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CSF Biomarkers

Lumbar puncture in patients with neurologic conditions

Rosha Babapour Mofrad[a,b], Femke H. Bouwman[b], Rosalinde E. R. Slot[b], Tessa Timmers[b], Wiesje M. van der Flier[b,c], Philip Scheltens[b], Charlotte E. Teunissen[a,b,*]

[a]Neurochemistry Laboratory, Department of Clinical Chemistry, Amsterdam Neuroscience, VU University Medical Center, Amsterdam, The Netherlands
[b]Department of Neurology, Alzheimer Center, Amsterdam Neuroscience, VU University Medical Center, Amsterdam, The Netherlands
[c]Department of Epidemiology and Biostatistics, Amsterdam Neuroscience, VU University Medical Center, Amsterdam, The Netherlands

Abstract A lumbar puncture (LP) is performed to obtain cerebrospinal fluid. It is implemented in the clinic on a routine basis to aid the diagnosis of neurologic diseases. This paper accompanies an informative lumbar puncture video that shows the lumbar puncture procedure as routinely performed in the VUmc Alzheimer center based on the consensus guidelines by Engelborghs et al.

Keywords: Lumbar puncture; Lumbar puncture video; Educational video; Neurologic disease; Alzheimer's disease

1. Introduction

This article accompanies an informative lumbar puncture (LP) Video in which we illustrate how to perform an LP in neurologic diseases. Our aim is to provide a reference for educational purposes and to give an update on the state of the art. We wish to help reduce the reluctance in performing an LP by demonstrating an LP method based on recently published consensus guidelines by Engelborghs et al. [1] aiming to minimize the risk of complications. Moreover, we aim to demonstrate the utility of the LP as an aid in the diagnosis of neurodegenerative diseases, notably Alzheimer's disease. These are the first steps toward standardizing the LP procedure, which will help to implement cerebrospinal fluid (CSF) biomarkers in clinical practice [2].

Target audience: Our target audience includes trainees in neurology and other clinicians who perform an LP for diagnostic or scientific reasons. Moreover, the Video is informative for scientists who use CSF material and want to increase their awareness of the procedure. We do wish to emphasize that this Video can serve as a basis for practical supervised training. This Video shows the recommendations based on consensus guidelines by Engelborghs et al. [1]; every professional can choose to deviate from these recommendations when deemed necessary. The following section describes the LP procedure as routinely performed in the VUmc Alzheimer Center.

2. Materials and methods

2.1. Preparation

2.1.1. Patient instructions

Various studies have shown that one of the risk factors for experiencing post-LP complications is the actual fear of the LP procedure and post-LP complications by the patient [1]. This fear may be reduced by giving adequate information to the patient before and during the procedure. Providing visual support, such as showing a model of the lower back, is recommended. The importance of flexing the back and relaxation during the procedure should be emphasized. This creates more intervertebral space while inserting the needle, thereby increasing the chances of a successful procedure. The patient should also be informed of the most prevalent possible complications, which consist of post-LP back pain (17%), typical post-LP headache (PLPH) (9%), and atypical headache (19%) [1,3].

*Corresponding author. Tel.: +31-20-4443680; Fax: +31-20-4443895.
E-mail address: c.teunissen@vumc.nl

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2.1.2. Allergies and contraindications

The physician should check for allergies to bandages, latex, alcohol, or iodine as well as for possible contraindications. The most important contraindications include an intracranial space occupying lesion with mass effect or abnormal intracranial pressure, the use of oral anticoagulant medication, coagulopathies and uncorrected bleeding diathesis, and a local skin infection at the puncture site. For more information on contraindications and allergies we refer to the consensus guidelines by Engelborghs et al. [1].

2.2. Materials

Before performing the LP, it is essential to prepare all equipment. To reduce the risk of infection an aseptic technique is applied using the following materials:

(1) A 25-gauge needle with a stylet
(2) Polypropylene collection tubes
(3) Sterile gloves and sterile field
(4) Sterile and nonsterile gauzes
(5) Iodine or alcohol
(6) Bandage
(7) Protective mat

For (1) a needle with a small diameter, higher than 24 gauge, has proven to reduce the risk of post-LP complaints [1]. An atraumatic needle is recommended by authors of most studies because that will result in a lower incidence of PLPH, but it is not used in the Video, because it results in more attempts and failures of the LP procedure, when performed by less experienced clinicians [1]. It is important to keep in mind that when intracranial pressure measurement is necessary needles smaller than 22 gauge are not suitable [1]. A syringe may be convenient for collection of large volumes (>10 mL), but the use of a syringe is associated with an increased risk of post-LP complaints and is an additional step that leads to absorption of proteins [1,4].

2.3. LP procedure

2.3.1. Positioning

The LP can be performed in both the sitting and the lateral recumbent position. The position depends on the physician's preferences and the patient's clinical condition. In the sitting position the patient is positioned with his back toward the physician, leaning forward as far as possible, thus maximizing the space between spinal processes. The spinal processes should be perpendicular to the floor, to ensure that the needle is inserted in the midline. The lateral recumbent position, however, is recommended because of a lower risk of severe headache [1]. If needed, this position is the only way to perform intracranial pressure measurement [1]. In the lateral recumbent position, the patient is asked to lie down on the side and to flex the back by pulling the knees to the chest. The knees and shoulders are placed in the same plane to make sure the spinal processes are aligned. In both the sitting and the lateral recumbent position the back should be flexed as far as possible to generate more space between the lumbar spinal processes so the needle can be inserted more easily. The physician should verify with the patient that this position can be maintained for a sufficient period of time before starting the procedure.

2.3.2. CSF withdrawal

When the patient is positioned properly the physician locates the site of needle insertion by palpating the posterior superior iliac crest and follow it in a straight line to the lumbar spinal processes. This line indicates the position of the fourth lumbar vertebral body. The needle can be safely inserted into the subarachnoid space at the L3-4, L4-5, or L5-S1 interspace, because this is well below the lower end of the spinal cord.

The space between two lumbar spinal processes is palpated. This is followed by disinfection of the area with alcohol in a circular motion. The physician puts on sterile gloves and checks the position of the patient again because the patient may have slightly changed position. Then the area is disinfected again with a sterile gauze, after which the needle is inserted in midline aiming at the umbilicus of the patient. When the subarachnoidal space is reached, a loss of resistance is typically felt. The needle is positioned properly when CSF starts dripping after removal of the stylet. CSF is collected in a polypropylene tube. When no fluid is detected or bone is encountered the needle will be redrawn until the subcutaneous level and inserted again at a different angle, or the needle is completely removed and a new attempt is made at an interspace at a different level. A maximum of four attempts is advised; however, this depends on the clinical need [1]. When the suitable amount of CSF is collected, the stylet is positioned back before the needle is removed as this has shown to reduce post-LP complaints [1]. A bandage is placed at the site of insertion when the needle is removed. The physician should stay in contact with the patient during the entire procedure to describe the following steps of the procedure and to give reassurance.

2.3.3. Concluding the procedure

After the LP the patient remains lying for a few moments and gets up slowly when feeling well. Studies have shown that bed rest is not associated with a lower prevalence of PLPH or post-LP back pain [1]. The patient is provided with printed information on possible complications and how to react when they occur.

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Supplementary data

Supplementary data related to this article can be found at http://dx.doi.org/10.1016/j.dadm.2017.04.008.

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