone overgrowth or periosteal hypertrophy, and sunlight trabeculation or spicula formation was not found.

Computerized tomography (CT) scans were taken in only two cases. In plain scans, homogeneous oval mass lesions with densities slightly higher than that of brain were found at intracranial extradural and extracranial sites. Contrast-enhanced CT scans were also obtained in one patient, and a marked enhancement effect was found (Fig. 3).

Carotid angiography was undertaken in seven of the 12 patients, and showed vessels feeding the tumor through the external carotid artery (via the superficial temporal artery, occipital artery, and middle meningeal artery) (Fig. 4).

Thyroid gland scintigrams were performed in eight patients using iodine-131 (131I). A cold nodule was found over the thyroid tumor in six cases (Cases 5 to 9, and 11), a hot nodule in one case (Case 10), and a warm nodule in one case (Case 12). One of the two patients who had preoperative brain scintigrams (Cases 11 and 12) showed 131I accumulation coinciding with the tumor (Fig. 5). Of the two patients with postoperative scintigrams, one (Case 9) showed accumulation of 131I at the biopsy site and the other (Case 10) showed accumulation at a site different from the tumor excision which indicated another metastatic lesion. Full-body scintigrams were taken in three cases (Cases 10 to 12), and two showed metastatic foci at sites other than the cranium.

Six patients exhibited metastasis to the skull alone, and were thought to be cases of solitary metastasis. Six had metastases to locations other than the skull, including one with rib metastasis, one with bilateral lung metastasis, and three with multiple metastases to the lung, vertebrae, and femur.

Therapeutic Features

Total thyroidectomy was performed in nine cases. Eleven patients underwent skull metastasis excision: total excision in six cases, subtotal excision in two, and biopsy in three. Radiation therapy was given as follows: internal radiotherapy using 131I (three cases), external radiotherapy using cobalt-60 (two cases), and both (two cases). Chemotherapy was administered in two cases: Endoxan (cyclophosphamide) only in one case (Case 5), and a combination of Adriamycin, vincristine, and carboquone was given intra-arterially under conditions of elevated blood pressure in one case (Case 12). Embolization was achieved using conjugated estrogen in Case 12.

Pathological Findings

The histopathological diagnosis of the thyroid tumors and the skull metastases was follicular adenocarcinoma.
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in nine cases (Fig. 6 left), papillary adenocarcinoma in one case (Fig. 6 right), and a mixed type in two cases. Morphologically, they were all well differentiated, showing relatively little pleomorphism and atypism. When detailed histological study was undertaken, however, some pleomorphism and atypism was evident; when a sufficiently large number of tissue samples were examined, cellular infiltration of vessels and/or the surrounding pseudo-capsule indicative of a malignant lesion was often found.

Outcome

As of July, 1985, only one patient was still alive. The survival period from definitive diagnosis of the metastatic skull tumor was 5 months to 17½ years (mean 4½ years). The only living patient is leading a normal life 3 years after the diagnosis.

Discussion

Reports of bone metastasis from thyroid carcinoma indicate an incidence ranging from less than 10% to more than 40%. It is known that bone metastasis is the second most common form of metastasis, after lung metastasis. Metastasis to the skull is the next most common form of bone metastasis after metastasis to the ribs, sternum, and vertebrae. McCormack reported 15 cases (5.8%) of skull metastasis among 259 cases of thyroid cancer. The incidence of skull metas-
tasis in our study was 2.5%. In 1972, 10 cases (3.3%) of skull metastasis were reported among 307 cases of thyroid cancer from our institution:20 since then, we have experienced only two cases (1.2%) among 166 cases of thyroid carcinoma. It is significant that the incidence of skull metastasis from thyroid cancer has recently decreased because of the earlier diagnosis and treatment of thyroid cancer.

Bone metastasis from thyroid carcinoma has a much greater incidence among women than men and is predominant in the sixth and seventh decades of life.12 The same characteristics are found with skull metastasis from thyroid cancer: the mean age of our patients was 60.4 years.

The absence of increased intracranial pressure or brain compression in this series may be attributed to the fact that the tumors were usually associated with large cranial defects, but an intracranial extension can cause severe neurological symptoms.3 Most of the tumors were located in the posterior portion of the head and were fed from the external carotid artery. It is worth noting that bleeding is often profuse during excision. The histopathological diagnosis of the thyroid tumors and skull metastases were follicular adenocarcinoma or papillary adenocarcinoma. They were morphologically well differentiated and showed relatively little pleomorphism or atypism. A detailed histological study does reveal some pleomorphism or atypism and cellular infiltration of vessels and surrounding tissue.14 In 1876, Cohnheim6 introduced the term "benign metastatic struma," but this phrase gives the impression of completely benign morphology with no malignant findings. As mentioned above, since features of malignancy can be demonstrated, it is undoubtedly wiser to abandon the "benign" label and term such lesions "metastatic struma" or "malignant struma."11 The clinical course of this disease is very long; the mean period from diagnosis of the thyroid tumor until discovery of the skull metastasis in our cases was 23.3 years. In this, it clearly differs from most other forms of cancer.

Since McCormack12 reported an average of three sites for each case of bone metastasis (91 sites among 33 cases), detailed examinations using x-ray and radioisotope studies have been recommended even in patients diagnosed as having a solitary metastasis. A postoperative scintigram revealed a metastasis in Case 10 at a site thought to be clinically normal. In general, demonstration of metastatic sites by 131I scintigrams is closely related to the histology of the lesion. The affinity of 131I is strongest for follicular adenocarcinoma, whereas its affinity for papillary adenocarcinoma and Hühle cell cancer is inconsistent, being extremely weak for undifferentiated cancers.16,17,19 Moreover, after excision of the thyroid gland and treatment of metastatic foci, the use of thyroid-stimulating hormone (TSH) is effective in the diagnosis of such metastases, since the affinity of 131I for the remaining metastatic foci then increases.5,16,19

Currently, the best therapy in cases of bone metastasis from thyroid cancers includes complete excision of the thyroid gland and removal of as much of the metastatic focus as possible. When excision of such foci is not possible, internal irradiation with 131I and administration of TSH are recommended.5,10,16,19 In cases where the uptake of 131I by the metastatic focus is weak or absent, however, external radiotherapy should be administered.21 Finally, to prevent the development of cancers by means of suppression of endogenous TSH, administration of thyroid hormone is necessary.7,22

In McCormack's report,12 the mean survival period from the time of definitive diagnosis of bone metastasis was 3.1 years, and only three of the reported 33 patients were still alive. Our mean survival time was 4 years 5 months. It can be said that the prognosis for bone metastasis from thyroid cancer is relatively poor, considering its long clinical course.

References

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