Revista Mexicana de Neurociencia

PERMANYER

Check for updates

REVIEW ARTICLE

Cisternal puncture and cervical puncture: current uses and historical review

*Pablo Martínez-Arellano, Jorge L. Balderrama-Bañares, Alonso Gutiérrez-Romero, and Diego López-Mena**

Department of Interventional Neuroradiology, Instituto Nacional de Neurología y Neurocirugía, Mexico City, Mexico

Abstract

A 61-year-old female diagnosed with neurocysticercosis was evaluated in the interventional neuroradiology department. Cerebrospinal fluid by cervical puncture was requested by the attending physician, and informed consent was obtained. The process was completed satisfactorily; fluid samples were obtained on the first attempt, and no complications were noted. Despite their drawbacks, both cisternal and cervical punctures continue to be techniques of great value and scope for various types of patients, whose descriptions and procedures must be remembered. This article describes a case report and a bibliographic review of the procedures, history and progress, indications and contraindications, as well as their probable complications.

Keywords: *Cisternal puncture. Cervical puncture. Diagnostic test. Intrathecal administration.*

Punción cisternal y punción cervical: usos actuales y revisión histórica

Resumen

Una mujer de 61 años diagnosticada con neurocisticercosis fue evaluada en el departamento de neurorradiología intervencionista. El médico tratante solicitó una punción cervical para obtener líquido cefalorraquídeo y se obtuvo el consentimiento informado. El proceso se completó satisfactoriamente; se obtuvieron muestras de líquido cefalorraquídeo en el primer intento y no se observaron complicaciones. A pesar de sus inconvenientes, tanto la punción cisternal como la cervical siguen siendo técnicas de gran valor y alcance para diversos tipos de pacientes, cuyas descripciones y procedimientos deben ser recordados. En este artículo se describe un caso clínico y una revisión bibliográfica de los procedimientos, antecedentes y evolución, indicaciones y contraindicaciones, así como sus probables complicaciones.

Palabras clave: *Punción cisternal. Punción cervical. Prueba diagnóstica. Administración intratecal.*

***Correspondence:**
Diego López-Mena
E-mail: dlopez@innn.edu.mx

Date of reception: 20-06-2024
Date of acceptance: 19-08-2024
DOI: 10.24875/RMN.24000030

Available online: 18-10-2024
Rev Mex Neuroci. 2024;25(5):143-147
www.revmexneurociencia.com

Introduction

Cisternal puncture (CP), also known as suboccipital puncture, is a medical technique initially used to obtain a sample of cerebrospinal fluid (CSF) from the subarachnoid space[1]. Cervical puncture (CerP), which is also a way to access the CSF in the lateral upper cervical spinal region, is an alternative to this technique, which has also been described similarly[2]. While not as commonly performed as lumbar puncture (LP), CP and CerP play a crucial role in diagnosing and managing various neurological conditions[2].

CSF surrounds the brain and spinal cord, and its analysis provides valuable information about infections, hemorrhages, tumors, and other pathologies. Unlike LP, which is performed at the lower lumbar level, CP occurs just below the skull in the cisternal space[3], while CerP performs a lateral puncture for accessing the upper spinal canal[2].

Some of the current applications of these techniques include:

- Diagnostic sampling: They allow the collection of CSF for biochemical, microbiological, and cytological analysis[4]. This can aid in diagnosing infections, tumors, and other neurological conditions.
- Intrathecal medication: These procedures enable the direct introduction of medications into the meningeal space. For instance, they can be used to administer contrast agents for myelography or to deliver therapeutic drugs[5].
- Increased intracranial pressure: In cases of elevated intracranial pressure or hydrocephalus, they may be used as a therapeutic measure to drain excess CSF and relieve symptoms[6].

Despite their historical significance, CP and CerP are now less commonly performed due to advances in other diagnostic techniques. However, they remain relevant in specific clinical scenarios: their diagnostic accuracy and ability to detect early neurological diseases make them a valuable tool in medical practice.

In this article, we will explore the indications, techniques, and clinical considerations associated with CP and CerP.

Clinical case

A 61-year-old female patient with a medical record of neurocysticercosis was scheduled for CSF sampling by LP. During the procedure, LP was performed, but CSF could not be obtained. Later, consultation was carried out with the Interventional Neuroradiology to perform sampling through CerP.

The patient was scheduled for CerP, achieving adequate sample collection without major peri- and post-procedure complications. The patient was discharged from a short stay on the same day.

Once the CerP was performed, the samples were sent for their analysis. The patient did not report any symptoms or adverse events related to the CerP.

Procedure description

Under conscious sedation, the patient was placed in a prone position, and an aseptic maneuver was carried out in the posterior cervical area. With fluoroscopy, the C1 and C2 cervical segments of the spine, the space between them, and the spinolaminar line were located.

Once the anatomical structures were identified, a simulation of the needle orientation through the overlay was performed using lateral and anteroposterior radiographic projections. The puncture site was anesthetized with lidocaine.

A 22 g needle was inserted medially using fluoroscopy guidance and continued to be advanced horizontally through planes of skin, connective tissue, trapezius, and occipital muscles; finally, resistance was encountered when reaching the dura mater. After penetrating the dura, it was advanced by 2 more millimeters, and the flow of CSF was verified. When no sample was obtained, the needle was repositioned caudally, making an angulation of approximately 30° (Fig. 1). It was verified again, and on verifying the successful exit of CSF, obtaining samples began (Fig. 2). A total of 25 mL of CSF was drained. Samples were sent for cytological and cytochemical studies and cultures, as well as a vial for storage in case, new tests were requested.

At the end of sampling, the needle was removed, and momentary compression was performed. The patient remained under surveillance for a few hours and did not report symptoms.

Early indications and techniques

The CP was first performed on living human patients by Dr. Alexandru Obregia in 1908[1] using a suboccipital approach where a needle was advanced along the inferior midline to the occipital protuberance[7].

In 1919, Dr. Ayer described his technique of cisterna magna puncture, introducing a needle a thumb's length cranial to the spinal process of C1 in the cervical spine, directing the needle in the same orientation[8]. By 1920, the same author had published his experience with 43 patients, all of whom were successful[9].

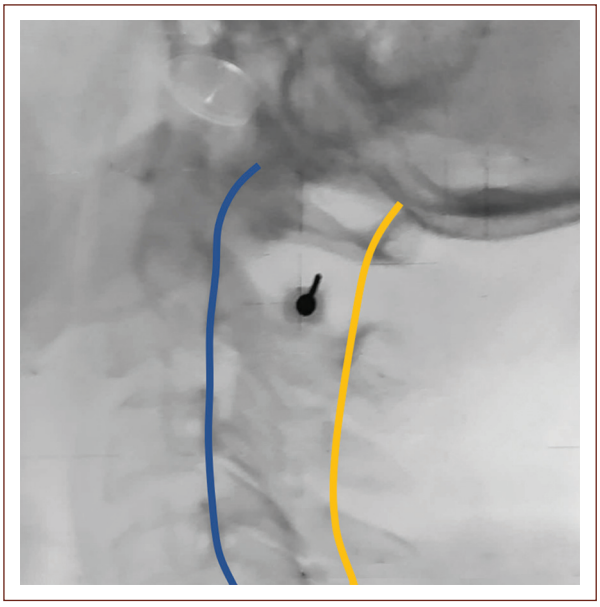

Figure 1. X-ray of the cervical spine showing the spinolaminar line in yellow and the posterior vertebral line in blue. Cervical puncture was performed near to the spinolaminar line, the needle is shown between them.

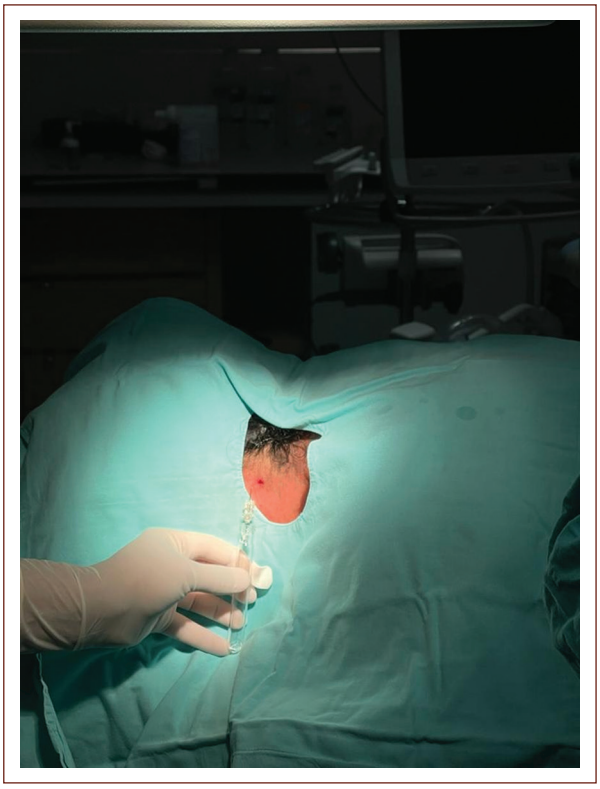

Figure 2. After the subarachnoid space was accessed, cerebrospinal fluid was collected and sent to analysis.

Initially, suboccipital punctures were performed for the sole purpose of obtaining CSF samples; however, with the advent of myelography, complication rates increased for this procedure, which led to the development of safer and more cost-effective techniques[10].

By the 1960s, various specialists in neurosurgery and radiology began to perform procedures using the C1-C2 space as access[11]. The CerP previously described is an example of this technique[2]. The advantage of this modified technique was the possibility of performing myelography with fewer complications and more direct access to the subarachnoid space[7,11].

Current use

With the advent of new non-invasive imaging techniques of the skull, brain, and central nervous system, mainly computed tomography and magnetic resonance imaging, the number of suboccipital puncture procedures decreased considerably, being relegated to patients with specific indications[7]. Likewise, lumbar access for contrast injection in myelograms gradually supplanted suboccipital or cervical access for myelograms, eventually falling into disuse.

Some of the current indications for CP or CerP include[7,8,12]:

- Failed or difficult LP
- Patients are not suitable for a radiographic investigation of the lumbar region
- Arachnoiditis, or infection of the site of the puncture
- Ankylosis or lumbar stenosis
- Spinal cord obstruction
- Intrathecal administration of drugs in patients who are not candidates for LP or radiographic investigation
- Stem cell transplantation
- Certain congenital spinal malformations.

Furthermore, some of the contraindications for these procedures include[7,8]:

- Lack of cooperation from the patient
- Local infection of the site of the puncture
- Coagulation disorders.

Regarding vertebral levels, CerP from C1-C2 is preferred over suboccipital access through the midline because a thickening forms in the subarachnoid space at the level of C2, allowing safer access for procedures to be performed[6]. In a lateral CerP, the remoteness of the vertebral artery from the puncture site provides a considerable safety margin for interventional manipulation

with a lower risk of bleeding[13]. This may vary depending on the disease and anatomical configuration of the vertebral artery and posterior cerebral circulation of each patient.

As mentioned, the lateral CerP at C1-C2 has several indications for this procedure. The vast majority of cases in which this intervention is performed are those with neurological pathology who have been candidates for LP but in which samples or successful access could not be obtained in the procedure. Some of the common causes of failed LP, include[6,12]:

- Ankylosis
- Lumbar stenosis
- Spinal cord malformations.

As previously discussed, these situations may encourage the physician to perform CerP or CP instead of LP.

For a lateral CerP, patients can be placed in a prone, lateral, or supine position with the head rotated, always keeping the possible access site visible[6,14]. The patient must be immobilized to prevent movement during the procedure. The puncture should be performed with a 20- to 23 g epidural needle and its stylet placed perpendicular to the patient (as close as possible to 90°) without changing its angulation until reaching the subarachnoid space[6].

Unlike a LP, the needle does not have the same support due to loose connective tissue, so the interventional doctor or an assistant must maintain the position and angle of the needle at all times while the procedure is completed[6,14].

For each vial or bottle of CSF, 1-2 mL must be collected, and samples can be obtained for storage in pathology, microbiology, and biochemistry laboratories[4]. If necessary, a larger sample can be collected as long as the patient is stable and viable for an extension in the duration of the procedure[4,6].

As happened in the clinical case, if CSF does not come out when the needle is in the correct position, the needle can be redirected 30° caudally to have better access to the subarachnoid space. If bleeding occurs during the procedure, it should be suspended and the needle removed as soon as possible to avoid injury to the subarachnoid space that could lead to neurological disability.

Limitations and complications

The complication rate from a CerP is around 0.05%, according to studies[15]. The most common side effect recorded was headache, mostly mild to moderate in intensity and self-limiting. The second is nausea and vomiting.

One of the most feared complications of CerP is bleeding due to a puncture or dissection of the arteries of the posterior circulation. The anatomical variants and pain of the vertebral artery, especially in its V3 segment, increase the possibility of complications due to bleeding[7]. However, if there is suspicion of normal variations, the patient can be turned slightly to anteriorize the vertebral arteries and reduce the risk of injury.

This technique, despite its adverse effects and the emergence of safer procedures, continues to be used in selected patients with contraindications to LP[15]. Eighty-five percentages of neuroradiology departments in the United States perform this procedure at least once a year, and most interventional radiology and interventional neuroradiology programs consider CerP within their curricula[16].

Certain authors have questioned the usefulness of CerP today, given access to imaging studies and diagnoses with a lower probability of complications. However, consensus among interventional radiologists and neuroradiologists has confirmed the usefulness of this study, as well as its value in the diagnosis and treatment of difficult patients[15,16]. Some studies have even hypothesized that CerP is an underused technique that could have a higher frequency in complicated cases[2].

Another point to highlight is the low complication rate of this procedure when performed by trained physicians with a high number of cases of CerP[2]. This supports the proposal to reintroduce or reinforce the teaching of the puncture technique, as well as the dissemination of its diagnostic advantages.

Ongoing research

Despite their infrequent usage, CP and CerP continue to be the subject of scientific studies and reviews. In 2017, the use of a lateral atlanto-occipital puncture was proposed instead of the standard C1-C2 technique for CSF sampling. The results of their study demonstrated similar efficacy to traditional punctures with a lower complication rate. Among the most common adverse events were headaches and transient elevations of blood pressure[17]. This technique has also been tested experimentally in animals using ultrasound as imaging support for the procedure instead of radiographic projections[3].

Likewise, CerP has regained utility for access to the epidural space[18] and drug administration[5] in patients with pathologies that limit the therapeutic approach through LP.

Conclusion

CP and CerP are safe and effective alternatives to performing procedures that involve access to the subarachnoid space whenever the LP is unsuccessful or is not significant.

Although rarely performed, they offer an alternative to LP. Despite their infrequent use, CP and CerP remain valuable techniques in specific clinical scenarios.

Funding

The authors declare that this work was carried out with the authors' own resources.

Conflicts of interest

The authors declare that they have no conflicts of interest.

Ethical disclosures

Protection of human and animal subjects. The authors declare that no experiments were performed on humans or animals for this study. The authors declare that the procedures followed were in accordance with the regulations of the relevant Clinical Research Ethics Committee and with those of the Code of Ethics of the World Medical Association (Declaration of Helsinki).

Confidentiality of data. The authors declare that they have followed the protocols of their work center on the publication of patient data. The anonymity of the participants was preserved, and the data were used solely for scientific purposes.

Right to privacy and informed consent. The authors have obtained the written informed consent of the patients or subjects mentioned in the article. The corresponding author is in possession of this document.

Use of artificial intelligence for generating text. The authors declare that they have not used any type of generative artificial intelligence for the writing of this manuscript, nor for the creation of images, graphics, tables, or their corresponding captions.

References

1. Săceleanu MV, Marinescu AA, Mohan AG, Popescu M, Ciurea AV. Remember the Romanian pioneers: Alexandru Obregia (1860-1937) - first *in vivo* suboccipital puncture. Rom J Morphol Embryol. 2019; 60:333-6.
2. Thomas A, Narayanan S. Cervical puncture: an important tool for the interventional neurologist (P07. 259). Delhi: AAN Enterprises; 2013.
3. Etienne AL, Audigié F, Peeters D, Gabriel A, Busoni V. Ultrasonographic percutaneous anatomy of the Atlanto-Occipital region and indirect ultrasound-guided cisternal puncture in the dog and the cat. Anat Histol Embryol. 2015;44:92-8.
4. Rahimi J, Woehrer A. Overview of cerebrospinal fluid cytology. Handb Clin Neurol. 2018;145:563-71.
5. Veerapandiyan A, Pal R, D'Ambrosio S, Young I, Eichinger K, Collins E, et al. Cervical puncture to deliver nusinersen in patients with spinal muscular atrophy. Neurology. 2018;91:e620-4.
6. Reichman EF. Lateral cervical puncture. In: Emergency Medicine Procedures. 2nd ed., Ch. 117. New York: McGraw-Hill Companies; 2013. Available from: https://www.accessemergencymedicine.mhmedical.com/content/aspx/aid=57712526 [Last accessed on 2024 Jun 21].
7. Daniels SP, Schweitzer AD, Baidya R, Krol G, Schneider R, Lis E, et al. The lateral C1-C2 puncture: indications, technique, and potential complications. Am J Roentgenol. 2019;212:431-42.
8. Souza D, Simões TF. Pioneers in the cisterna magna puncture. Arq Neuropsiquiatr. 2020;78:176-8.
9. Ayer JB. Puncture of the cisterna magna. Arch Neurol Psychiatry. 1920; 4:529-41.
10. Robertson HJ, Smith RD. Cervical myelography: survey of modes of practice and major complications. Radiology. 1990;174:79-83.
11. Pellot JE, De Jesus O. Suboccipital puncture. In: StatPearls. Treasure Island, FL: StatPearls Publishing; 2023. Available from: https://europepmc.org/article/NBK/nbk560630
12. Teasdale E, Macpherson P. Guidelines for cervical myelography: lumbar versus cervical puncture technique. Br J Radiol. 1984;57:789-93.
13. Satti SR, Cerniglia CA, Koenigsberg RA. Cervical vertebral artery variations: an anatomic study. AJNR Am J Neuroradiol. 2007;28:976.
14. Raininko R, Sonninen P. Dorsal CSF space at CI-II level - technique of cervical myelography. Neuroradiology. 1987;29:73-5.
15. Mironov A. Practicing lateral cervical puncture for myelography. AJNR Am J Neuroradiol. 2009;30:E129.
16. Yousem DM, Gujar SK. Are C1-2 punctures for routine cervical myelography below the standard of care? AJNR Am J Neuroradiol. 2009; 30:1360-3.
17. Gong D, Yu H, Yuan X. A new method of subarachnoid puncture for clinical diagnosis and treatment: lateral Atlanto-occipital space puncture. J Neurosurg. 2017;129:146-52.
18. Ali HM, Toble YM, Tolba YY. Cervical epidural puncture guided by fluoroscopy in comparison to acoustic signals: clinical results. Saudi J Anaesth. 2017;11:305-8.