Southern African Journal of Anaesthesia and Analgesia 2015; 21(3):77–80
http://dx.doi.org/10.1080/22201181.2015.1054612.

South Afr J Anaesth Analg
ISSN 2220-1181 EISSN 2220-1173

RESEARCH

Clinical anatomy of the superior cluneal nerve in relation to easily identifiable bony landmarks

L Loubser[a*], RP Raath[b] and AN Van Schoor[a]

[a]*Department of Anatomy, University of Pretoria, Pretoria, South Africa*
[b]*Jakaranda Pain Clinic, Jakaranda Hospital, Pretoria, South Africa*
**Corresponding author, email: leighloubser@yahoo.com*

Background: Lower back pain (LBP) remains a common ailment among adult populations and a superior cluneal nerve (SCN) entrapment accounts for 10% of reported LBP cases. The diagnostic criteria for SCN entrapment include anaesthesia of the area supplied by the SCN after performing a nerve block. Several surgical reports describe the anatomy of the SCN but purely anatomical studies of the course of the SCN are rare. This study aimed to describe the location of the SCN in relation to easily identifiable bony landmarks.
Methods: The SCN was identified as it pierced the thoracolumbar fascia and crossed over the posterior part of the iliac crest on both sides of 27 adult cadavers. A sliding dial calliper was used to measure the distance from the posterior superior iliac spine (PSIS) to the SCN and from the midline lumbar spinous processes to the nerve.
Results: The PSIS to SCN measurement was found to be 69.6 ± 15.0 mm (mean ± SD) while the midline to SCN measurement was 72.1 ± 10.2 mm.
Discussion: This study showed clear gender differences in the PSIS to SCN measurement, due to the sexual dimorphism of the bony pelvis. There was also found to be a positive correlation between the height of the sample and the distances of the SCN from both the midline and PSIS. This study provides a clear anatomical description of the course of the SCN as it crosses the iliac crest, which will allow for the successful identification of the SCN.

Keywords: bone harvesting, entrapment syndrome, lower back pain, regional nerve block, superior cluneal nerve

Introduction

Lower back pain (LBP) is estimated to have a prevalence of 85–90%. There are many aetiological factors for LBP but even with the use of new imaging techniques no obvious cause can be found in approximately 50% of these cases.[1]

One of the many missed causes of LBP is entrapment of the medial branch of the superior cluneal nerve (SCN), which accounts for approximately 10% of all reported LBP cases.[2] SCN entrapment syndrome is often confused with a facet syndrome, lower lumbar disc problems or an iliolumbar syndrome as it presents with the same clinical features.[1]

The SCN originates from the dorsal rami of the L1–L3 spinal nerve roots and provides sensory innervation over the posterior aspect of the iliac crest and upper middle buttock. Within its course, the SCN pierces the psoas major muscle and paraspinal muscles, runs posterior to the quadratus lumborum muscle and pierces the thoracolumbar fascia as it crosses over the posterior part of the iliac crest. Lu et al. described the anatomical relationships of the SCN and the posterior part of the iliac crest. In their study they dissected 15 cadavers and found that the SCN passes over the iliac crest within an osteofibrous tunnel approximately 7–8 cm lateral to the midline.[3] This tunnel is formed by the iliac crest posteriorly and the thoracolumbar fascia anteriorly. The position of the SCN therefore makes it particularly vulnerable to entrapment. As it crosses over the iliac crest it may become entrapped within this osteofibrous tunnel. This may be exacerbated by continuous stretching or flexion of the hip joint that may cause tissue oedema, irritation and inflammation.[4]

The posterior iliac crest is also an excellent site for autogenous bone procurement for osteoinduction, osteoconduction and osteogenesis as it affords the ability to yield a large amount of corticocancellous bone with multiple applications.[2] Many patients have reported chronic pain at the donor site after the procurement procedure and it was found that SCN entrapment syndrome was a complication of bone procurement from the posterior iliac crest. However, Trescot reported that SCN neuralgia was mostly due to a spontaneous entrapment of the nerve and less commonly due to nerve injury during bone harvesting.[4] Although there are many studies that investigate the possibility of damaging the SCN during bone procurement, there are not many that investigate the anatomical course of these nerves to ascertain their position and other possible causes of SCN entrapment syndrome.[2]

The proposed criteria for SCN entrapment are if the pain presents itself as unilateral and localised projecting from the iliac crest to the upper buttock, a myofascial trigger point may be palpated and relief is found by a nerve block. There should also not be any pathological signs on lumbosacral radiography, computerised tomography and magnetic resonance imaging.[5] SCN entrapments should be considered as a cause of LBP when all other causes have been ruled out.[3]

The most widely accepted and first-line treatment for SCN entrapment syndrome is by injecting over the iliac crest with local anaesthetic solution.[6] Talu et al. described a technique using fluoroscopic guidance to localise the SCN over the iliac crest. Seven to eight centimetres lateral to the midline at the level of lumbar vertebrae 5 (L5), the superficial tissues and the thoracolumbar fascia over the iliac crest were infiltrated with 20 ml of 0.5% bupivacaine and 80 mg of triamcinolone solution. This was found to give complete pain relief. [6] Akbas et al. also used fluoroscopic guidance to identify the position of the SCN over the iliac crest but there are discrepancies in the level of the lumbar vertebrae targeted. Akbas et al. described the procedure using the L4 vertebra. They used 3 ml of 0.2% ropivacaine with 20 ml of triamcinolone as a local anaesthetic and also reported complete pain relief.[7] There was little difference between using ropivacaine and bupivacaine. They both showed the same extent of local anaesthesia but time of onset differed slightly between the two. There was no difference in the side effects experienced between the two different local anaesthetic agents.[8]

The success of this procedure depends on the anatomical knowledge of the anaesthesiologist as well as clear descriptions of the course and location of the target nerve. This study therefore aimed to investigate the course of the SCN on an anatomical basis and to provide clear descriptions of the location of the SCN in relation to bony landmarks that can be easily palpated.

Methods

The left and right SCN of 27 (17 male and 10 female) adult cadavers were dissected. Only cadavers with a body mass index (BMI) of less than 29.9 kg/m^2 were included in the study. This is because the area to be dissected is the typical 'love handle' area and therefore may be affected by a larger BMI due to the fatty deposits in this area. Cadavers were further excluded from the study if the SCN was seen to be damaged or disturbed and if any skeletal changes or deformities of the vertebrae or os coxae, e.g. scoliosis or previous surgery in the area, were seen. Ethical clearance was obtained from the Research Ethics Committee at the University of Pretoria (76/2014).

The lower lumbar area, from L1 to the gluteal region, of each cadaver was dissected. A midline incision was made along the spinous processes of the lumbar vertebrae and the skin was reflected laterally to expose the thoracolumbar fascia, posterior part of the iliac crests and PSIS. Tracing the iliac crests, the medial branch of the SCN was exposed and marked with a pin (point A).

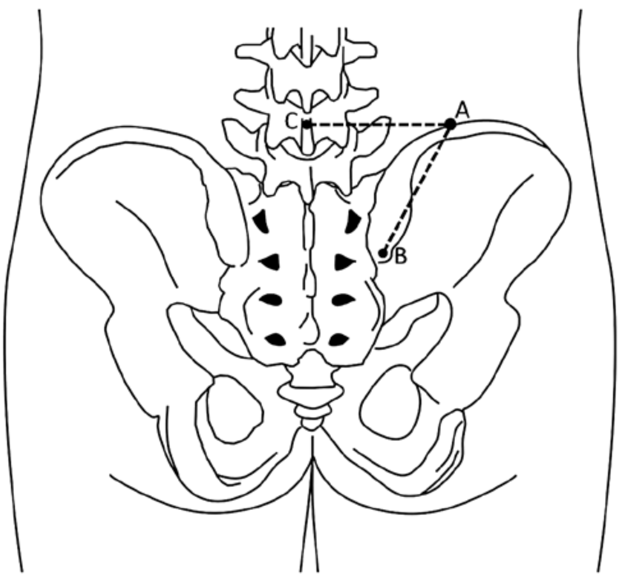

Figure 1: Line diagram of back and posterior iliac crest with the point where the SCN crosses the iliac crest (Point A), the PSIS (Point B) and the midline of the cadaver (Point C) indicated.

A second pin was placed in the centre of the PSIS (point B), and a third pin at a point where a horizontal line, traced from the point where the SCN crossed over the iliac crest, crossed the midline of the cadaver (point C). The midline in this study was defined as a vertical line along the spinous processes of the lumbar vertebrae.

The first measurement taken was the linear distance from point A to point B on both left and right sides. The second measurement taken was the linear horizontal distance from point A to point C (Figure 1). All measurements were taken with a sliding dial calliper (accuracy: 0.01 mm) and recorded on a data sheet.

Descriptive statistics were done on the data to delineate the location of the SCN. A paired t-test was used to compare the measurements of left versus right sides as well as males versus females. To determine the strength of the relationship between the measurements taken (dependent variable) and the height, weight and BMI of the sample (independent variables), Pearson's correlation test was used. Measurements were captured in a Microsoft Excel worksheet and Statistix version 8.0 (Analytical Software, Tallahassee, FL, USA) was used for all the statistical analyses.

Results

The results of this study were divided into two parts: measurements from the PSIS to the SCN and measurements from the midline to the SCN.

For the PSIS to SCN measurement, no statistically significant difference was found in the position of the medial branch of the SCN between left and right sides ($p = 0.2666$). This allowed the combination of both sides to give a sample size of $n = 38$ after exclusions. The Pearson's correlation test revealed a positive correlation between the PSIS to SCN measurement and the height of the population. However, no correlation was found between the PSIS to SCN measurement and the BMI and weight of the sample. Table 1 summarises the results obtained for the PSIS to SCN measurement.

It was found that gender does play a role in PSIS to SCN measurement as there was a statistically significant difference between males and females ($p = 0.039$). In males, the PSIS to SCN distance was significantly longer (74.8 mm ± 11.6 mm) compared with the much shorter distance in females (63.9 mm ± 17.6 mm).

The midline to SCN distance also revealed no statistically significant difference between the left and right sides ($p = 0.2076$) or between males and females ($p = 0.5923$). This allowed the combination of both sides to give a sample size of $n = 32$ after exclusions. No correlation was found between the midline to SCN measurement and the height, BMI or weight of the sample. Table 2 summarises the results obtained for the midline to SCN measurement.

Although there were no statistically significant gender differences, the midline to SCN measurement in males was still slightly larger (73.2 mm ± 10.9 mm) than in females (70.8 mm ± 7.8 mm).

Discussion

Pain experienced over the posterior aspect of the iliac crest may present as an iliolumbar syndrome, facet syndrome or as a lower lumbar disc problem. The insertion of the iliolumbar ligament corresponds to the area in which LBP is experienced in an iliolumbar syndrome.[3] However, the insertion of this ligament is on the ventral aspect of the posterior iliac crest and is therefore protected by the iliac crest.[9] This makes the insertion point of the ligament

Table 1: Summary of results obtained for PSIS to SCN measurement

	Age (years)	Height (m)	Weight (kg)	BMI (kg/m²)	PSIS to SCN (mm)
Mean	65	1.7	59.1	21.0	69.6
Standard deviation	18	0.1	13.6	4.3	15.0
Minimum	22	1.5	39.2	13.1	35.1
Maximum	87	1.9	90.0	29.8	100.6
Range (95% confidence interval)					64.3–74.3

Table 2: Summary of the results obtained for the midline to SCN measurement

	Age (years)	Height (m)	Weight (kg)	BMI (kg/m²)	Midline to SCN (mm)
Mean	69	1.7	61.7	21.4	72.1
Standard deviation	12	0.1	15.2	4.6	10.2
Minimum	49	1.5	40.6	13.1	51.3
Maximum	87	1.9	90.0	29.8	91.1
Range (95% confidence interval)					68.5–75.6

difficult to palpate and may not correspond to the area where the trigger point is experienced. Facet syndromes have been described as originating from the cutaneous dorsal rami from the thoracolumbar junction and radiographic abnormalities have led to the incorrect diagnosis of LBP. These three diagnoses do not account for all LBP cases.[1] Pain and tenderness experienced over the posterior iliac crest may also correspond to the position of the medial branch of the SCN over the iliac crest as it passes through the osteofibrous tunnel.[3]

The lower lumbar region is covered by a posterior aponeurosis that is attached to the posterior iliac crest and is formed by the thick fibres of latissimus dorsi and the posterior layer of the thoracolumbar fascia.[3] Constant contraction of the latissimus dorsi muscle[3] and flexion and extension of the hip joint[4] showed an influence on the tension of the fibres of the thoracolumbar fascia. As the medial branch of the SCN passes through these fibres to reach the cutaneous area of sensory innervation over the medial part of the central buttock, the increased tension in these fibres may lead to a subsequent entrapment of this branch. In the current study, only one out of 54 cadavers showed an entrapment of the medial branch of the SCN compared with 2 out of 10 found in the study done by Lu et al.[3]

Autogenous bone, harvested from the posterior iliac crest, is used for multiple applications such as the repair of long bone reconstruction, fracture non-union, spinal fusion, arthrodesis in various joints and facial and cranial reconstructions. However, many patients have reported chronic pain at the donor site after the procurement procedure and it was found that entrapment of the SCN was a complication of bone procurement from this site.[4] Anatomical studies revealed that the bone-harvesting technique being used placed the SCN in a vulnerable position of being damaged.[3] The current study revealed with a 95% confidence interval that the medial branch of the SCN emerged between 68.5 mm to 75.6 mm (mean: 72 mm) lateral from the midline and 64.8 mm to 74.3 mm (mean: 69 mm) from the PSIS. If surgeons were to perform skin incisions and procurement techniques within a zone no more than 64 mm lateral to the PSIS, nerve injury and postoperative complications would be kept to a minimum. This measurement is in agreement with the study done by Lu et al.[3] in which they report the safe zone as 60 mm lateral to the PSIS.[3] Unfortunately, this will not completely avoid the SCN in all cases. In one case the nerve was found to be 35 mm from the right PSIS and 42 mm from the left. This was in a 1.52 m female cadaver and therefore the stature of the patient should always be taken into account when targeting the SCN. When trying to avoid the SCN, physicians should stay more medial in patients of a shorter stature.

The most commonly used treatment method for an SCN entrapment is to inject the area approximately 7–8 cm lateral to the midline with a local anaesthetic agent.[6] According to the literature, this should provide complete relief from the LBP experienced as a result of the entrapped SCN as well as confirm the diagnosis of an SCN entrapment.[5] Table 3 shows a comparison of the results from the current study with the only two previous studies that looked at similar measurements. These two studies were done by Lu et al. on a Chinese cadaver population[3] and Kuniya et al. on a Japanese cadaver population. The current study revealed similar measurements for the midline to SCN measurement when compared with the study done by Kuniya et al.[10] Lu et al. reported measurements of 10 mm more than both the current study and that conducted by Kuniya et al.[10] When comparing the PSIS to SCN measurement, the current study found measurements similar to those found by Lu et al.[3] However, Kuniya et al. reported measurements almost 20 mm shorter[10] than those reported in the current study and by Lu et al.[3]

Table 3: Comparison of the measurements from the current study with a by Lu et al.[3] and Kuniya et al.[10]

	Population		
	South African (current study)	Chinese[3]	Japanese[10]
Midline to SCN	72.1 mm	81.0 mm	71.0 mm
PSIS to SCN	69.0 mm	64.7 mm	45.7 mm

The differences seen between males and females can be attributed to the high degree of sexual dimorphism of the bony pelvis. The male pelvis, when viewed from the posterior aspect, has more vertical and upright iliac crests when compared with the female pelvis that has flattened and more laterally projecting iliac crests.[9] As a result, males will have a longer PSIS to SCN measurement compared with females with a similar BMI.

In conclusion, this study showed that the SCN crosses the posterior aspect of the iliac crest an average of 72 mm from the midline and 70 mm from the PSIS. The differences seen between the different populations and between genders should be taken into account when the SCN is the target of the procedure or when trying to avoid nerve injury during a bone graft. The measurements that were found in this South African population also differed from both a Chinese and Japanese population, examined in previous studies, which may indicate a correlation between the measurements and height of the population.

Acknowledgements – Opinions expressed and conclusions arrived at are those of the authors and are not necessarily attributed to the NRF. The authors would like to thank Ms M Pretorius for her assistance with Figure 1.

Funding – No funding/support was obtained for this research.

References

1. Ermis MN, Yildirim D, Durakbasa MO, et al. Medial superior cluneal nerve entrapment neuropathy in military personnel; diagnosis and etiologic factors. J Back Musculoskelet Rehabil. 2011;24(3):137–44.
2. Sittitavornwong S, Falconer DS, Shah R, et al. Anatomic considerations for posterior iliac crest bone procurement. J Oral Maxillofac Surg. 2013;71(10):1777–88. http://dx.doi.org/10.1016/j.joms.2013.03.008
3. Lu J, Ebraheim NA, Huntoon M, et al. Anatomic considerations of superior cluneal nerve at posterior iliac crest region. Clin Orthop Relat Res. 1998;347:224–8.
4. Trescot AM. Cryoanalgesia in interventional pain management. Pain Physician. 2003;6:345–60.
5. Akbas M, Yegin A, Karsli B. Superior cluneal nerve entrapment eight years after decubitus surgery. Pain Pract. 2005;5(4):364–6. http://dx.doi.org/10.1111/ppr.2005.5.issue-4
6. Herring A, Price DD, Nagdev A, et al. Superior cluneal nerve block for treatment of buttock abscesses in the emergency department. J Emerg Med. 2010;39(1):83–5. http://dx.doi.org/10.1016/j.jemermed.2009.08.033
7. Talu GK, Özyalçin S, Talu U. Superior cluneal nerve entrapment. Reg Anesth Pain Med. 2000;25(6):648–50. http://dx.doi.org/10.1097/00115550-200011000-00018
8. Zaric D, Nydahl P, Philipson L, et al. The effect of continuous lumbar epidural infusion of ropivacaine (0.1%, 0.2%, and 0.3%) and 0.25% bupivacaine on sensory and motor block in volunteers: a double-blind study. Reg Anesth Pain Med. 1996;21(1):187–9.
9. Moore KL, Dalley AF, Agur AMR. Clinically oriented anatomy. 7th ed. Baltimore, MD: Lippincott Williams & Wilkins; 2014. p. 330–2.
10. Kuniya H, Aota Y, Saito T, et al. Anatomical study of superior cluneal nerve entrapment. J Neurosurg Spine. 2013;19(1):76–80. http://dx.doi.org/10.3171/2013.4.SPINE12683

Received: 11-11-2014 Accepted: 21-05-2015