Learning objectives

The aim of our study was to characterise the clinical-radiological-pathological spectrum of parotid oncocytomas in the largest imaging series to date consisting of 10 histopathologically proven cases, with an emphasis on the CT imaging features.
Background

Oncocytomas of the salivary gland which were first termed by Jaffè in 1932, are benign epithelial tumours which occur most commonly in adults in their 6th-8th decades,\(^1\)\(^-\)\(^6\) although there is no clear gender predilection.\(^3\)\(^,\)\(^4\)\(^,\)\(^6\)\(^-\)\(^9\) These neoplasms are histologically composed of monotonous sheets of oncocytes, epithelial cells named by Hamperl in 1931 which are characterized by an intensely eosinophilic and granular cytoplasm. These metabolically altered epithelial cells accumulate numerous cytoplasmic mitochondria through the process of oncocytic metaplasia.\(^1\)\(^,\)\(^4\)\(^,\)\(^5\)\(^,\)\(^7\)\(^,\)\(^10\)\(^-\)\(^12\) Synonyms for this tumour include oncocytic adenoma, oxiphilic granular-cell adenoma and oxiphilic adenoma.

Oncocytomas are rare, comprising just 0.5-1.5% of salivary gland tumours.\(^4\)\(^,\)\(^7\)\(^-\)\(^9\)\(^,\)\(^13\)\(^-\)\(^16\) The parotid gland is the most commonly involved salivary gland, accounting for 78-84% of salivary gland oncocytomas.\(^2\)\(^,\)\(^3\) Oncocytomas occurring in the submandibular gland and the minor salivary glands have been reported, but are relatively uncommon.\(^2\)\(^,\)\(^7\)\(^,\)\(^9\)

Computed tomography (CT) is one of the established first-line imaging modalities used in the assessment of major salivary gland tumours.\(^2\)\(^,\)\(^17\)\(^,\)\(^18\) To the authors' knowledge, there is limited description of the CT imaging features of parotid gland oncocytomas in the published literature apart from a few case reports.\(^15\)\(^,\)\(^16\)\(^,\)\(^19\)\(^-\)\(^21\)

Since the surgical resection of parotid tumours is generally the treatment of choice and allows for histopathological confirmation, the identification of specific CT imaging features suggestive of benign parotid oncocytomas will become helpful in terms of simply managing the patient expectantly when certain clinical scenarios arise - for example if the patient declines surgical intervention, when patient factors such as age and multiple co-morbidities preclude surgical resection or where biopsy results are non-diagnostic.
Imaging findings OR Procedure details

METHODS

A review of parotid tumours which were discussed at combined clinical-radiological-pathological sessions in our institution between January 2003 and November 2008 revealed 10 cases of histopathologically confirmed parotid gland oncocytomas. The gender, age at diagnosis, clinical presentation, type of surgical resection (superficial vs. total parotidectomy) and recurrence during patient follow-up of all 10 cases were recorded retrospectively. Institutional review board approval was obtained prior to the study.

All 10 cases were imaged using the TOSHIBA Aquilion multislice CT SCAN SYSTEM with the scan level extending from the level of the external auditory canal to the hyoid bone, and the plane of the scan parallel to the hard palate.

Five of the 10 cases were imaged using the 4-slice Toshiba system. Images were acquired at 135 kV and 250 mA with a pitch factor of 3.5 and a total scan time of 30 seconds. Axial sections of 3 mm thickness were reconstructed with use of the FC 10 soft tissue algorithm. A bolus intravenous dose of 70 ml of non-ionic contrast (350 mg I/ml) was administered to patients at an injection rate of 1.5 ml per second. Scanning was initiated 47 s after the onset of contrast injection.

The remaining 5 patients were imaged using the 64-slice Toshiba system. Images were acquired at 120 kV and 200 mA with a pitch factor of 0.8 and a total scan time of 7 seconds. Axial sections of 3 mm thickness were reconstructed with the use of the FC 04 soft tissue algorithm. A bolus intravenous dose of 50 ml of non-ionic contrast (350 mg I/ml) was administered to patients at an injection rate of 1.5 ml per second. Scanning was initiated 50 s after the onset of contrast injection.

A senior head and neck radiologist retrospectively reviewed the CT images of the 10 confirmed cases of parotid gland oncocytomas. The tumours were then categorised in terms of location, size, margins, contour and pattern of enhancement.

Tumour location was defined as involving the superficial, deep or both the superficial and deep lobes of the parotid gland. The intraparotid segment of the facial nerve creates a surgical plane that divides the gland into superficial and deep lobes, but is not routinely identified even with high-resolution imaging.\textsuperscript{22} The course of the intraparotid facial nerve can be inferred by identification of the retromandibular vein within the gland since the nerve lies just lateral to this vessel.\textsuperscript{17, 22}
were classified as involving the superficial lobe if the tumor was located lateral to the retromandibular vein; and as involving the deep lobe if the tumor was located medial to the retromandibular vein or showed extension medially through the stylomandibular gap. Each patient was also evaluated for synchronous bilateral and multifocal disease. The size of the tumour was expressed in terms of maximal axial dimensions measured to the nearest millimeter. The largest lesion was measured in cases of multifocal disease. The tumour was deemed to have 'sharp' margins if it was well demarcated throughout its circumference and 'indistinct' margins if otherwise. A tumour was considered to have a 'lobulated' contour if it demonstrated surface undulations or a 'smooth' contour if it lacked such undulations.

As pre-contrast images were not acquired, a tumour was presumed to be enhancing if it showed a mean attenuation of more than 100 HU and appeared significantly more hyperdense than the native parotid parenchyma and ipsilateral muscles on visual comparison. The enhancement pattern of the tumours was categorised as either homogenous or inhomogeneous. Tumours which showed inhomogeneous enhancement were further described as demonstrating either a non-enhancing 'curvilinear cleft' or 'cystic component', the latter defined as having a mean attenuation of 20 HU or less and being round or oval in appearance.

RESULTS

Table 1 (Figure 7) shows the age and gender distribution as well as the radiological features of the parotid gland oncocytomas. Of the 10 cases, 7 were women and 3 were men aged between 49 and 74 years (mean age of 61 years). All 10 patients initially presented with slowly enlarging painless parotid masses over a period of 6 to 96 months (mean 30 months), 2 of whom were found clinically to have bilateral parotid masses.

CT revealed a unilateral solitary tumour in 4 patients, unilateral multifocal disease in 1 patient and synchronous bilateral multifocal tumours (Figure 1) in the remaining 5 patients. Three of the 5 patients found to have bilateral parotid tumours following CT had presented with unilateral parotid masses and were clinically occult for bilateral disease. The tumour was limited to the superficial lobe of the parotid gland in the 4 patients with unilateral solitary tumours on CT (Figure 2), while both the superficial and deep lobes were involved in the other 6 patients.

The maximum axial diameter of the tumors ranged from 6 to 66 mm with a mean of 19.8 mm. All of the tumors showed sharp margins. The oncocytomas in 4 of the cases demonstrated a lobulated contour with the tumours in the other 6 cases showing smooth contours. Three patients had large parotid oncocytomas which involved the deep lobe and showed extension to the parapharyngeal space through the stylomandibular gap.
The contours of these large oncocytommas were distorted by surrounding anatomical structures such as the styloid process and surrounding muscles, giving rise to the 'deformable' appearance of the tumours (Figure 3).

The tumors in 4 of the cases showed homogenous enhancement. Heterogeneous enhancement was demonstrated in the remaining 6 cases (60 %), out of which a central non-enhancing curvilinear cleft was seen in 4 cases (Figures 4 and 5) and a cystic component seen in the other 2 cases (Figure 6). None of the tumours showed calcification. Cut sections of the gross specimens of the tumours which showed central non-enhancing curvilinear clefts revealed central grey-white scars which correlated microscopically with hyalinised and fibrous tissue. Cystic degeneration was noted histopathologically with respect to the 2 tumours demonstrated to have non-enhancing cystic components on the CT scan. We concluded that these central scars and areas of cystic degeneration would most likely be responsible for the non-enhancing curvilinear cleft and cystic component detected on CT respectively.

Seven of the patients in our series underwent either superficial or total parotidectomy depending on the location of the tumour. Ultrasound-guided core-needle biopsy was used to obtain the histopathological diagnosis in the 3 patients who declined surgery.

The follow-up duration of the 7 patients who underwent surgical resection ranged from 12 months to 19 months with a mean of 18 months. At the time of the last follow-up, no clinical evidence of local tumour recurrence was detected in these 7 patients.
Fig. 0: A 60-year-old man with bilateral parotid oncocytopmas. CT showed bilateral multifocal and homogenously enhancing parotid tumours with well-defined margins involving both the superficial (white asterisks) and deep (black asterisks) lobes of the parotid gland.

Fig. 0: A 49-year-old woman with a unilateral solitary parotid oncocytooma. A well-defined tumour with a lobulated contour and homogenous enhancement was identified on CT in the superficial lobe of the left parotid gland (white asterisk).

Fig. 0: A left parotid oncocyctoma in a 68-year-old woman. CT revealed a large 'deformable' tumour (white asterisk) which extended medially into the parapharyngeal space through the stylomandibular gap. The contour of the tumour was distorted by the styloid process (black arrow) and the left medial pterygoid muscle (black arrowheads).

Fig. 0: A 70-year-old woman with a large right parotid oncocytoma. The large tumour (white asterisk) extended medially through the stylomandibular gap into the parapharyngeal space and demonstrated a non-enhancing curvilinear cleft (black arrow).

Fig. 0: Synchronous bilateral parotid oncocytomas in another 70-year-old woman. CT demonstrated tumours in the right parotid gland (white asterisks) which showed homogenous enhancement, and a large left parotid tumor (black asterisk) with a non-enhancing curvilinear cleft (black arrow).

**Fig. 0:** A 49-year-old man with a unilateral solitary parotid oncocyтомa. The parotid tumour in the superficial lobe of the left parotid gland (white asterisk) had a lobulated contour and showed a cystic component (black arrow).

Table 1. Age and gender distribution including the radiological features of the 10 cases of parotid gland oncocytopomas.

Conclusion

DISCUSSION

Clinical features of oncocytomas resemble those of other benign and low-grade salivary gland tumours which makes clinical diagnosis challenging. Patients typically present with a solitary, slow-growing, painless parotid mass,\(^3\), \(^4\), \(^6\), \(^8\), \(^9\), \(^16\), \(^19\), \(^20\) similar to what was observed in our series. All 10 cases in our series were diagnosed in adults in their 5\(^{th}\) to 8\(^{th}\) decades with a female preponderance.

Complete surgical excision of oncocytomas in the form of superficial or total parotidectomy depending on the location of the tumour is the treatment of choice, with radiotherapy not indicated as oncocytes are radio-resistant.\(^3\) Local recurrence for oncocytomas following surgery is uncommon, although recurrence rates of 20-22% have been reported in the literature.\(^4\), \(^7\)-\(^9\), \(^23\) Malignant forms of oncocytomas or oncocytic carcinomas, characterised by cytomorphologically malignant oncocytes or evidence of metastasis, are occasionally reported and account for less than 1% of all salivary gland tumours.\(^1\), \(^3\), \(^6\), \(^14\), \(^24\), \(^25\) These are usually associated with a pre-existing oncocytoma but may arise de novo.\(^3\) No histological features of malignancy were detected in our series and none of the 7 cases who underwent surgery showed clinical features of disease recurrence following surgery.

Due to their low prevalence, only a few case reports on the CT imaging features of parotid oncocytomas are available in the published literature.\(^15\), \(^16\), \(^19\)-\(^21\) The few case reports in the published literature on MRI imaging of parotid oncocytomas describe these tumours as demonstrating T1 and T2 hypointensity with homogenous contrast enhancement.\(^19\)-\(^21\) Özcan et al. reported an oncocytoma in the deep lobe of the right parotid gland which showed T1 hyperintensity, T2 hypointensity and heterogeneous contrast enhancement.\(^15\) Kasai et al described multiple bilateral oncocytomas which were isointense on STIR images and hyperintense on DWI with corresponding low ADC values. The tumours also demonstrated early enhancement with early washout on dynamic contrast-enhanced images.\(^21\)

The ultrasound features of parotid oncocytomas are non-specific and include a hypoechoic mass with well-defined margins, not unlike other benign parotid tumours such as pleomorphic adenomas.\(^2\) Parotid oncocytomas have shown focal uptake of
technetium-99m pertechnetate but not with Gallium $^{67}$m scintigraphy.\textsuperscript{19-21} These tumours have also been reported to demonstrate uptake of FDG during PET scanning.\textsuperscript{26, 27}

The common CT findings of parotid oncocytomas described in the reviewed literature are that of a well-defined parotid mass showing homogenous enhancement. The important differential diagnoses for a well-defined enhancing parotid tumour seen on CT include a Warthin’s tumour and basal cell adenoma. Warthin’s tumours show enhancement in the early phase post-contrast scan but decreased enhancement in the delayed phase.\textsuperscript{30} Basal cell adenomas show similar increased enhancement in the early phase post-contrast scan, with Yerli et al. describing gradual washout of contrast in the delayed phase.\textsuperscript{31, 32} Pleomorphic adenomas, the most common parotid tumour which usually occurs in adults over 40 years with a slight female predominance,\textsuperscript{2, 26} are considered a less likely differential diagnosis as these demonstrate minimal or no enhancement in the early post-contrast scan but progressive enhancement in the delayed scan.\textsuperscript{29, 30} A low grade parotid malignancy is an important differential diagnosis and a major diagnostic pitfall in the imaging assessment of a well-defined enhancing parotid tumour.\textsuperscript{2, 17, 18, 30}

In addition, we have reported the features of a non-enhancing curvilinear cleft and a cystic component in the 6 cases of parotid oncocytomas with heterogeneous enhancement in our series. We concluded by correlating with histology findings that the non-enhancing curvilinear cleft was most likely secondary to a central scar. The cystic component seen on CT probably corresponded to an area of cystic degeneration, a histological finding previously associated with oncocytomas.\textsuperscript{7, 9} These imaging features have not been previously described in parotid oncocytomas, although Chawla et al. reported similar ‘linear bands’ and ‘cystic areas’ in parotid basal cell adenomas.\textsuperscript{31} Shellenberger et al. described the CT finding of a cystic parotid tail mass which was confirmed histopathologically as nodular oncocytic hyperplasia, a multifocal process with diffuse oncocytic replacement of the parotid gland which is categorically distinct from an oncocytoma.\textsuperscript{16} Cyst formation has also been commonly associated with Warthin’s tumours.\textsuperscript{2, 17, 30}

The parotid oncocytomas in all of our cases had sharp margins which conveyed benignity, in contrast to malignant salivary gland tumours which usually demonstrate ill-defined margins.\textsuperscript{2, 17, 31} The contours of the parotid oncocytomas in 4 of our cases were lobulated, a feature seen mainly with pleomorphic adenomas but also in Warthin’s tumours and basal cell adenomas.\textsuperscript{2, 17, 31, 33} Three of our cases showed large tumours which extended to the parapharyngeal space through the stylomandibular gap. The contours of these tumours were distorted by the surrounding anatomical structures, giving the appearance of ‘deformable’ tumours which is similar to the CT finding in the
Rare cases of large parotid deep lobe tumours extending to the parapharyngeal space have been described with Warthin's tumours and pleomorphic adenomas.\textsuperscript{34, 35}

Warthin's tumors are usually diagnosed in elderly men, with 10-15% showing synchronous bilateral disease.\textsuperscript{17, 25, 36} There is tendency for oncocytomas to present with synchronous bilateral, multifocal disease as evidenced by 5 out of 10 cases in our series, with the reported incidence of synchronous bilateral oncocytomas in the reviewed literature ranging from 7-15%.\textsuperscript{3, 8, 23}

There is therefore overlap of radiological features between oncocytomas and other benign parotid tumours such as Warthin's tumours, basal cell adenomas and to less degree, pleomorphic adenomas. However when taken together, the diagnosis of a benign parotid oncocytoma is favored in a middle-aged or elderly woman who presents with CT findings of well-defined, enhancing bilateral and multifocal parotid tumours which demonstrate a non-enhancing curvilinear cleft. These imaging findings will be atypical for pleomorphic adenomas due to their lack of enhancement in the early post-contrast phase. Bilateral and multifocal parotid tumours on CT also render pleomorphic adenomas and basal cell adenomas as less likely differential diagnoses as these tend to present as unilateral, solitary tumours.

Although Warthin's tumours are commonly associated with cyst formation, they are usually seen in elderly men and have not been reported to demonstrate a non-enhancing curvilinear cleft correlating histologically to a central scar. Large parotid oncocytomas in our series which extended to the parapharyngeal space through the stylomandibular gap exhibited contour distortion by the surrounding anatomical structures. The 'deformable' appearance of these tumours has only been rarely reported with other benign parotid tumours in the reviewed literature and may therefore be useful in distinguishing parotid oncocytomas on CT.

There are several limitations in our study. The CT imaging findings of the 10 cases of parotid oncocytomas in our study were described by a single unblinded senior head and neck radiologist. The authors acknowledge that a retrospective study where the CT imaging features of parotid oncocytomas were reported based on consensus by a group of blinded independent observers would have resulted in a reduction in observer bias. Further studies which examine the imaging features of parotid oncocytomas in conjunction with other parotid tumours (both benign and malignant) are necessary to assess the specificity and positive predictive value of the non-enhancing curvilinear cleft and 'deformable' appearance of parotid oncocytomas which were described in our imaging series. A high specificity and positive predictive value of these imaging features
for parotid oncocytomas may potentially aid the reporting radiologist in excluding other parotid tumours, particularly malignant neoplasms.

Although there are several reports in the published literature which describe the high sensitivity, specificity and accuracy of ultrasound-guided core-needle biopsy in establishing the histopathological diagnosis for both benign and malignant parotid tumours,

the potential for misdiagnosis in the 3 patients who underwent needle biopsy exists, in particular with respect to differentiation from oncocytic carcinomas. Judicious follow-up of these 3 patients is suggested, with a view for further imaging and repeat biopsy should malignancy become a concern.

Although an equal number of 2 parotid oncocytomas with non-enhancing curvilinear clefts were detected by each of the 4-slice and 64-slice Toshiba systems using comparable time delays in our study, the authors recognise that the difference in the speed of image acquisition between the two imaging systems may result in the representation of different phases of tumour enhancement and alter the conspicuity of the non-enhancing curvilinear cleft. In a small series of major salivary gland tumours which included a single submandibular oncocytoma, Kei et al. also described how weak tumour enhancement in an early phase post-contrast CT scan could potentially produce attenuation values similar to that of the surrounding native parotid gland parenchyma and make the tumours inconspicuous.

It is suggested that a further study be undertaken to examine the conspicuity of parotid oncocytomas and the non-enhancing curvilinear cleft described in our series with dynamic contrast-enhanced CT imaging.

CONCLUSION

A combined clinical, radiological and pathological assessment of a patient who presents with a parotid mass is essential in establishing an accurate diagnosis. The CT findings of a non-enhancing curvilinear cleft and ‘deformable’ appearance of parotid oncocytomas described in this largest imaging series to date are potentially helpful in distinguishing these benign lesions from other parotid tumours in clinical scenarios which preclude surgical resection or when biopsy results are non-diagnostic. Further studies are however advocated to validate the specificity and positive predictive value of these imaging features.
Personal Information

CT Imaging Features of Parotid Gland Oncocytomas: A Study of Ten Cases

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