Block of the Superior Cervical Ganglion,
Description of a Novel Ultrasound-Guided
Technique in Human Cadavers

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Abstract

Objective. Injection of opioids to the superior cervi-
cal ganglion (SCG) has been reported to provide
pain relief in patients suffering from different
kinds of neuropathic facial pain conditions, such as
trigeminal neuralgia, postherpetic neuralgia, and
atypical facial pain. The main disadvantage of this technique is that the
needle tip is positioned distant from the actual
target, possibly impeding successful block of the
SCG. A further limitation is that injection of local
anesthetics due to potential carotid artery puncture
is contraindicated. We hypothesized that the SCG
can be identified and blocked using ultrasound
imaging, potentially increasing precision of this
technique.

Interventions. In this pilot study, 20 US-guided
simulated blocks of the SCG were performed in 10
human cadavers in order to determine the accu-
curacy of this novel block technique. After injection
of 0.1 mL of dye, the cadavers were dissected
to evaluate the needle position and coloring of
the SCG.

Results. Nineteen of the 20 needle tips were located
in or next to the SCG. This corresponded to a simu-
lated block success rate of 95% (95% confidence
interval 85–100%). In 17 cases, the SCG was com-
pletely colored, and in two cases, the caudal half of
the SCG was colored with dye.

Conclusions. The anatomical dissections con-
firmed that our ultrasound-guided approach to the
SCG is accurate. Ultrasound could become an
attractive alternative to the “blind” transoral tech-
technique of SCG blocks.

Key Words. Interventional; Neuropathic Pain; Pain
Management; Sympathetic Block; Ultrasound

Introduction

The superior cervical ganglion (SCG) is the most cranial
part of the sympathetic chain and provides sympathetic
innervation to the face and head [1]. It is the largest of the
cervical ganglia, fusiform in shape, often flattened, and
located in a plication of the prevertebral (deep cervical)
fascia anterior to the longus capitis muscle and dorsal to
the internal carotid artery. At the C3 level, it is located
posteromedial to the vagus nerve. In contrast with the
other two cervical ganglia, it is absolutely constant. It may
reach caudally as far as to the upper border of the fourth
cervical vertebra, but the main portion is found at the level
of the transverse processes of the second and third cer-
vical vertebrae [1–4].

Injection of low-dose buprenorphine to different sympa-thetic ganglia has been termed “GLOA” (ganglionic local
Ultrasound-Guided Superior Cervical Ganglion Block

Opioid analgesia and is used to treat various chronic pain states. Even though clear evidence of a specific therapeutic effect of buprenorphine injected next to the SCG is lacking [5], the procedure has been reported to provide pain relief without side effects in patients suffering from different kinds of neuropathic facial pain conditions, such as trigeminal neuralgia, postherpetic neuralgia, and atypical facial pain [6–8]. The standard technique described to block the SCG is a blind, transoral approach where a needle is inserted at a slightly retrotonsillar location through the dorsolateral pharyngeal wall using a so-called “stopper,” preventing the needle from penetrating the pharyngeal wall deeper than 1 cm and avoiding accidental carotid artery puncture (Figure 1). Using this method, the area of the SCG is targeted at C2 and/or intersection C1/2 level. The potential risk of an unnoticed carotid artery puncture (not least due to a possible tortuous course/coiling of the ICA) remains the main reason why the application of local anesthetics with this blind, transoral approach is contraindicated [1,2].

In addition to the blind approach, a fluoroscopically guided technique to block the SCG has been described as well. The fluoroscopic technique is performed in a similar manner as the paratracheal approach to the stellate ganglion, although at a more cranial paratracheal location at the level of the transition of the vertebral body of C3 to its transverse process [9]. Treggiari and coworkers blocked the level of the transition of the vertebral body of C3 to its transverse process of C3 to its transverse process of C6 was located by identifying its prominent anterior tubercle (Chassaignac’s tubercle). Thereafter, the probe was carefully moved in a cephalad direction, and each transverse process was counted until the level C3 was identified. Here, the transducer was moved medially until the landmarks of the longus capitis muscle and internal carotid artery were identified. Between these two structures, we searched for a slightly hypoechoic oval to round (in the transversal plane) and fusiform structure (in the consecutively performed longitudinal scan), which we hypothesized to be the SCG. After measuring its maximal visible length and anteroposterior diameter, a 21-G needle (SonoTAP needle 80 mm, Pajunk Medical Products, Geisingen, Germany) was introduced from a posterolateral approach with an in-plane technique using real-time ultrasound guidance. The needle was directed into or immediately adjacent to the structure appearing to be the SCG.

Once the needle was in position, 0.1 mL of indocyanine green (ICG) (ICG Pulsion, Pulsion Medical Systems AG, Munich, Germany) was injected. Immediately after injection, the cadavers were carefully dissected by the independent anatomist (B.M.) under manual fixation of the needle to show the actual position of the needle tip and...
the spread of the dye. The needle position was defined as correct if its tip was in contact to or located within the targeted ganglion and the SCG itself was colored.

Results

The characteristics of the 10 examined cadavers were: sex: four female, six male; median age at death 80 years (range 66–91); median body mass index 23 (range 19.1–27) kg/m².

We targeted both sides in each of the 10 cadavers; hence, 20 simulated SCG blocks were performed. Anatomical dissection revealed that in 19 cases, the needle tip was located in or next to the SCG; thus, the success rate of our simulated SCG block was 95% (95% confidence interval 85–100%). Of the 19 successfully reached SCGs, 17 were completely colored by the dye, and in two, the caudal half of the ganglion was colored.

In the single case, where the SCG was missed, the needle tip was identified in a too caudal position at C4 and located in between the internal and external carotid artery.

In the 19 correctly identified SCGs, the median of the maximal anteroposterior diameter as measured with ultrasound was 2 mm (range 1–4), and the median measurable length was 10 mm (range 7–17).

Figure 2 shows an example of a successful simulated SCG block as confirmed by anatomical dissection, and Figure 3 shows the corresponding ultrasound image.

Discussion

This investigation is the first description of an ultrasound-guided approach to the SCG. In the 10 examined cadavers, the new technique proved to be highly accurate with a simulated block success rate of 95%.

The main advantages of this novel approach is that the needle tip can be positioned under ultrasound guidance directly next to the SCG, as opposed to the classic transoral technique where the needle tip is located anterior to the internal carotid artery and hence distant from the SCG.

A previous study by Feigl and coworkers investigated the simulated success rate of the classic transoral approach to the SCG [11]. They were able to demonstrate that volumes as little as 1–2 mL spread sufficiently to the SCG, but a strictly lateral puncture direction was considered as crucial because only a slightly too medial puncture direction resulted in penetration of the prevertebral fascia with resulting block failure.

Other potential advantages of this ultrasound-guided approach are as follows: Application of local anesthetics to the SCG could be reconsidered with this novel approach, as accidental internal carotid artery puncture (due to a tortuous course and/or coiling of the artery [1,2]) should be prevented with ultrasound imaging.

As opposed to the fluoroscopic approach described in the study of Treggiari and coworkers [9], where block of the SCG was performed in order to alleviate cerebral

Figure 2 An example of the injection site after anatomical dissection. The dye was injected into the superior cervical ganglion (SCG), which has been colored completely. Note that the internal carotid artery (ICA) has been shifted anteriorly in order to enable visualization of the SCG. LCM = longus capitis muscle.

Figure 3 Ultrasound image and measurement (+-----+) of the SCG in a cadaver. Both the superior cervical ganglion (SCG) and the internal carotid artery (ICA) have been cut in a longitudinal plane. Note the typical hypoechoic appearance and fusiform shape of the SCG. The lumen of the ICA is partially compressed; this is a common observation when scanning these specially embalmed cadavers.
vasospasm after subarachnoid hemorrhage (SAH), the most important advantage of ultrasound guidance is that it avoids radiation exposure and can be performed outside lead-shielded facilities. Even though radiation exposure of a single SCG block may be low, usually several blocks on different occasions are required to relief facial pain [1] or bring other acceptable results, which may lead to considerable radiation exposure of patients and staff [12]. A further advantage to fluoroscopy (or the blind transoral approach) is that ultrasound imaging enables identification of other potentially hazardous structures in the needle path (besides the already-mentioned internal carotid artery), such as other relevant arteries (e.g., ascending pharyngeal artery) and nerves (e.g., the vagus and the accessory nerves). Even though these structures are visible using ultrasound, needle tip position should be as close as possible to the mentioned prevertebral muscles to avoid potential damage.

Some technical considerations need to be addressed. Standard high-resolution linear ultrasound probes are not suited to identify the SCG using our technique because of the difficulty of trying to scan the cranial cervical spine in a transverse plane in the presence of the mandible. A transversal scan is mandatory to introduce the needle using an in-plane technique in order to prevent penetration of the internal carotid artery. Hence, we used a considerably smaller 13-mm microconvex array transducer to overcome this issue. Despite the lower resolution, the large SCG could be identified in most cases. However, its actual length, as assessed by a longitudinal scan, could not reliably be measured in most cases because of the difficulty of trying to scan the cranial cervical spine in the presence of the mandible impairing visibility of the cranial ending of the SCG. This explains the considerably smaller lengths we assessed by ultrasound measurements (median 10 mm, range 7–17 mm) as opposed to values described in the anatomical literature (25–30 mm [3]).

We conclude that in our pilot study performed on 10 human cadavers, the SCG could reliably be identified and a needle placed in or immediately next to it using a novel ultrasound-guided approach. Further clinical research is required to compare this technique to previous techniques and to reconsider the injection of local anesthetics. This presumably more reliable ultrasound-guided approach could also serve as platform for the planning of better future clinical outcome studies.

References