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Case study

The facial nerve versus the retromandibular vein: a new anatomical relationship

FR Alzahrani*, KH Alqahtani

Abstract

The facial nerve is an important nerve that controls different functions. Its relationship to the retromandibular vein and parotid tumours should be pre-operatively estimated to avoid nerve injury or bleeding that may result from a different unknown nerve–vein relationship. Here, we report the case of a 65-year-old male with Warthin's tumour of the right parotid gland and who under went superficial parotidectomy that showed a novel facial nerve and retromandibular vein relationship.

Introduction

The facial nerve (FN) is an important and sensitive nerve having different essential functions. Its location and anatomical relationship with the surrounding tissues in the parotid gland, especially the retromandibular vein (RMV), are of great importance. Variations in the course of the FN in the parotid gland must be taken into consideration when performing parotid tumour excision in order to avoid nerve injury. There are several methods to localize the FN. One of them involves using standard anatomical landmarks including the mastoid process, posterior belly of digastric muscle, tragal pointer and tympanomastoid fissure. Subsequently, by following the nerve from the mastoid process or tracing its distal branches in a retrograde manner, the main trunk can be located. In posteriorly located tumours between the parotid gland and mastoid process, there is another method for locating the FN; this method involves locating the RMV in the neck and following it upward until the inferior division of the FN superficially passes to the vein. By locating the inferior division, the main trunk of the nerve can be traced and located[1]. In the present study, we report a novel variation of an abnormal relationship between the FN and RMV that, if missed, may increase the risk of bleeding and nerve injury.

Case Study

A 65-year-old male patient presented with progressive painless periauricular swelling in the right parotid region for the last three years with no facial asymmetry. There was no complaint of dysphagia or shortness of breath. No weight loss was noticed. A 1.5 × 2 cm tail of parotid mass was observed on physical examination that was firm, static and mildly tender. The colour of the skin over and around the mass was normal with no trophic changes. The FN was intact with no other swellings. Neck lymph nodes were not palpable. A computed tomography (CT) scan showed that the right parotid gland was mildly and diffusely prominent, showing two oval, relatively hyperdense and well-defined structures located in the superior and facial portion of the right parotid gland. The larger structure was approximately 2.2 × 1.4 cm in diameter with a relatively hypodense centre (Figure 1). There was minimal enhancement after administration of intravenous contrast material. These features were suggestive of an enlarged right intra-parotid lymph node. The patient underwent fine needle aspiration that showed Warthin's tumour.

Surgical procedure

After obtaining the patient's consent, he was taken to an operating room where he underwent the surgery under general anaesthesia. The surgical procedure was initiated using a modified Blair incision, raising the sub-superficial musculoaponeurotic system, subplatysmal flap until we reached the masseter muscle. The aim was to identify the FN using an antegrade technique. To achieve this aim, the greater auricular nerve was identified and followed until it reached the auricle. Subsequently, the sternocleidomastoid muscle was separated, the digastric muscle was identified and it was followed until the digastric ridge. We dissected the region between the ear cartilage and parotid gland until we reached the FN.

We identified the main trunk of the FN and followed it using an antegrade technique until we reached all branches. The FN was observed to pass through the RMV, which is very unusual. There were two separate upper and lower rings in the vein course; the superior and inferior divisions of the FN passed through these rings, respectively (Figures 2 and 3). Subsequently, the tumour was removed. Haemostatic agents were applied, and the skin was closed into two layers. No immediate post-operative complications were reported, and the patient had an uneventful recovery.

Discussion

Knowledge of the normal anatomy of the extra-cranial FN and its relationship with the RMV is essential for surgeons dealing with parotid glands. Formation of the RMV by union of the superficial temporal vein and maxillary vein mostly occurs at a level

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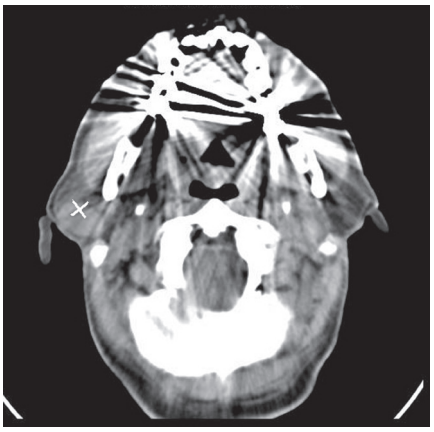

Figure 1: Axial CT scan showing right parotid tumour.

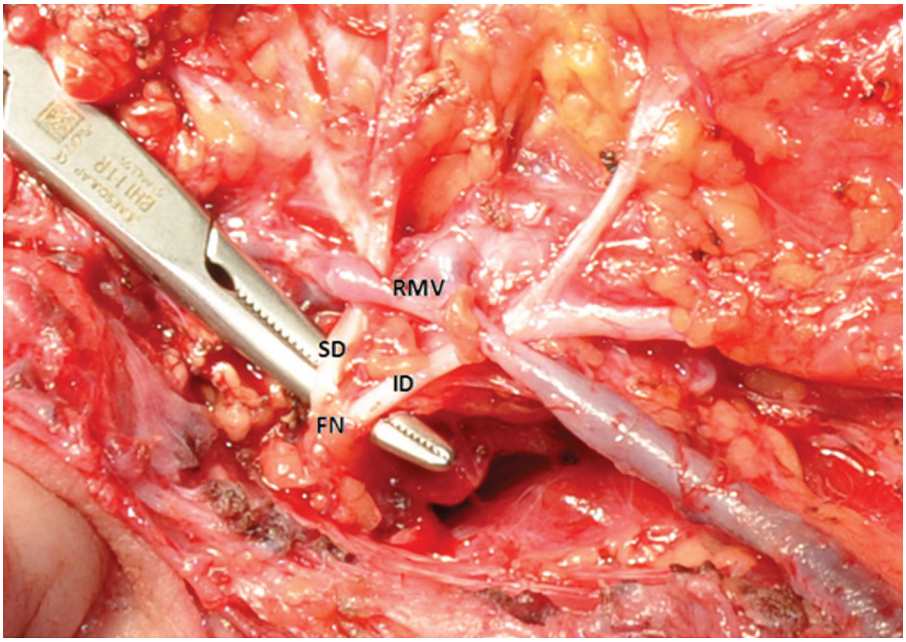

Figure 2: Lateral view of right facial nerve (FN) giving superior division (SD) and inferior division (ID); each of them pass through a separate ring in theretromandibular vein (RMV).

higher than the passage of the main trunk and branches of the FN, where they laterally pass to the vein. In normal anatomical variation, the risk of bleeding from the RMV as a result of its injury is not high during parotid surgery. In contrast, in cases of abnormal anatomical variation where RMV passes laterally to the FN or its branches, the risk of bleeding and nerve injury during parotid surgery is much higher[1,2].

Maxillofacial surgeons should be also familiar with different FN variations. In open surgical reduction of mandibular condyle fractures, the FN and its branches can be localized by using the superficial temporal veins and the RMVs as a guide, even in abnormal course of the nerve. This approach can be useful in protecting the FN during surgery[3]. In a study conducted by Kim *et al.*[4], 85 facial-halves were examined to document the anatomy of the marginal mandibular branch of the FN by correlation with the surrounding tissues. They found that the inferior division of the FN in 83% specimens crossed laterally to the RMV (52% dividing into cervical, marginal mandibular and buccal branches after crossing the vein, where 31% divided into the same branches before crossing). Further, 17% of the inferior division of the FN crossed medially to the RMV (6% dividing into terminal branches after crossing the vein, where 11% divided before crossing). The nerve–vein relationship does not have to be the same in both halves of the face, as was shown by Kopuz *et al*. in 15% of bilaterally dissected cadavers[5].

Unfortunately, few cases have been reported in the literature regarding different variations in the courses of the FN and RMV. Because of this, we could not decide if such variations are uncommon. In a study conducted by Wang *et al*., facial halves of 120 Chinese adults were selected; it was found that 100% of the mandibular branches of the FN were lying superficially to the RMV[6]. There seems to be no fixed rule regarding this nerve–vein relationship, because we found that other studies presented some cases of the deep course of the FN in relation to the RMV. In a study conducted by Laing and McKerrow[2], of a total of 54 parotid dissections, five cases showed that the superior division of the FN divided to pass medially and laterally to the RMV and that the inferior division passed laterally; however, only one case showed that the inferior division of the FN divided to pass medially to the RMV. Another report involved a left superficial parotidectomy, which showed that the inferior division of the FN passed medially to the RMV, while the superior division passed laterally[1]. Although these variations are believed to be uncommon, their percentages should not be underestimated, because in one study, 5 of 50 FN dissections (10%) showed that the inferior branches of the FNs pass medially to the RMV[5]. Different relationships between the FN and RMV are not limited to which one of them passes medially or laterally to the other. Recently, Babademez *et al*. reported a new anomalous relationship in left superficial parotidectomy of pleomorphic adenoma[7]. They showed that the inferior division of the FN passes between the superficial temporal and maxillary veins, where they unite to form the RMV at a level lower than normal[7]. In a recently published study involving 132 parotid dissections, four cases showed that the RMV

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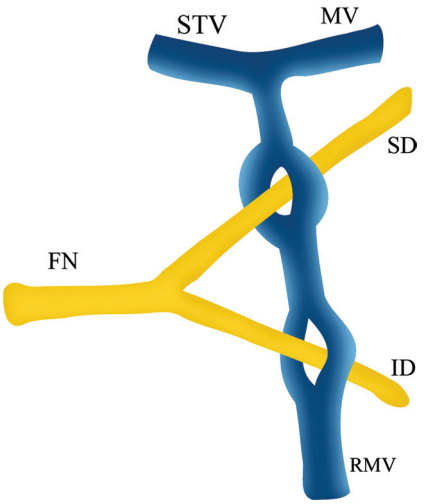

Figure 3: FN, facial nerve; RMV, retromandibular vein; STV, superfacial temporal vein; MV, maxillary vein; SD, superior division; ID, inferior division.

formed a ring. The FN trunk passed through this ring in two cases, while the other two cases showed that the inferior division of the FN passed through this ring[8]. Our case is close to these four cases but not exactly the same, because it shows that the two RMV rings formed around the superior and inferior divisions of the FN.

Nowadays, parotid tumour cannot be excised without pre-operative assessment of the tumour location and its extension. CT sialography was a good tool in locating the tumour, but it was withdrawn because of its invasiveness and development of other contrast-mediated modalities with better results[9]. To examine whether the parotid mass is cystic or solid, ultrasound is of good value. However, it has a weak tendency in locating the anatomical site of the mass[10]. CT is considered to be the initial choice for localizing the tumour, measuring its size and demonstrating abnormal pathology of the salivary gland[11]. Magnetic resonance imaging (MRI) is believed to be better than CT for differentiating soft tissues; this is advantageous as it allows examining if the mass originates from the parotid gland itself or from the surrounding tissues[12]. Parotid tumours can be localized as deep, superficial or both by knowing the course of the FN which divides the parotid gland into deep and superficial parts. Determination of the tumour site and size and whether the tumour is benign or malignant can aid in deciding the surgical procedure to be performed and the possibility of FN injury[6]. In a study conducted by Ragbir *et al.*[13], three pre-operative radiological (involving CT and MRI) techniques were used in 26 patients with parotid tumour to localize the FN. These findings were then compared with intraoperative findings, as a gold standard. The results were not 100% accurate and few false positive and negative values were reported. This is the reason why pre-operative imaging, which is used as an indicator of FN location, cannot be completely trusted. The FN and RMV can be pre-operatively used to locate the tumour site. In a study conducted by Ariyoshi and Shimahara[14], with the help of MRI, two criteria were used to locate the tumours depending on the FN and RMV. The first criterion involved a facial line that connects the lateral surface of the posterior belly of digastric muscle to lateral surface of the cortical bone of ascending ramus of mandible. If majority of the mass was located laterally to this line, it was considered to be a superficial tumour; and if it was located medially to the line, it was considered to be a deep parotid tumour. The other criterion involved the relationship to the RMV criterion. If the vein was medially pushed or not displaced and the mass was present laterally to it, then the tumour was considered to be superficial. Using the FN line, 7 of 8 parotid tumours were correctly located pre-operatively, whereas using the RMV criterion, 5 of 8 tumours were correctly located. In another study involving 44 parotid tumours, other methodology was used, i.e. the RMV was used as a marker to localize the FN in pre-operative imaging; this method was found to be 86.4% accurate[15]. Thus, realizing the existence of various relationships between the FN and RMV is not only important from a perspective of surgical safety but also of great value in localizing the parotid tumours pre-operatively. Although pre-operative prediction of the relationship between the FN and tumour is crucial, it is not 100% guaranteed. Patients should be made aware of the fact that the FN could be intentionally damaged during surgery in order to successfully remove the tumour[2].

This novel variation should be considered in any surgery that involves the parotid area to avoid any complications. At the same time, we need to expect further novel variations, because there are few cases in the literature reporting information pertaining to this nerve–vein relationship.

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