Pictorial essay

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Gray scale and Doppler ultrasonography of the benign tumors of the parotid gland (pleomorphic adenoma and Warthin's tumor)

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Abstract

The purpose of this pictorial essay is to illustrate the ultrasonographic appearance of the most common benign tumors of the parotid gland: pleomorphic adenoma and Warthin's tumor. The gray scale and Doppler ultrasonographic findings of the two tumors are reviewed and exemplified.

Keywords: pleomorphic adenoma, Warthin's tumor, gray scale ultrasonography, Doppler ultrasonography

Rezumat

Scopul acestui eseu în imagini este de a ilustra aspectele ecografice a celor mai frcvente tumori benigne ale parotidei: adenomul pleomorf şi tumora Warthin. Trăsăturile ecografice ale celor două tumori, în scală gri şi color/power Doppler sunt exemplificate şi se face o trecere în revistă a datelor din literatură.

Cuvinte cheie: adenomul pleomorf, tumora Warthin, ecografie scală gri, Doppler color/power

The parotid gland is located in the parotid fascial space, anterior and inferior to the external ear and posterior to the mandibular ramus. In the same space are found: the facial nerve and its branches, Stenon's duct, lymph nodes, and vessels are found. Inside the gland the external carotid artery divides in two terminal branches – the maxillar artery and superficial temporal artery. The retromandibular vein, located near the external carotid artery and above the facial nerve trunk is used as a landmark to separate the sperficial from the deep lobes of the parotid gland. The gland extends from the zygomatic arch to the angle of the mandible, covering in part the ramus of the mandibule and posterior part of masseter muscle and resembles to a three sided pyramid. The apex of the pyramid is directed downwards and the four surfaces are orientated superior, superficial, anteromedial and posteromedial. The gland is covered by subcutaneous tissue and in its posterior side is related to the digastic (posterior belly), styloid and sternocleidomastoid muscles [1].

The normal ultrasonographic (US) appearance of the parotid gland (fig 1) is that of homogenous tissue with a very good delineation from the superficial structures. The echogenicity varies from slightly hyperechoic in comparison to adjacent muscles to very bright and markedly hyperechoic, depending on the amount of intraglandular fatty tissue [2]. Stenon's duct is usually visible only when it is dilated. In the parenchyma lymph nodes may be found: oval in shape, the short axis not exceeding 5-6 mm, with hyperechoic hilum [2,3].

One of the most common situations encountered in parotid pathology is the evaluation of parotid masses. US is considered to be the first imaging method in assessment of the lymph nodes and soft-tissue diseases of the head and neck, including the parotid gland [2,3]. A complete US examination should determine whether the mass has an intraglandular or extraglandular location, if it is a solid, cystic or mixed mass, poor or highly vas-

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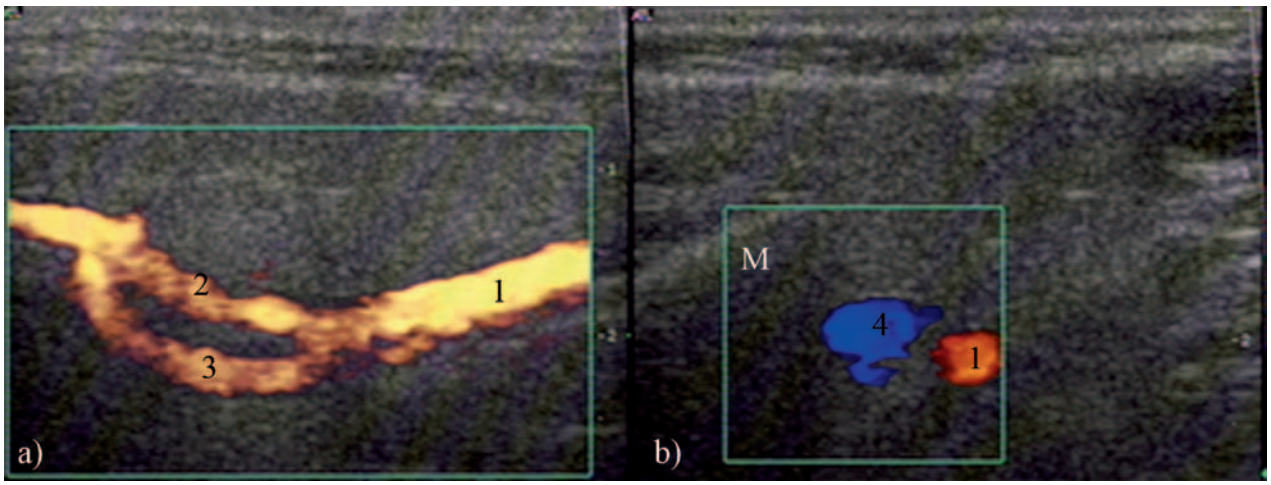

Fig 1. Normal US aspect of the parotid gland: a) power Doppler US, longitudinal scan; b) color Doppler US, transverse scan. 1 – external carotid artery with its terminal branches: superficial temporal artery (2) and maxillary artery (3); 4 – retromandibular vein; M – mandible bone

cularisated, with well or ill definite contours, associated or not with lymphadenopathy, and whether it is solitary or multicentric. All these may suggest the final diagnosis and are important for surgical planning. The majority of parotid tumors (about 80%) are benign, the most common being the pleomorphic adenoma, followed by Warthin's tumor [5].

In some cases US is not able to completely characterize a parotid mass (peculiar location, penetration of the deep lobe or behind the mandibule or a highly echoic gland with marked suppression of ultrasound waves). In these situations other imaging techniques (CT, MRI) are required.

Pleomorphic adenoma is the most frequent benign tumor of the parotid gland (60-90%). There is a slight predominance in women and it occurs most often in the fourth and fifth decades of life but may appear at any age, including in children. Pleomorphic adenomas are commonly encapsulated, grow gradually and some of them undergo malignant transformation after decades [2,4,6]. There is a risk of recurrence in 15% of cases. Because the risk is higher in cases with preoperative biopsy (the needle biopsy will open the capsule) a correct preoperative diagnosis is mandatory [4,7] and a partial parotidectomy should be performed.

The main US characteristic feature of pleomorphic adenoma (fig 2-4) is the lobular shape present in 55-91% of cases. Over 80% of tumors have well defined boundaries, formed of a thin hyperechoic line. Cases with no capsule-like structure are rare. No pleomorphic adenoma has ill-definite boundary, this being a common findings in malignant salivary gland tumors. Echogenicity is always low when compare to normal salivary gland parenchyma. Rarely, when the tumor contains mainly chondroid, the hypoechogenicity can be very pronounced [8,9,10]. As far as the echotexture the opinions are divided – heterogeneous aspect in most of the cases [9,10] (fig 5) or homogeneous internal echos (fig 6) [8,11]. Białek et al [2,12] emphasize that this disagreement could be related to the transducer resolution – when high-frequency transducers are used the internal dishomogeneity become visible. Sometimes hemorrhage or cystic degeneration occurs and small and close to oval in shape anechoic spaces

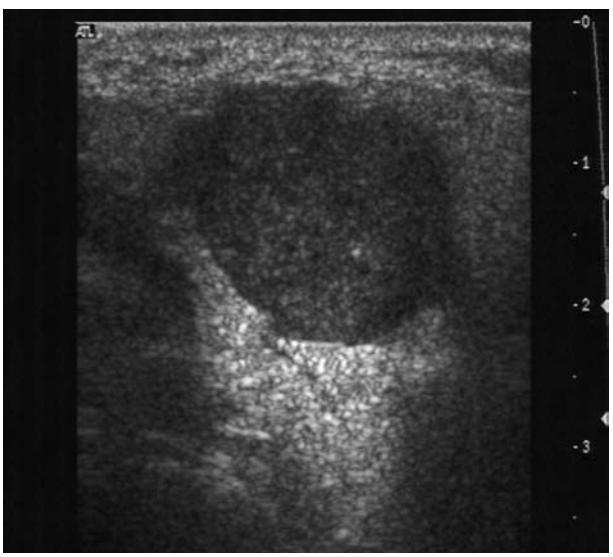

Fig 2. Typical gray scale US appearance of the medium pleomorphic adenoma: lobular shape, well defined boundaries, homogeneous structure, posterior acoustic enhancement.

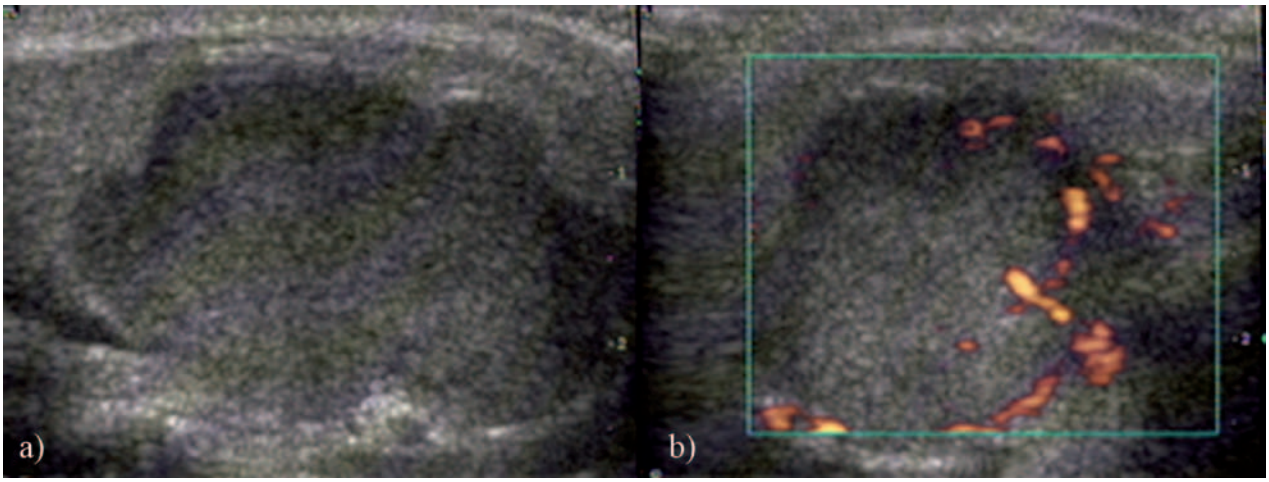

Fig 3. Medium pleomorphic adenoma: a) longitudinal scan, gray scale US; b) transverse scan, power Doppler US. The lobular shape, well defined boundaries with a visible capsule, homogeneous structure, posterior acoustic enhancement, and predominant peripheral vascularization are observed.

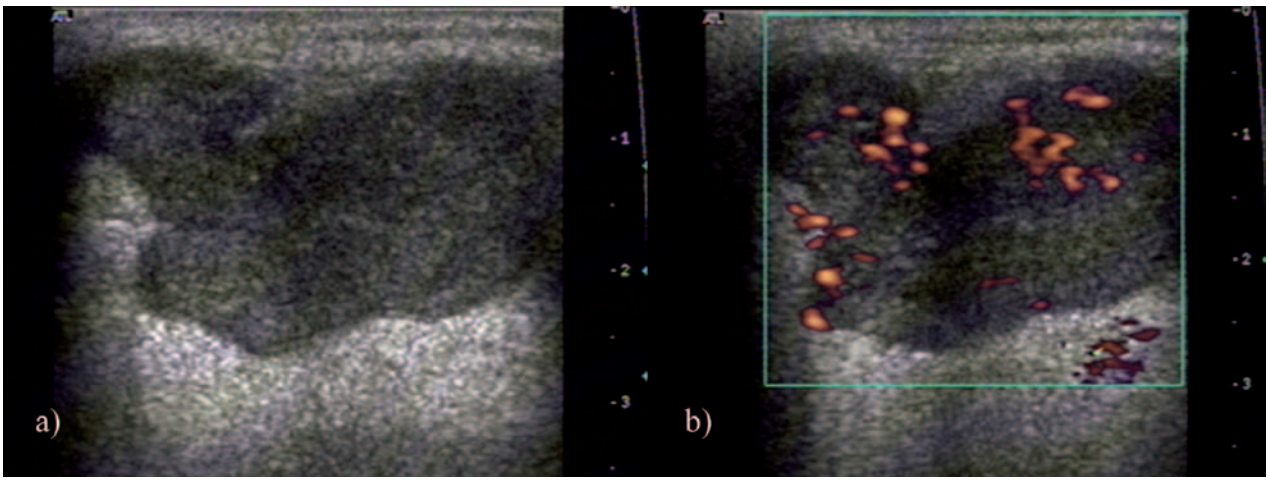

Fig 4. Medium pleomorphic adenoma a) gray scale US; b) power Doppler US, with characteristic US findings: lobular shape, well defined boundaries, homogeneous structure, posterior acoustic enhancement, and predominant peripheral vascularization.

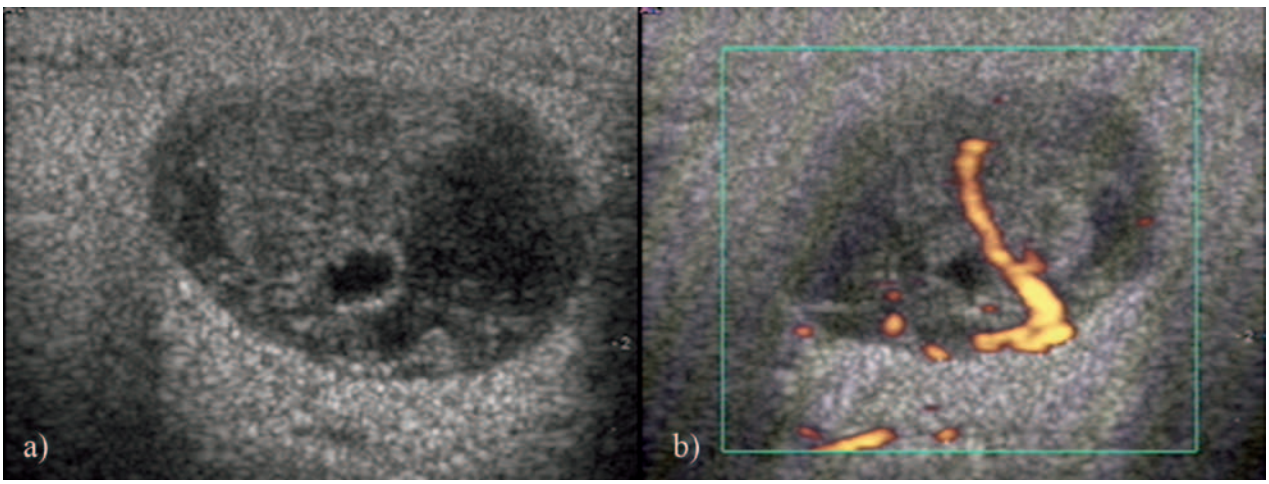

Fig 5. Heterogeneous aspect of an oval pleomorphic adenoma a) gray scale US – mixture of hyperechoic, hypoechoic, and cystic areas; b) power Doppler US – a single pole of vascularization. Well defined boundaries and posterior acoustic enhancement are preserved

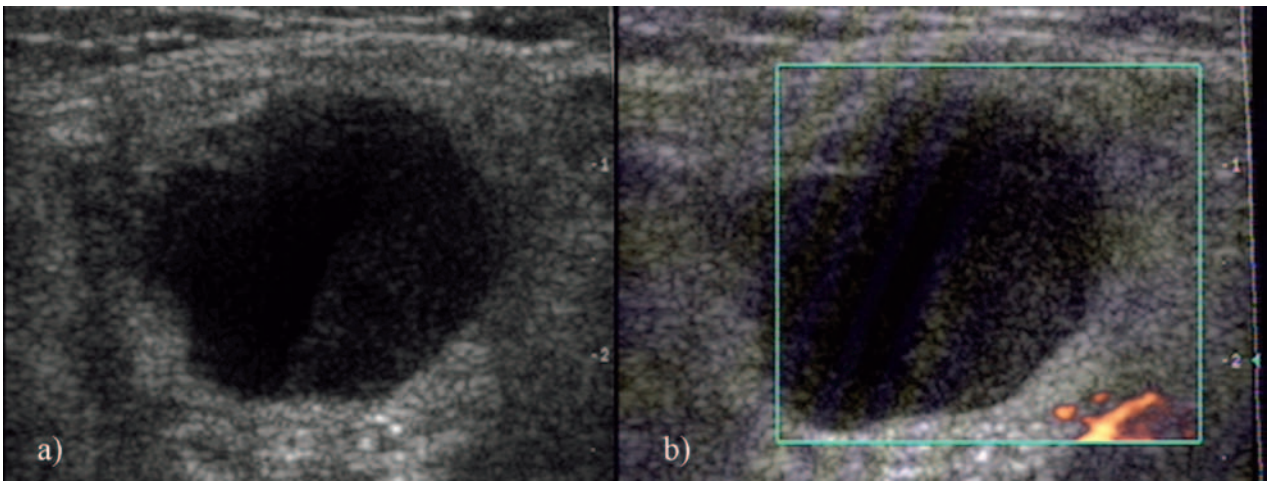

Fig 6. Pleomorphic adenoma with slightly lobular shape, well defined boundaries, and posterior acoustic enhancement: a) gray scale US suggests that the almost anechoic, clearly delineated, medial part of the tumor represents fluid component. However, at surgery no cystic part was found: b) power Doppler US- no vascularization was detected

appear [12]. The posterior acoustic enhancement is found in 73% of tumors [8].

Many previous studies reported low or intermediate degrees of vascularization of pleomorphic adenomas [9,11,12], with a peripheral basketlike pattern (fig 7) due to a fine vascular network surrounding the tumor [11]. An increased marked vascularisation, with a systolic peak flow over 60 cm/sec is indicator of malignancy [11].

Warthin's tumor (papillary cystadenoma, adenolymphoma) originates from heterotopic parotid tissue located within parotid lymph nodes [4]. It is more often found in middle-aged or older men and the relationship between smoking and Warthin's tumor was proved [13]. The tumor is usually a slow growing one, painless, and

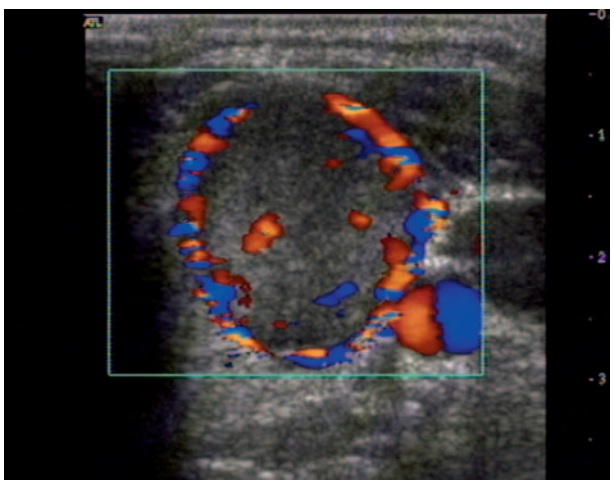

Fig 7. Typical color Doppler US of the medium pleomorphic adenoma – peripheral basketlike pattern

in 10-15% of the cases it may be bilateral or multifocal [4]. Enucleation is used as surgical treatment in Warthin's tumor because this tumor does not recur [14].

Warthin's tumor is located more often in the superficial lobe of the parotid gland, has an oval or round form except for the large tumors where the shape can be lobular (fig 8) [9,14]. The borders are well-defined in the majority of cases, an ill-defined boundary should be interpreted as a warning sign for malignancy [9,11,14]. Warthin's tumor is a hypoechoic mass with a heterogeneous echotexture in about 50% of cases due to the cystic component. The proportion of the cystic component tends to be higher in larger tumors and the presence of multiple anechoic cysts is a sensitive marker of Warthin's tumor [8,9,14]. The acoustic enhancement is less frequent encountered when compared with pleomorphic adenoma (37%) [8].

Vascularization of intermediate degree can be detected in over 90% of Warthin's tumors, of intermediate degree. Martinoli et al [11] described a special pattern of Warthin's tumor vascularization: vessels that enter into nodule through one or more pedicles with a regular distribution within the tumor (fig 9, fig 10). When the structure is mixed the vessels only emerged from the parenchimatous portion of the tumor. This pattern was not confirmed in the study of Yuan et al [9] (fig 11, fig 12).

Differential diagnosis to malignant tumors of the parotid gland can be achieved easily when US malignant findings are encountered (fig 13) or it can be a challenge when there are insufficient data (fig 14).

In conclusion most pleomorphic adenomas are hypoechoic, homogeneous and lobulated masses, with acoustic enhancement and peripheral vascularization while

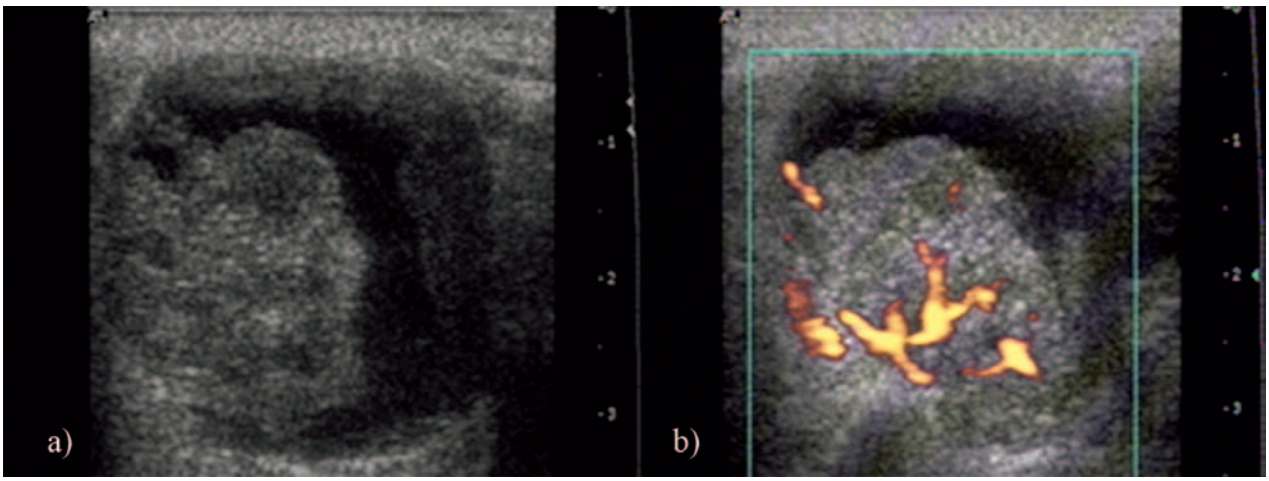

Fig 8. Small homogeneous and hypervascularizated Warthin's tumor of the left parotid gland: a) gray scale US; b) color Doppler US. The patient, a 67 year old man, had 3 years before a partial parotidectomy of the right parotid gland due to a Warthin's tumor infected with Pseudomonas aeruginosa.

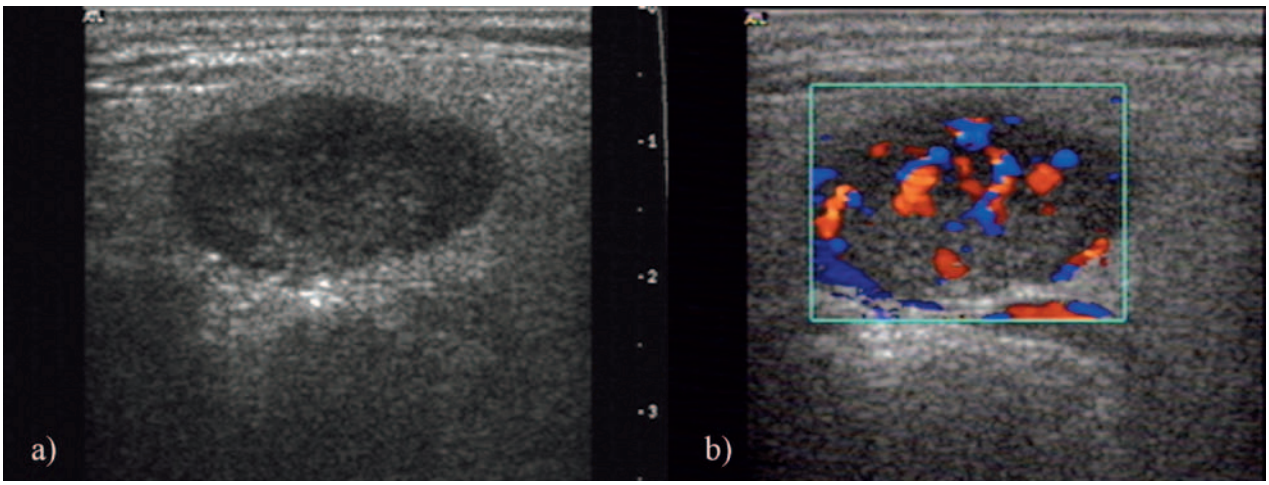

Fig 9. Large Warthin's tumor with mixt structure: a) longitudinal scan; b) transverse scan; c) power Doppler US. The cystic areas are dominants and the vascularization emphasizes the parenchimatous component of the tumor.

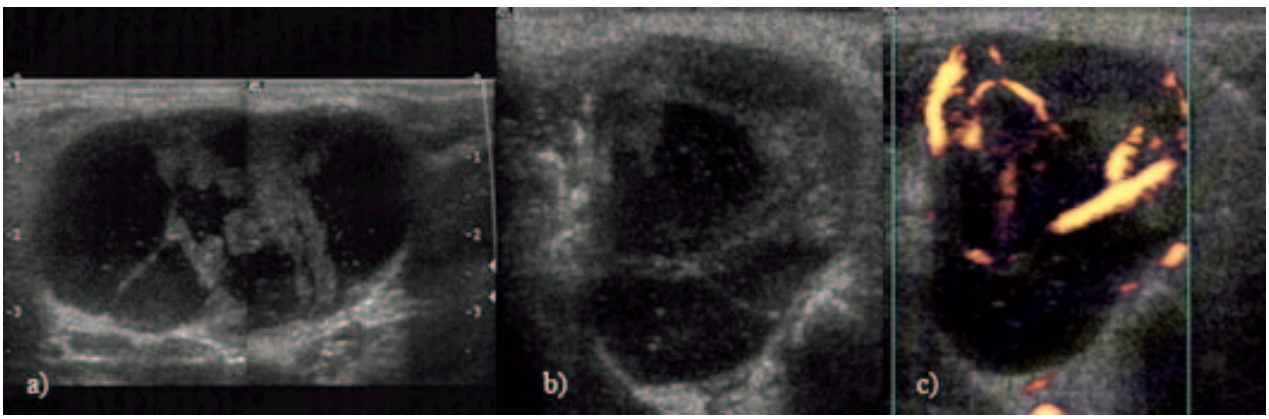

Fig 10. Large Warthin's tumor with fluid-filled space clearly delineate from the solid part of the tumor: a) gray scale US; b) power Doppler US

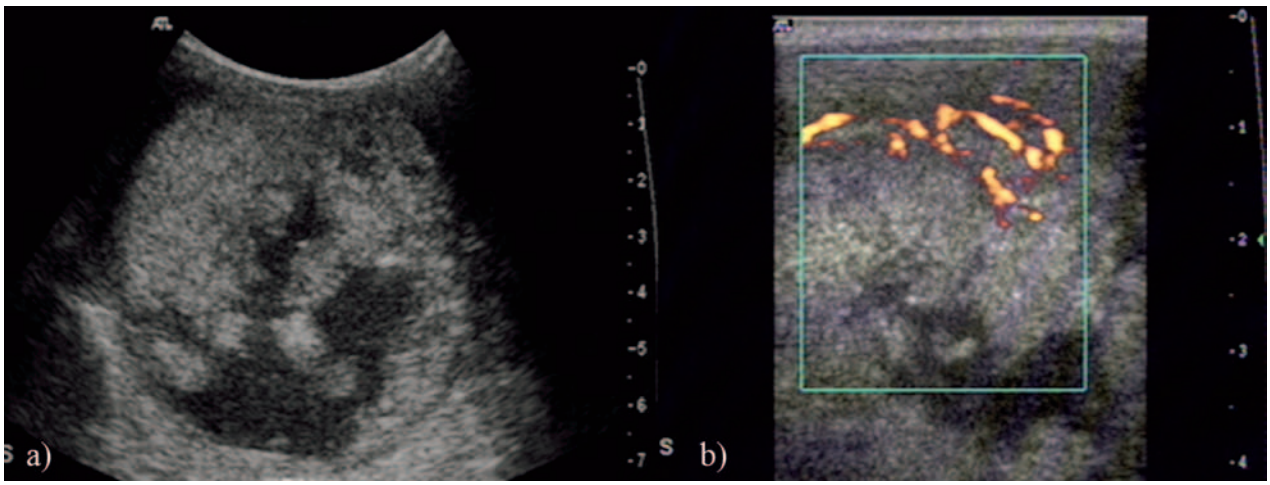

Fig 11. Well delineation and heterogeneous structure of a giant Warthin's tumor extended in the whole parotid gland a) gray scale US with 3.5 MHz convex transducer; b) power Doppler US showing entering in the tumor through multiple pedicle

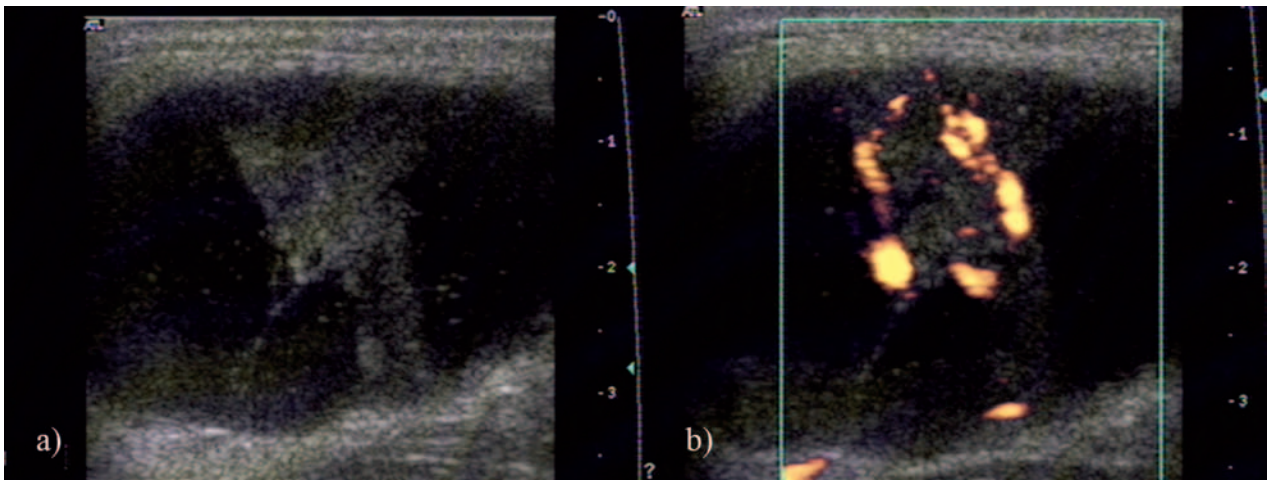

Fig 12. Warthin's tumor a) gray scale US; b) power Doppler US with high vascularization of the solid component, in a 64 years male patient. The tumor had a fast growing in the last week and became very painful. Infection with Staphylococcus aureus was proven postoperatively.

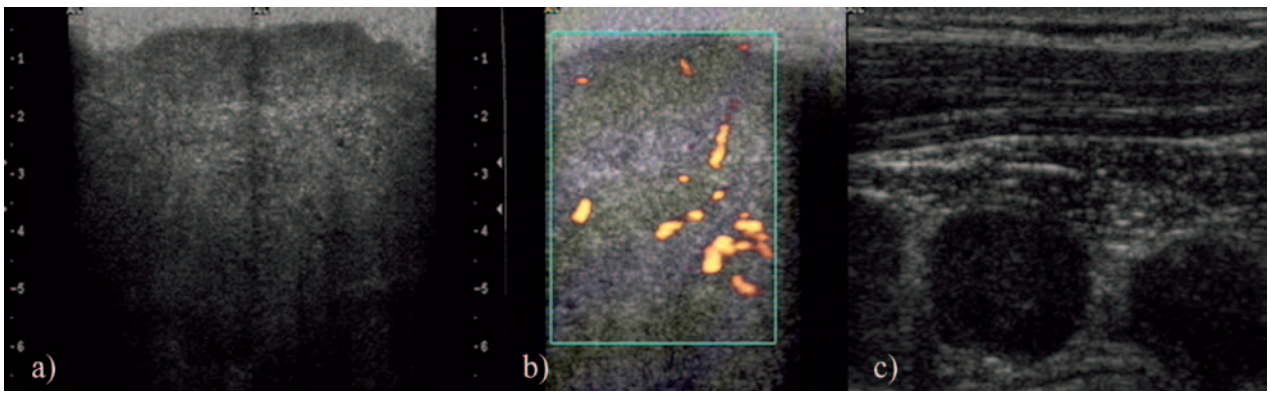

Fig 13.

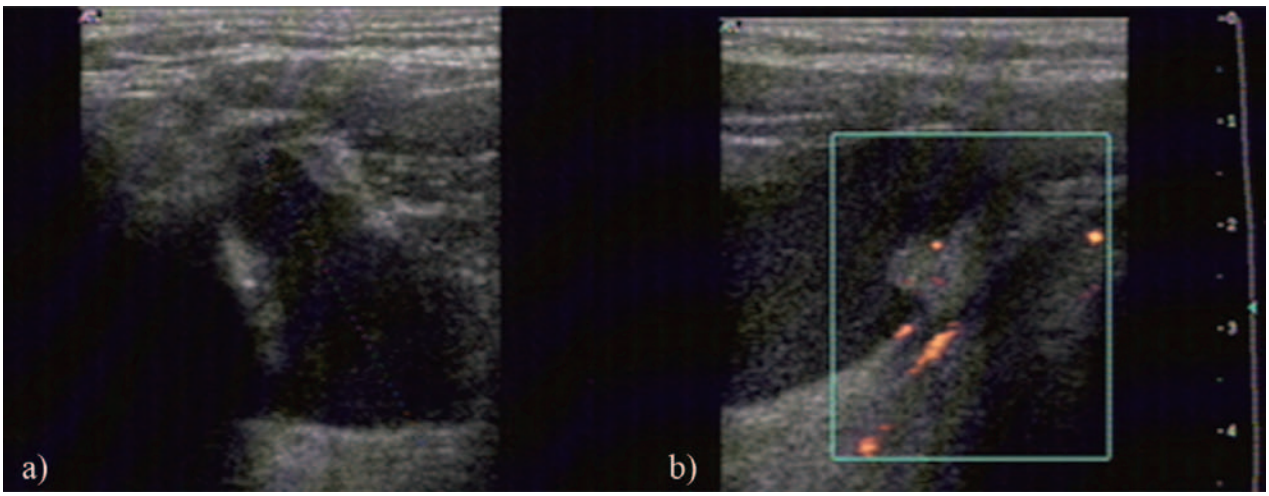

Fig 14.

Warthin's tumors are more likely to be ovals, with cystic component and internal vascularization. US should be considered as the first imaging technique to be used for the preoperative assessment of the parotid gland tumors.

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