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British Journal of Oral and Maxillofacial Surgery 57 (2019) 232–235

BRITISH Journal of Oral and Maxillofacial Surgery

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Communication between the transverse cervical nerve (C2,3) and marginal mandibular branch of the facial nerve: a cadaveric and clinical study

P.A. Brennan [a,*], J. Mak [b], K. Massetti [b], D.A. Parry [b]

[a] *Surgery Queen Alexandra Hospital, Portsmouth PO6 3LY, UK*
[b] *Department of Anatomy, King's College London, Hodgkin Building, London SE1 1UL, UK*

Accepted 5 October 2018
Available online 23 February 2019

Abstract

Several branches of the facial nerve are known to anastomose with branches of the cervical plexus, other cranial nerves, and the trigeminal nerve. Communication between the sensory transverse cervical nerve (C2, 3) and marginal mandibular nerve is, however, less well known, and in a previous study of 86 neck dissections we reported a 2.3% incidence of anastomoses between them. In this prospective study, we meticulously searched for more examples using both formalin-fixed cadavers and neck dissections. A total of 102 necks were included (both sides of 36 cadavers (n = 72 necks), and 30 patients who had neck dissection for the management of squamous cell carcinoma). We found communications between these nerves on one side of a cadaver and in one neck dissection. When combined with the numbers from our previous study, the overall incidence was 2.1% in 188 necks. The marginal mandibular nerve was inseparable from the anastomosis with the transverse cervical nerve, and the variant should not be forgotten if we are to reduce the chance of postoperative weakness of the lower lip, particularly when operative exposure is more limited (such as during removal of the submandibular gland).

Keywords: Marginal mandibular nerve; transverse cervical nerve; anastomosis; neck dissection; cadaveric study

Introduction

The transverse cervical nerve (C2,3) courses around the mid portion of the sternocleidomastoid muscle from posterior to anterior, and is located inferior to the great auricular nerve (GAN, also C2,3). After passing deep to the external jugular vein, it usually bifurcates to form both ascending and descending branches, which supply sensation to the mid neck. The nerve is commonly seen during operations on the neck but, as with the anterior branch of the GAN, it is often cut to facilitate subsequent dissection. It is perhaps for this reason that any communication with branches of the facial nerve is overlooked.

Anastomosis of the transverse cervical nerve with the cervical branch of the facial nerve is well known,[1,2] and anastomoses of the facial nerve with other sensory afferent nerves have been reported, for example, between the temporal and zygomatic branches and the auriculotemporal parts of the trigeminal nerve.[3–5] The facial nerve, however, has far more communications with other nerves than are routinely taught, and these include communications with the glossopharyngeal and vestibulocochlear nerves,[6] as well as branches of the trigeminal nerve.[7]

Surgeons are routinely taught that the marginal mandibular branch of the facial nerve can sometimes be located

* Corresponding author.
E-mail address: peter.brennan@porthosp.nhs.uk (P.A. Brennan).

https://doi.org/10.1016/j.bjoms.2018.10.289

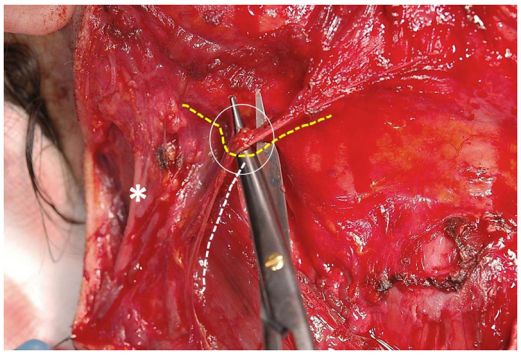

Fig. 1. Right neck dissection showing the previously found transverse cervical nerve (white dotted line) joining the marginal mandibular nerve (yellow dotted line). The great auricular nerve has been highlighted with a white asterisk.

below the lower border of the mandible,[8] and that the Hayes-Martin technique can aid its superior retraction by ligating the facial vessels.[9] However, communications between the marginal mandibular branch and cervical plexus are less well known.[10–12]

We previously found an anastomosis between the transverse cervical nerve and marginal mandibular nerve during a neck dissection,[11] and subsequently identified one further case in a prospective study of 85 neck dissections (incidence 2.3%) (Fig. 1).[12] In both patients, the transverse cervical nerve that we found in the submandibular triangle could easily have been mistaken for the marginal mandibular nerve, particularly because touching it with a nerve stimulator resulted in activity of the lower lip depressor muscle.

To investigate this anastomosis further, we have conducted a cadaveric study of 72 sides, together with a further 30 neck dissections in patients treated for squamous cell carcinoma (SCC), to find out whether the communication could be found in cadavers, and to provide an incidence in a larger series of necks.

Methods

The necks of 36 cadavers were dissected bilaterally (n = 72). Cadavers had been embalmed using hard-fix, formalin-based embalming fluid that consisted of 59% water, 27% industrial methylated spirits (IMS or denatured alcohol), 7% formaldehyde, and 7% phenol.

All cadaveric dissections were done by the same anatomist (DP) to minimise operator variation. The subplatysmal region was dissected on a broad front to reveal the sternocleidomastoid, and a large-field and careful dissection followed to enable identification of the transverse cervical nerve in all the necks. Photographs of any variants of the nerve were taken with a Nikon Coolpix (Nikon Corporation) L340 20.2-megapixel digital camera.

We also included 30 patients who required neck dissection for the management of oral SCC or SCC of the skin since January 2017. The same consultant (PAB) did or supervised all the operations. As no changes in surgical practice were required for the study, and a careful and meticulous technique is always used during neck dissections in an attempt to preserve the nerves in the neck, approval by the ethics committee was not required.

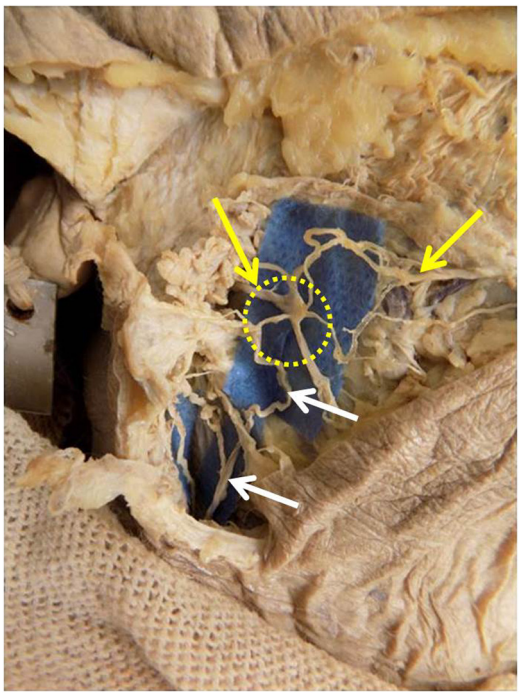

Fig. 2. Cadaveric dissection showing the right transverse cervical nerve (white arrows) passing superiorly to join the marginal mandibular branch of the facial nerve (yellow arrows). The anastomosis is highlighted with a yellow circle. Other branches of the facial nerve can also be seen.

Several other potential neck dissections were excluded because nodal metastases in levels I or II prevented an oncologically safe dissection of the nerves, or because the sternocleidomastoid was included as part of the neck dissection. A Nikon D70 camera with a Nikon 60 mm 1:2.8 macro lens (Nikon Corporation) was available to photograph any anatomical variants. This had been discussed with and agreed by the patients when they gave their consent for the operation, and they gave their consent in writing for any photographs to be taken.

Results

We found a communication between the transverse cervical and marginal mandibular nerves on one side of a cadaver (but interestingly not on the other) (Fig. 2). The transverse cervical nerve joined the marginal mandibular nerve on its inferior aspect and the two had become inseparable. We found no other anatomical variants in the 72 dissected cadaveric necks.

There was a further example of the transverse cervical and marginal mandibular nerves being united in a selective I–III neck dissection (Figs 3 and 4). Use of a hand-held nerve

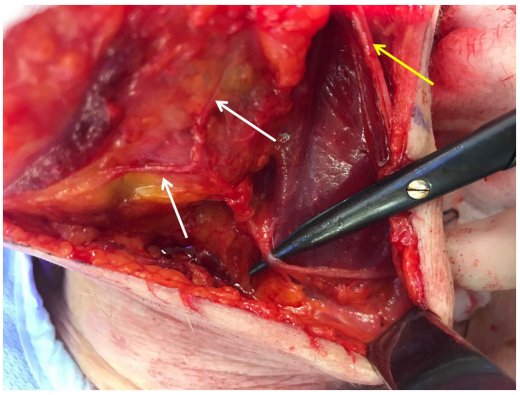

Fig. 3. Left neck dissection showing the transverse cervical nerve crossing the sternocleidomastoid and running over the black scissors to join the marginal mandibular nerve (white arrows) in the submandibular triangle. The great auricular nerve is shown with a yellow arrow.

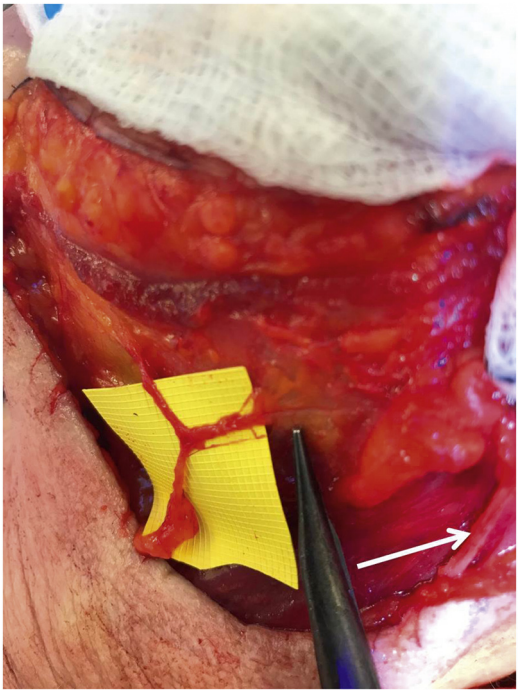

Fig. 4. Close up of left neck with yellow surgical background placed under the anastomosis to highlight it better. The great auricular nerve is shown with a white arrow.

stimulator on the transverse cervical nerve (no patients were paralysed when the nerves were dissected) resulted in contraction of the depressor muscles of the lower lip, presumably as a result of direct transmission along the anastomosis. A diagram of the nerve communication is shown in Figure 5.

Together with the results of our previous study,[12] we have found this communication four times in 188 necks (72 cadaveric sides and 116 neck dissections). This gives an overall incidence of 2.1%, which is similar to that of our original study (2.3% in 86 neck dissections).

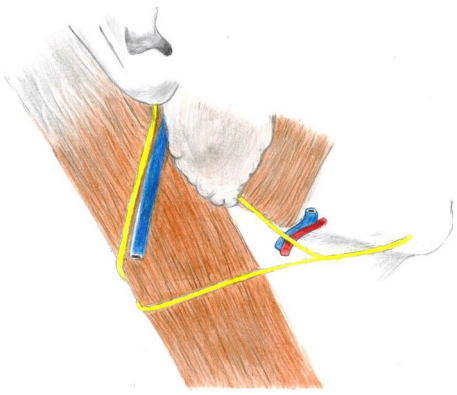

Fig. 5. Diagram of the neural anastomosis in a right neck.

Discussion

To our knowledge, two previous cadaveric studies have reported connections between the cervical plexus and the cervical branch of the facial nerve.[1,2] In one study of 11 cadavers (22 sides of the neck), anastomosis between the transverse cervical nerve and cervical branch of the facial nerve was found in all 22 dissections.[2] In the other, communications between the cervical branch of the facial nerve and the marginal mandibular nerve were found in 35% of 20 cadaveric sides dissected.[1]

Anastomoses between the facial nerve and other nerves are not commonly taught at medical school or during surgical training. Surgeons are routinely taught to identify and preserve the marginal mandibular branch, and often use the Hayes-Martin technique of ligating the facial vessels and retracting them superiorly.[9] While this will protect the marginal mandibular nerve as it crosses superficial to the facial vessels, it cannot be relied upon when dissections are more proximal or distal. Often there are two marginal mandibular branches, but even four have recently been reported.[13] Care is always required when dissecting in the submandibular triangle, particularly when proximal to the facial vessels, to avoid nerve damage and subsequent weakness of the lower lip.

While it is possible to identify anatomical variants in a dissecting room, or during a neck dissection when it is safe to do so, more limited access to the neck (such as during excision of a branchial cyst or neck node, or removal of a submandibular gland) results in a much smaller operative field. In such a situation, and given the variant described, it could be easy to confuse the (sensory) transverse cervical nerve for the marginal mandibular nerve, particularly when use of a nerve stimulator on the transverse cervical nerve can result in activity of the lower lip muscle (presumably because of conduction to the facial nerve if such an anastomosis is present).

Similar situations can be encountered with anastomoses between the cervical plexus and other cranial nerves, including the spinal accessory and vagus, and some experts now

regard the complex connections within the neck as a more general neural plexus.[14,15]

Knowledge of the variant presented in our study and of other interesting anastomotic connections is important for established consultants as well as for trainees. If possible, we encourage colleagues to photograph any unfamiliar anatomical variant at the time of operation. It is also important to take extra care when encountering unexpected nerves or other anatomical variants, to reduce the likelihood of postoperative morbidity.

Conflict of interest

We have no conflicts of interest.

Ethics statement/confirmation of patients' permission

Ethics approval not required. All dissections and images were done in accordance with The Human Tissues Act. Although the operative photographs are not identifiable, the patients' consent was obtained.

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