Surg Radiol Anat (1989) 11 : 11-15

Surgical and Radiologic Anatomy

Original articles

A contribution to the study of the accessory nerve: surgical implications

Ph Caliot, V Bousquet, D Midy and P Cabanié

Laboratoire d'Anatomie, Université de Bordeaux II, UER II, 146, rue Léo-Saignat, F-33076 Bordeaux Cedex, France

Summary. The anatomy of the accessory n. is defined in the light of 100 dissections with particular regard to the following aspects: its relations with the internal jugular v.; its participation in the innervation of the sternocleidomastoid m.; its location in relation to the anterior and posterior borders of that muscle and to the anterior border of the trapezius; and its branching and anastomoses in the supraclavicular fossa.

Contribution à l'étude du nerf accessoire et incidences chirurgicales

Résumé. Cent dissections pratiquées au Laboratoire d'Anatomie tentent de contribuer à préciser l'anatomie du n. accessoire (n. spinal) et plus particulièrement : ses rapports avec la v. jugulaire interne; sa participation à l'innervation du m. sterno-cléido-mastoïdien; son repérage par rapport aux bords antérieur et postérieur de ce muscle, et au bord antérieur du trapèze; sa ramescence et ses anastomoses dans le creux sus-claviculaire.

Key words : Accessory n. — Internal jugular v. — Sternocleidomastoid m. — Supraclavicular fossa

During the removal of cervical lymphnodes we have found the course of the accessory n. exceedingly variable. Therefore, we have sought to supplement previous studies on the basis of a series of 100 dissections in order to define its relations with the internal jugular v., its participation in the innervation of the sternocleidomastoid m. (SCM), its surgical location in relation to the anterior and posterior borders of the SCM and to the anterior border of the trapezius, and its branches and anastomoses in the supraclavicular triangle. We shall consider these various parameters after a brief review of the classical anatomic concepts.

Offprint requests : Ph Caliot

Material and methods

This study relates to 100 right and left dissections performed at the Anatomy Department in Bordeaux on 50 formalin-preserved subjects. Observations made in the context of cervical surgical procedures for malignant ENT disease were valuable, but are not reported here.

Anatomic review

Classically, the accessory n. exhibits 2 groups of roots at its origin: *the superior group* (3 to 5 rootlets) emerges from the posterolateral groove of the medulla or groove of the mixed nerves below the strands of the vagus. It forms the medullary root of the accessory n. Classical writers give the origin of these fibers as the lower part of the nucleus ambiguus (common to cranial nerves IX, X and XI). For more modern authors, such as Winckler, the nucleus ambiguus is restricted to IX and X; the origin of the medullary portion of the accessory n. is from the lower part of the dorsal nucleus of the vagus and the medullary root of XI carries the motor fibers of the striated muscles of the larynx. It is not our intention to engage in the vago-spinal controversies advanced by

Lazorthes. *The inferior group*, or spinal root, consists of 5 to 6 rootlets arranged at intervals vertically along the first 5 or 6 segments of the spinal cord. They emerge close to the posterolateral groove in front of the posterior roots, and their relations with these have been very precisely described (Lance, Guerrier and Olivier). These fibers originate in a lateral cell group of the anterior horn of the cord extending from the 6th cord segment to the neck of the medulla. The origin and course of the fibers within the neuraxis have formed the subject of numerous studies reviewed and summarized by Laruelle and Réomont. After emerging from the neuraxis, these radicular fibers unite and ascend within the spinal canal, traversing the foramen magnum to enter the posterior fossa.

The trunk of the nerve is formed by the junction in the posterior fossa of the two roots, medullary and spinal. The accessory n. then forms part of the bundle of the lower cranial nerves (IX, X, and XI) within the subarachnoid space. It traverses the base of the skull via the jugular foramen and reaches the retrostyloid or posterior subparotid space, where it divides into 2 terminal branches.

It terminates in 2 branches: the medial branch, which immediately joins the superior ganglion of the vagus and the descending lateral branch which passes obliquely downwards, backwards and outwards to take part in innervation of the SCM and trapezius muscles. Its relations in the retrostyloid space need only be mentioned here: it leaves the vagus and the internal carotid medially and the hypoglossal n. and the sympathetic posteriorly, and is related at this level with the internal jugular v. and the lymph-node chains as will be discussed later. Its relations in the SCM m. will be discussed with the results of our dissections.

Classically, the nerve perforates the SCM, passing between the deep cleidomastoid and superficial cleido-occipital planes of that muscle. It shares the innervation of the SCM with the cervical plexus, with which it anastomoses via the communicating branch.

In the supraclavicular fossa, and more especially in the omotrapezial triangle, it is superficial and travels beneath the investing layer of deep cervical fascia, embedded in the superficial part of the fibro-adipose-areolar layer. It continues its oblique course caudal dorsal and lateral and comes into relation with the branches of the superficial cervical plexus (these are dealt with in a thesis by one of the authors). It then reaches the anterior margin of the trapezius, comes into relation with the transverse cervical a. and the lymph-nodes, and ends in the muscle after having often received anastomoses from the nerves to the rhomboid and levator scapulae muscles.

Of the composition of the nerve we shall say only that there is no unanimity on this point, and that the attitude of modern authours has been summarized by Lazorthes, for whom the "medial branch", composed of fibers of medullary origin and conveying motor fibers to the pharynx and larynx, soon joins the vagus, of which it seems to be an "aberrant" root; the lateral branch, composed of "fibers of spinal origin destined for the SCM and trapezius m., seems to be a spinal n. diverted into the cranium".

Results

Our studies were concerned with the relations between the accessory n. (descending lateral branch of XI) and the internal jugular v.; participation of XI in innervation of the SCM; the location of XI at the anterior and posterior borders of the SCM and at the anterior margin of the trapezius; the branching of XI in the supraclavicular triangle, and the anastomosis between the accessory n. and the cervical plexus in the supraclavicular triangle.

Relations between the descending lateral branch of XI and the internal jugular v.

Classicaly, according to Paturet, there are 2 arrangements; an anterior variant, "where the descending lateral branch of XI crosses in front of the vein" in 75% of cases, then following a spiral course before entering the SCM m.; and a posterior variant where the nerve crosses behind the vein (25%).

In our series, the anterior variant was found in 90% of cases and the posterior variant in only 10%, the latter therefore being rarer than previously thought. In 1 subject only, we found a posterior variant on both sides (symetric arrangement).

Participation of XI in innervation of the SCM

We had investigated this in previous studies and have added to the series since; only the principal features will be discussed.

Innervation of the SCM is usually mixed (96% of cases). The nerves derived from the cervical plexus usually originate from the ansa of the axis (ansa of C2-C3) or directly from C3 (72% of cases), more rarely from C2 and the C3-C4 ansa. This nerve to the SCM and the mastoid branch of the superficial plexus have closely adjacent origins, and in a third of the cases even arise from a common trunk. Because of this contiguity, the mastoid branch forms an excellent landmark for the nerve to the SCM. The accessory n. provides one or more motor branches to the SCM: 1 branch in 17% of cases, 2 small branches in 25%, 3 in 27%, 4 in 23% and 5 or more branches in 6% of cases. Distal to these

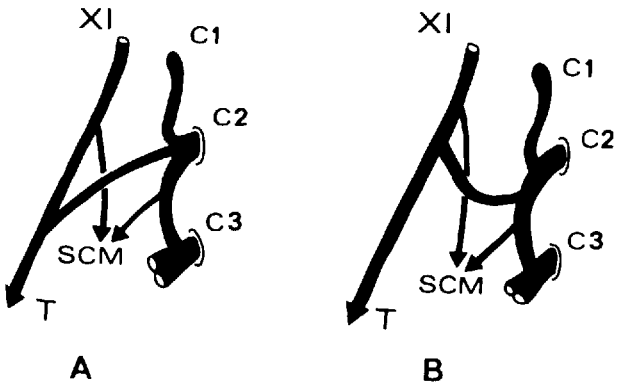


Fig. 1 A, B
The two mode of anastomosis between XI and the cervical plexus **A** 92% of cases: anastomosis of the acute angle of the ansa of Maubrac **B** 8% of cases: classical ansiform appearance

Les deux modes d'anastomose entre XI et plexus cervical **A** 92 % des cas : anastomose à angle aigu de l'anse de Maubrac **B** 8 % des cas : aspect ansiforme classique

branches there exists an anastomosis between the cervical plexus and the accessory n., called the ansa of Maubrac, present in 87% of cases in our series. The form of this ansa is variable and has been classified into several types in previous studies. Rather than having a classical ansiform appearance (found in 8% of cases), the more usual finding is the junction at an acute angle of the branch of the cervical plexus with the accessory n. (92% of cases, Fig. 1). Morphologically, the evidence is that anastomosis supplies the accessory n. with fibers destined solely for the trapezius and not for the SCM. In 8% of cases there is certainly a double innervation of the SCM by the accessory n. and the cervical plexus, but without any anastomosis between the two systems.

In 4 of our 100 dissections (4% of cases), innervation of the SCM was from the accessory n. alone without participation of the cervical plexus.

In 5 cases out of 100 the accessory n. terminated in the SCM and gave no branch to the trapezius, which was therefore innervated solely by the cervical plexus. These 5 arrangements are shown diagrammatically in Fig. 2.

In terms of the symmetry of these arrangements, as noted by comparison of the right and left sides in our 50 subjects, there was certainly a symmetry of origin of the nerves emerging from the cervical plexus in 37% of cases; but if the ansa of Maubrac is taken into consideration as part of the entire arrangement, asymmetry is the rule as only 8% of cases were symmetrical.

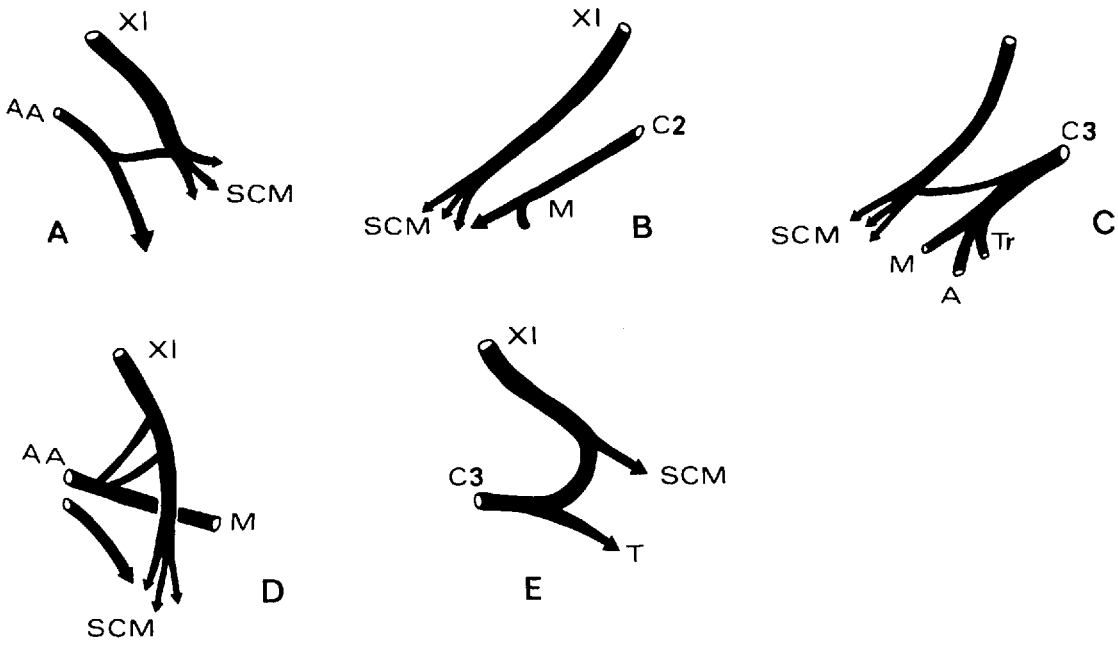


Fig. 2 A-E
Five special cases *M* mastoid branch of cervical plexus *TR* transverse branch *A* auricular branch *T* nerve to trapezius *SCM* nerve to SCM *XI* accessory n. *AA* (in fig.) ansa of axis

Cinq cas particuliers *M* br. mastoïdienne du plexus cervical *TR* br. transverse *A* br. auriculaire *T* nerf du trapèze *SCM* nerf du SCM *XI* n. accessoire *AA* anse de l'axis

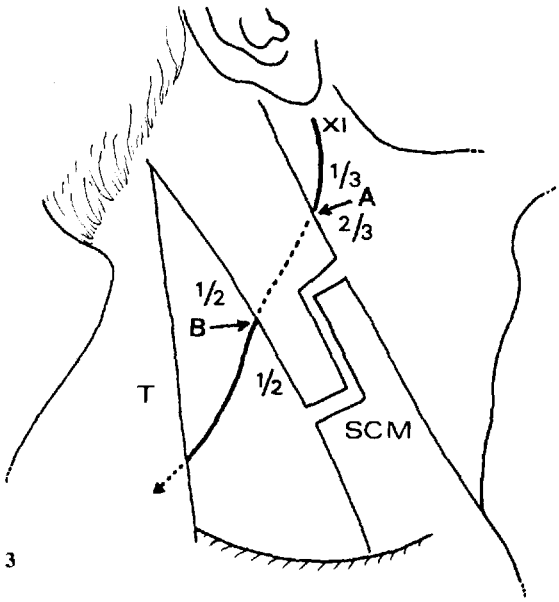
Location of XI at the anterior and posterior borders of the SCM and the anterior border of the trapezius

Four parameters were studied: the perforation of the SCM by the accessory nerve; the location of the nerve at the anterior and posterior borders of the SCM; and its location at the anterior border of the trapezius.

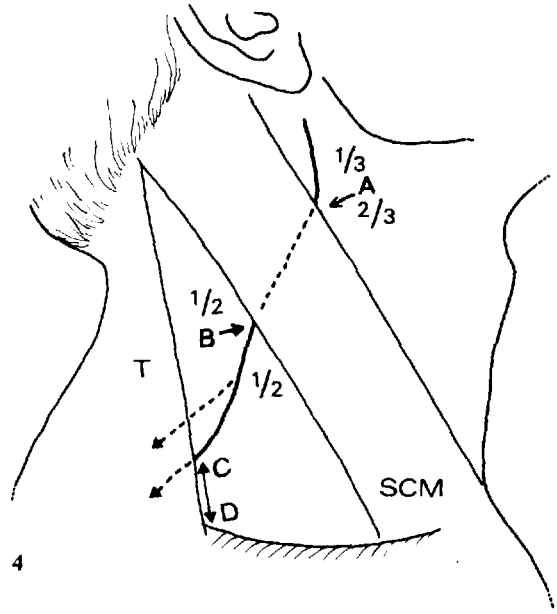
Most authors state that the accessory n. traverses the deep head of the SCM, but that rarely (Turner, Houtsaeger, Paturet) it passes under the muscle without entering it. This latter arrangement was found in only 7 of our 100 cases.

Location of the nerve at the anterior and posterior borders of the SCM. Despite numerous measurements made in situ, on tracings and on photographic records, we are bound to acknowledge our inability to lay down any new rule permitting reliable identification of the spinal n. during clearance of cervical nodes. We can only specify certain landmarks. The arrival of the accessory n. at the anterior margin of the SCM has been described as 4 cm below the tip of the mastoid process by Poirier, Testut and Rouvière, as 3 cm by Lazorthes, and at the level of the 3rd cervical vertebra by Paturet who also records it at 2 or 3 fingerbreadths below the tip of the mastoid. It is evident that it is actually variable, lying between 2 extremes (Fig. 3): either at the junction of the upper fourth and lower three-fourths of the anterior border of the SCM, or at the junction of the upper third and lower two-thirds (the latter seems to be the commonest landmark and the one usually described (Houtsaeger, Lazorthes). Emergence of the nerve at the posterior border of the SCM has been classically described as follow: at 4 fingerbreadths below the tip of the mastoid (Hovelacque); at 5 cm (Lazorthes); on the horizontal plane passing through the hyoid bone (Lazorthes) or just below it (Paturet); at the level of the 4th cervical vertebra (Lazorthes); or slightly above the emerging branches of the cervical plexus (Paturet). Obviously, it is very variable. For practical purposes, the nerve emerges slightly above the midpoint of the posterior margin of the SCM just above the superficial branches of the cervical plexus (but sometimes between the mastoid branch and the others), just below the zone of adherence of the SCM to the skin, in most cases between 4 and 6 cm from the tip of the mastoid. It is impossible to be more precise.

In this context it is important to refer to Z section of the SCM for congenital torticollis by means of a transverse section at a higher level anteriorly than posteriorly, in order to avoid any risk to the accessory n.



3



4

Figs. 3, 4

3 Intramuscular Z-elongation of SCM as proposed for congenital torticollis *A* Junction of upper 1/3 and lower 2/3 of anterior border of SCM *B* junction of upper and lower halves of posterior border of SCM

4 Accessory n. in the supraclavicular triangle *A* Junction of upper 1/3 and lower 2/3 of anterior border of SCM *B* junction of upper and lower halves of posterior border of SCM *C-D* distance between XI and clavicle at anterior margin of trapezius

3 Allongement intramusculaire en Z du SCM proposé pour le torticolis congénital *A* Union 1/3 sup. 2/3 inf. bord antérieur du SCM *B* union 1/2 sup. 1/2 inf. bord postérieur du SCM

4 Le XI dans le triangle sus-claviculaire *A* Union 1/3 sup. 2/3 inf. bord ant. du SCM *B* union 1/2 sup. 1/2 inf. bord post. du SCM *C-D* distance entre XI et clavicule au bord ant. du trapèze

(Fig. 3). Finally, the nerve is always more superficial and more vulnerable at the upper part of the omo-trapezial triangle than is commonly imagined.

The location of the accessory n. at the anterior margin of the trapezius (Fig. 4) is classically described as at 2 cm above the clavicle by Lazorthes, and at 2 to 3 cm by Poirier, Testut, Rouvière and Paturet. Our findings place it at between 1.5 and 11 cm above the upper border of the clavicle, but these extreme values are rare and the usual level is between 3 and 5 cm. The values found in our last 20 dissections (numbered from 81 to 100) are given in the Table.

CD indicates the distance in cm between the accessory n. and the clavicle at the anterior margin of the trapezius

Subject No	CD Right	CD Left
81	4,5	3,1
82	4	3,2
83	1,5	4
84	5	5,5
85	6,8	3,5
86	3	4
87	3,5	3
88	4	3,8
89	3	4,5
90	4	3,3
91	4	3
92	4,5	5,2
93	6	2
94	2	2
95	3,5	3
96	10	11
97	4	4
98	5	3,5
99	4	3,5
100	2	4,5

Branching of the accessory n. in the supraclavicular triangle

Most of the classical descriptions refer to the "trunk" of the accessory nerve in the omo-trapezial triangle, but there is often a branching of the nerve at this site. The main trunk continues its general oblique course downwards, backwards and outwards. Quite often, it gives off branches or fine twigs which are usually above the main trunk and reach the trapezius above it. In 45% of cases there are no branches. Branches exist in 55%: 1 branch in 20% of cases, 2 in 32% and 3 in 3%. These branches usually arise 2 or 3 cm in front of the anterior margin of the trapezius, but in a third of the cases they arise at an earlier stage in the omo-trapezial triangle.

Conclusion

The course of the accessory n. is variable, but we hope to have helped specify certain fixed parameters within which these variations lie. The identification and dissection of the accessory n. during clearance of cervical nodes is never really difficult but requires care.

References

Brun G, Kamina P, Khalef M (1968) Contribution à l'étude de la branche trapézienne du spinal. Arch Anat Pathol 16 : 193-195

Caliot Ph, Cabanié P, Bousquet V, Midy D (1984) A contribution to the study of the innervation of the sternocleidomastoid muscle. Anat Clin 6 : 21-28

Corbin KB, Harrison F (1938) Proprioceptive components of cervical nerves. J Comp Neur 69 : 315-328

Dubousse J (1982) Torticolis musculaire congénital. Enc Med Chir App Loco 15260 A : 103

Guerrier Y (1980) Traité de technique chirurgicale ORL et cervico-faciale, tome 4. Masson, Paris 89 : 56-123

Hamoir M (1952) Anatomie chirurgicale de la branche externe du spinal et de la branche interne du nerf laryngé supérieur. Cahiers d'ORL XVI : 1065-1066

Hill JH, Olson NR (1972) The surgical anatomy of spinal accessory nerve and the internal branche of the superior laryngeal nerve. Laryngoscope 89 : 1935-1942

Laruelle E, Réomont R (1948) Démonstration commentée concernant le nerf spinal. Bull Assoc Anat XXXV : 259

Lazorthes G (1971) Le système nerveux périphérique. Masson, Paris, pp 189-194

Maillard JP (1955) Contribution à l'innervation des muscles SCM et trapèze chez l'homme et quelques mammifères. Arch Anat Histol Embryol 57 : 38-40, 103-130

Maubrac G (1883) Recherches anatomiques et physiologiques sur le nerf SCM. Thèse Bordeaux (n° 38)

Poirier P, Charpy A (1899) Traité d'Anatomie humaine, tome III, fasc 3. Lahure, Paris, pp 775-857

Richer V (1922) Note sur l'innervation du muscle SCM. Bull Mem Soc Anat Paris XIX : 220-223

Robinet J, Lavergne F (1959) Apport moteur des nerfs cervicaux au nerf spinal, incidences chirurgicales. CR Assoc Anat, pp 727-730

Rouvière H (1970) Anatomie humaine, tome 1, Masson, Paris, p 180, 302, 575

Testut L, Latarget A (1949) Traité d'Anatomie humaine, tome 3, 9e éd. Crété, Corbeil, pp 187-193

Winckler C (1957) Innervation des muscles SCM et trapèze. Arch Anat Histol 40 : 120-129

Yee J, Harrison F, Corbin KB (1939) The sensory innervation of the spinal accessory in the rabbit. J Comp Neurol 70 : 314

Received February 28, 1988/Resubmitted May 13, 1988/Accepted July 5, 1988