Introduction

The salivary glands are the seat of many pathologic disorders. Many pathologic conditions of the salivary glands are diagnosed clinically because the parotid and the submandibular glands are easily accessible to palpation ***(Silvers et al., 1998)***

The Ultrasonographic diagnosis of salivary glands diseases can give more accurate information than clinical data alone, in patients with solid masses of the salivary glands; it confirms the finding of salivary gland tumour in 99% of the cases. In non solid diseases of the salivary glands its diagnostic accuracy is slightly lower ***(Ivanova et al., 2003)***

Due to their superficial position, the parotid, submandibular, and the sublingual glands can be imaged with high resolution transducers. In acute inflammatory diseases sonography can differentiate between obstructive and non obstructive sialoadenitis. Abscess may be detected and may be punctured under US guidance ***(Gritzmann et al., 2003).***

Nuclear scanning tests use a special camera to take pictures of the body tissues after a radioactive tracer (radionuclide or radioisotope) accumulates in the tissues to make them visible. Nuclear medicine imaging of salivary

glands and ducts does not need any substance to be injected in the duct orifices ***(Leslee et al., 2001).***

This investigation is useful when tumors or inflammations are suspected in the salivary glands. It is also requested in the case of salivary ducts obstruction ***(Roser Solans et al., 2001).***

Aim of the Work

The aim of this work is to highlight the value of both ultrasound and nuclear medicine imaging of salivary glands in different pathological processes.

Anatomy of the Salivary Glands

- Salivary glands contain cells discharging a secretion into the oral cavity. The major salivary glands are located at some distance from the oral mucosa, with which they are connected by extraglandular ducts.
- The minor salivary glands lie in the mucosa or the submucosa, opening directly through the mucosa or indirectly via many short ducts (Fig.1).
- The major salivary glands include the paired parotid, submandibular and sublingual glands while the minor salivary group includes those in the tongue, the anterior lingual glands and numerous small lingual (including Von Ebner's) glands of the lingual mucosa, and others as small labial, buccal and palatal glands ***(Sonesson et al., 2003).***

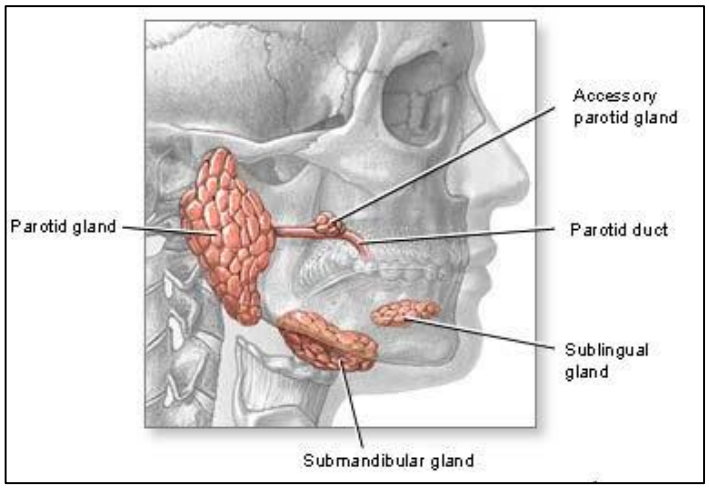

Fig. (1): Distribution of the major salivary glands ***(Williams et al., 1995*)**

Functions of the salivary glands:

- Lubrication of food to assist deglutition.
- Moistening the buccal mucosa (important for speech).
- Provision of an aqueous solvent necessary for taste and as a fluid seal for sucking.
- Secretion of digestive enzymes such as salivary amylase and of hormones and other compounds, such as a glucagon-like protein and possibly serotonin and secretion of antimicrobial agents (IgA, lysosyme and lactoferrin) ***(Humphrey et al., 2001).***

1- Parotid gland:

The paired parotid glands are the largest of the salivary glands, each has an average weight of about 25 grams.It is situated below the external auditory meatus and lies in a deep hollow behind the ramus of the mandible and in front of the sternocleidomastoid muscle ***(Gritzmann, 2003).***

The parotid gland is like an inverted, flat, three sided pyramid, presenting a small superficial, anteromedial and posteromedial surfaces: it tapers inferiorly to a blunt apex.

During development, the parotid gland covers the lateral surface of the facial nerve and in the fully formed gland, the facial nerve is said to divide the parotid gland into superficial and deep parts or lobes ***(Pedersen et al., 2002).***

The superior margin of the gland extends upwards behind the temporomandibular joint into the posterior part of the mandibular fossa.This part of the gland is called the glenoid process.

The anterior part of the gland extends forward superficial to the masseter muscle to form the facial process. A small part of the facial process may be separated from the main gland and is called the accessory part of the gland. The deep part of the gland may extend forwards between the medial pterygoid muscle and the ramus of the mandible to form the pterygoid process ***(Perdersen et al., 2002).***

*** Parotid duct or Stensen's duct:**

The parotid duct, 5 cm long, emerges from the facial process of the gland and passes forward over the lateral surface of the masseter muscle.

At the anterior border of the muscle it turns sharply medially and pierces the buccal pad of fat and the buccinator muscle. It then passes forward for a short distance between the muscle and the mucous membrane and finally opens into the vestibule of the mouth upon a small papilla, opposite the upper second molar tooth. The accessory part of the gland is drained by a small duct that opens into the upper border of the parotid duct. The accessory part of the parotid gland and the transverse facial artery lie above the duct ***(Mc Minn, 1998).***

*** Structures within the parotid gland:** (Fig. 2a,b)

The structures within the parotid gland from lateral to medial are:

1- The facial nerve.

2- The retromandibular vein.

3- The external carotid artery.

Some members of the parotid group of lymph nodes are located within the gland.

The facial nerve emerges from the stylomastoid foramen and enters the posteromedial surface of the gland. It passes forward within the gland, superficial to the retromandibular vein and the external carotid artery, and divides into its five terminal branches.

The retromandibular vein is formed within the parotid gland by the union of the superficial temporal and maxillary veins. The external carotid artery, at the level of the mandible, divides into the superficial temporal artery and the maxillary artery ***(Pedersen et al., 2002).***

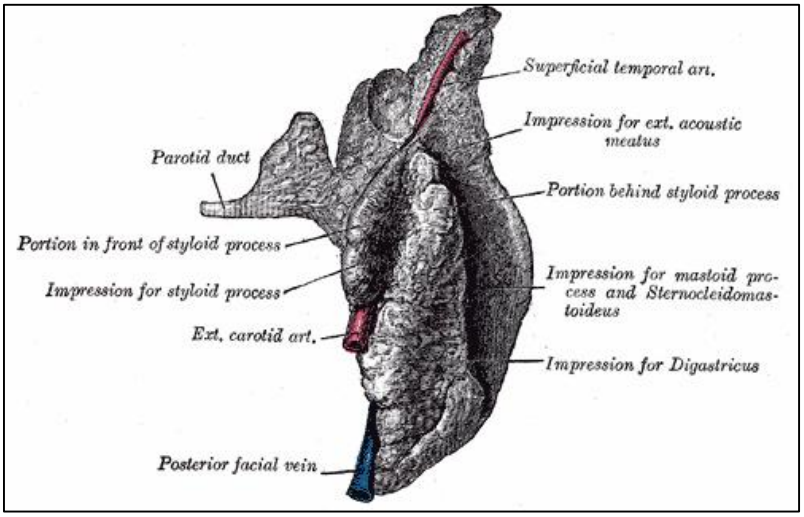

Fig. (2a): The right parotid gland: posteromedial surface ***(Williams et al., 1995).***

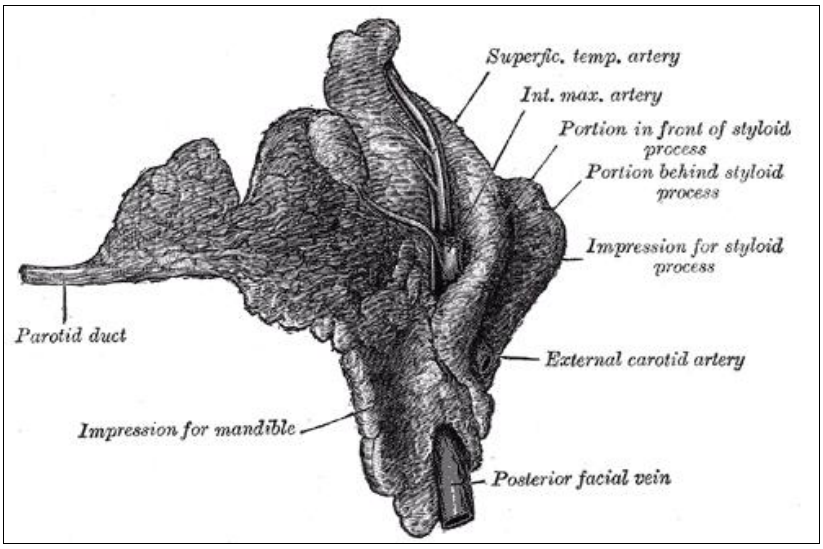

Fig. (2b): The right parotid gland: anteromedial surface ***(Williams et al., 1995)***

*** Blood supply of the parotid gland:**

The parotid arterial supply is from the external carotid and its branches near the gland namely: the superficial temporal and the maxillary arteries.The veins drain into the retromandibular vein ***(Gritzmann et al., 2003).***

*** Lymph drainage:**

The lymph vessels lying on and within the gland end in the superficial and deep cervical lymph nodes.

*** Nerve supply:**

Sympathetic:From plexus around ecternal carotid artery.

Parasympathetic:which is the secretomotor supply (interior salivatory nuckeus of the glossopharyngeal nerve) sends parasympathetic fibers that pass to the tympanic plexus in the middle ear. From this plexus arises the lesser petrosal nerve which relays in the otic ganglion.Post ganglionic parasympathetic fibers join the auriculotemporal nerve of the trigeminal nerve to reach the parotid gland (Fig.3)

Sensory nerves : To the gland from auriculotemporal nerve, to the capsule from the great auricular nerve. ***(Sonesson et al., 2003).***

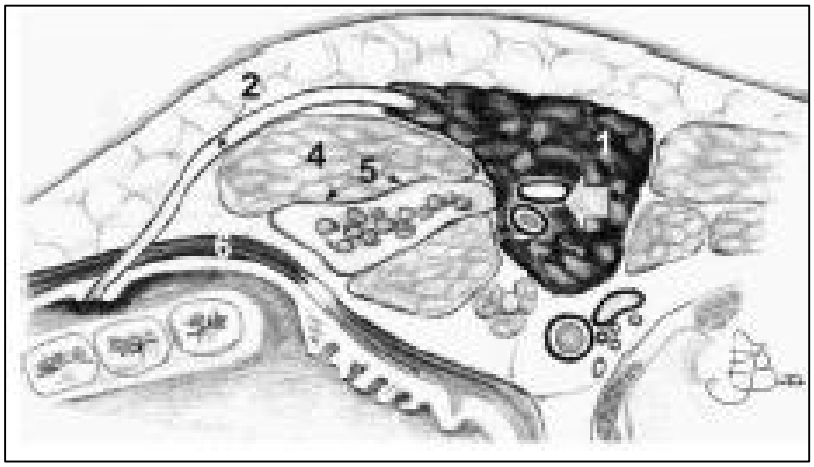

Fig. (3): Diagram shows the location of the Stensen's duct. **(1)** parotid gland, (**2)** stenon duct, **(4)** masseter muscle, **(5)** surface of the mandible, **(6)** buccal muscle, large arrow = retromandibular vein and external carotid artery ***(Candiani& Martinoli .,1995)***

* <u>Relations of the parotid gland</u>:

The relations can be divided into superficial, superior, posteromedial, and anteromedial (Figs. 4&5).

- *The superficial relations* are the parotid lymph nodes, superficial fascia, great auricular nerve and skin.

- *The superior relations* are the external auditory meatus, and the posterior surfaces of the temporomandibular joint.

- *The posteromedial relations* are the mastoid process, the sternocleidomastoid, the posterior belly of the digastric, the styloid process and its attached muscles, the carotid sheath with the internal carotid artery, the internal jugular vein and

the vagus, glossopharyngeal, accessory, hypoglossal and facial nerves.

- *The anteromedial relations* are the posterior border of the ramus of the mandible, the temporomandibular joint, the masseter, the medial pterygoid muscle, the terminal branches of the facial nerve, and the stylomandibular ligament. At the union of the anteromedial and posteromedial surfaces, the gland lies in contact with the pharyngeal wall ***(Williams et al., 1995).***

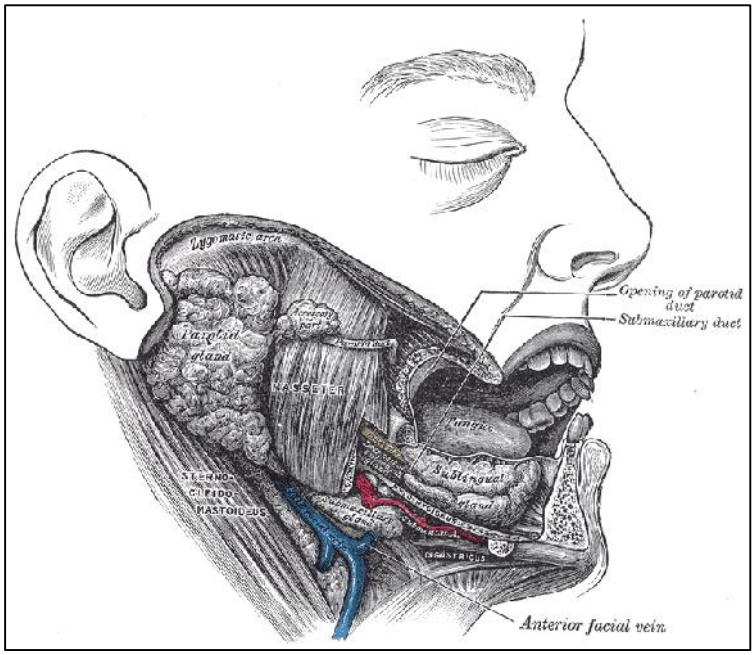

Fig. (4): Dissection showing the relations of the salivary glands of the right side ***(Williams et al., 1995).***

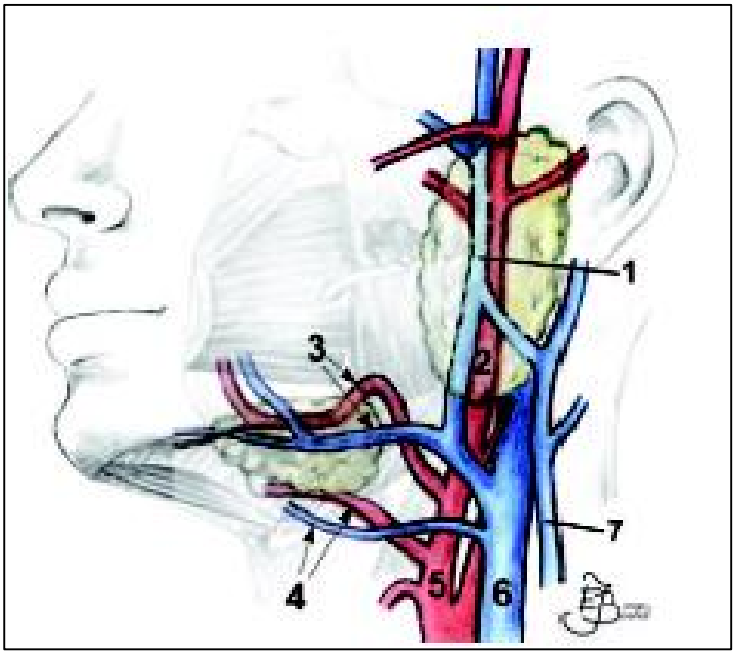

Fig. (5): Drawing shows the major blood vessels in the area of the salivary glands. **(1)** retromandibular vein, (**2**) external carotid artery, **(3)** facial artery and vein, **(4)** lingual artery and vein, **(5)** external carotid artery, **(6)** internal jugular vein, **(7)** external jugular vein***.(Takahashi et al .,2005)***

2- The submandibular glands:

The paired submandibular glands are irregular in shape and about the size of a walnut. Each consists of a large superficial and a smaller deep part, continuous with each other around the posterior border of the mylohyoid muscle.

The superficial part situated in the digastric triangle, reaches forward to the anterior belly of the digastric muscle and back to the stylomandibular ligament, which separates it from

the parotid gland. Above, it extends medial to the mandible's body; below, it usually overlaps the intermediate tendon of the digastric muscle and the attachment of the stylohyoid muscle The inferior surface covered by skin, platysma and deep fascia, is crossed by the facial vein and facial nerve's cervical branch; near the mandible the submandibular lymph nodes are in contact with the gland and some may be embedded in it. ***(Pedersen et al., 2002).***

The lateral surface is in relation with the submandibular fossa (on the medial surface of the mandibular body) and the mandibular attachment of the medial pterygoid muscle to reach the mandible's lower border.

The medial surface is related anteriorly to the mylohyoid muscle, separated from it by the mylohyoid nerve and vessels, and branches of the submental vessels. More posteriorly, it is related to the styloglossus muscle, stylohyoid ligament and glossopharyngeal nerve, which separates it from the pharynx. At its intermediate part, the medial surface is related to the hyoglossus muscle, separated from it by the styloglossus muscle, the lingual nerve, submandibular ganglion, hypoglossal nerve and deep lingual vein (from above downwards).

Below, the medial surface is related to the stylohyoid muscle and the posterior belly of the digastric muscle ***(Pedersen et al., 2002).***

*** <u>The submandibular duct or wharton's duct</u>:**

It is about 5 cm long and has a thinner wall than the parotid duct. It begins from numerous tributaries in the superficial part of the gland and emerges from the medial surface of this part of the gland behind the posterior border of the mylohyoid muscle; it traverses the deep part, passing at first up and slightly back for 4 or 5 mm and then forwards between the mylohyoid and hyoglossus muscles.

Passing between the sublingual gland and genioglossus muscle it opens in the oral floor on the summit of the sublingual papilla at the side of the frenulum of the tongue. As it traverses the gland's deep part it receives small tributaries draining this part of the gland (Fig.6) ***(Pedersen et al., 2002).***

*** <u>Blood supply</u>:**

The arteries supplying the submandibular gland are branches of the facial and lingual arteries .Venous drainage into the common facial and lingual veins

*** <u>Lymph drainage</u>:**

The lymph vessels drain into the submandibular lymph nodes

*** Nerve supply**

via submandibular ganglion which convey to the gland sensory nerves fro the lingual nerve and sympathetic fibers from the plexus arpund the facial artery,parasympathetic (secretomotor fibers) from chorda tympani. ***(Williams et al., 1995).***

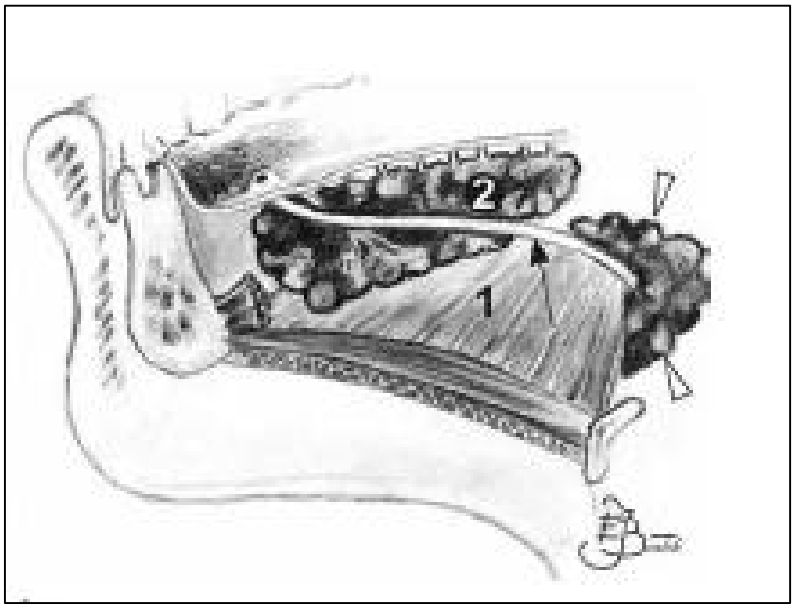

Fig. (6): Diagram shows the course of the Wharton duct (arrow). Arrowheads. Submandibular gland, **(1)** mylohyoid muscle, (**2)** sublingual gland ***(Pedersen et al., 2002).***

3- The sublingual glands:

They are the smallest of the major salivary glands, weighing about 2 grams, they lie just under the sublingual mucosa in the floor of the mouth, each in contact with the sublingual fossa on the lingual aspect of the mandible, close to the symphysis menti. Each is narrow, flat, shaped like an almond.