

Champagne and bloody taps: can we improve the success rate of neonatal lumbar punctures?

NEOCLEAR
optimising lumbar punctures
in newborns

NPEU

Neonatal lumbar puncture is an essential and common procedure. Its relatively high failure rate can have a significant impact on patients, parents, clinical teams and healthcare resources. NeoCLEAR is a large randomised controlled trial investigating whether success rates are affected by positioning, or timing of stylet removal. If successful, this trial may contribute to the future of neonatal care by reducing the need for repeat lumbar punctures, avoiding prolonged antibiotic courses and minimising postnatal hospital stays.

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Neonatal lumbar puncture (LP) is a common¹ but technically challenging procedure; hence the traditional promise of champagne if the sample obtained is perfectly clear – a ‘champagne tap’. Usually, however, the reward remains elusive, either because the cerebrospinal fluid (CSF) is blood-stained (a ‘bloody tap’) or because no sample is obtained at all.

Getting it right is crucial: LP is the *only* reliable test for meningitis and gives important information about other conditions (eg mitochondrial disease), as the clinical signs are non-specific.² Meningitis affects at least one in 4,000 neonates and carries high rates of mortality (approximately 10%) and morbidity (approximately 25%).³ Obtaining an interpretable CSF sample is essential for diagnosis, which subsequently

determines treatment and follow-up.

Success rates for neonatal LP are only 50–60%⁴ compared with 80–90% in older children.⁵ Most of us have witnessed the consequences of a failed LP: the diagnostic uncertainty, the possibility of repeat procedures causing further discomfort for the patient and distress for the family. If meningitis cannot confidently be ruled out, cautious management plans to cover for possible meningitis tend to involve prolonged courses of intravenous antibiotics, often requiring several venous cannulae and/or long-lines. Wider implications for healthcare systems include the risk of antimicrobial resistance and increased length of hospital stays, with their associated costs.⁶ The potential for delayed discharge also impacts the whole family as plans for returning home with

Keywords

neonatal; lumbar puncture; meningitis; preterm infant

Key points

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1. Despite suboptimal success rates, the technique for neonatal lumbar puncture (LP) has remained essentially unchanged for over 125 years.
2. NeoCLEAR is one of the first well-powered randomised trials to investigate neonatal LP technique. The primary outcome is the proportion of infants with a successful first LP.

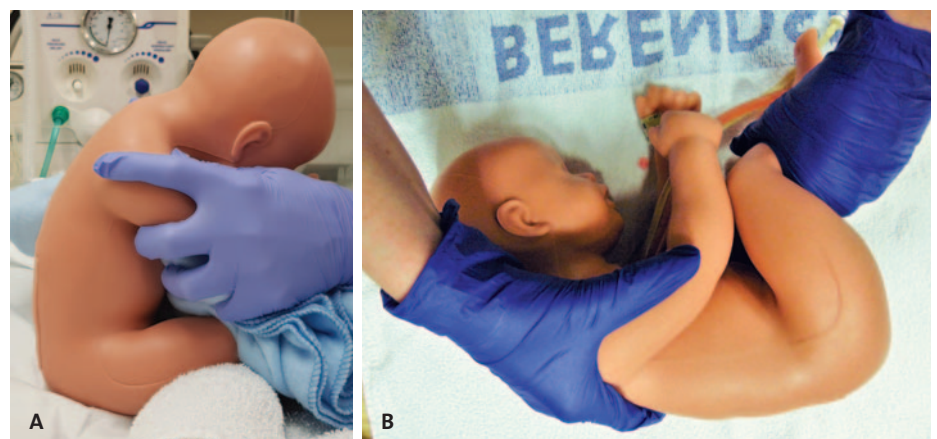


FIGURE 1 A manikin in the sitting and lying positions. A) Sitting position with a towel under the knees to improve lumbar flexion, shoulders held still and the head resting on a blanket. B) Lying position with thighs/legs held to improve lumbar flexion and shoulders held still. Photos taken using LumbarPunctureBaby manikin, Simulab, USA.

their newborn are rewritten.

Despite suboptimal success rates, the technique most commonly used for neonatal LP has remained essentially unchanged since the procedure was first described over 125 years ago.⁷ Previous neonatal research has investigated several modifications to traditional LP technique: the use of sedation, analgesia, additional training, sitting position, formulae for needle insertion depth, early stylet removal, and ultrasound guidance.⁸ Most of these studies have either been observational (low-grade evidence, open to bias) or too small to generate firm conclusions, or have made recommendations that appear difficult to implement widely.⁹ For these reasons, two easily-implementable modifications to current LP practice have been chosen for investigation.

1. Sitting versus lying position

FIGURE 1. Sitting increases the space between the spinous processes and may increase lumbar CSF pressure. It has been used in babies as small as 1,000g without additional cardiorespiratory instability.¹⁰

2. Early versus late stylet removal

The stylet (a thin piece of metal that sits inside the needle) is traditionally removed 'late', once the tip is assumed to have reached the CSF. Some evidence supports removing the stylet 'early', after going through the skin, and then slowly advancing the needle until CSF flows out. This may reduce the chances of inserting the needle beyond the CSF space into the venous plexus and obtaining a blood-stained sample.⁵

For both modifications there is observational evidence of improved success rates, but a large randomised study is needed to conclusively prove any significant benefit.

NeoCLEAR

NeoCLEAR – Neonatal Champagne Lumbar punctures Every time: A Randomised controlled trial – is one of the first well-powered randomised trials to investigate neonatal LP technique.¹¹ The NeoCLEAR team is aiming to recruit 1,020 patients. Most infants under neonatal care will be eligible to take part (**TABLE 1**). To investigate both techniques simultaneously, NeoCLEAR uses a '2x2' design where infants are randomised to one of four techniques (**TABLE 2**). The study team will regularly visit sites to train staff in each of

Study participants	
Neonates and infants in neonatal units and maternity wards who are having an LP	
Inclusion criteria	Exclusion criteria
Corrected gestational age from 27 ⁺ weeks to 44 ⁺ weeks • Working weight of 1,000g or more • First LP for current indication • Parent(s) willing and able to give informed consent	• Unable to be held in sitting position (including intubated infants) • Previously randomised to the trial

TABLE 1 The NeoCLEAR trial: inclusion and exclusion criteria.

	Lying	Sitting
Early stylet removal (ESR)	Lying + ESR	Sitting + ESR
Late stylet removal (LSR)	Lying + LSR	Sitting + LSR

TABLE 2 The '2x2' trial design.

Primary outcome	Secondary outcomes include
Proportion of infants with a successful first LP	• Number of procedures and attempts • Timing, movement, cardiovascular stability • Parental anxiety questionnaire • Diagnoses of meningitis • Length of antibiotics and hospital stay

TABLE 3 Primary and secondary outcomes. Outcome data are collected before and after the LP(s) and at discharge.

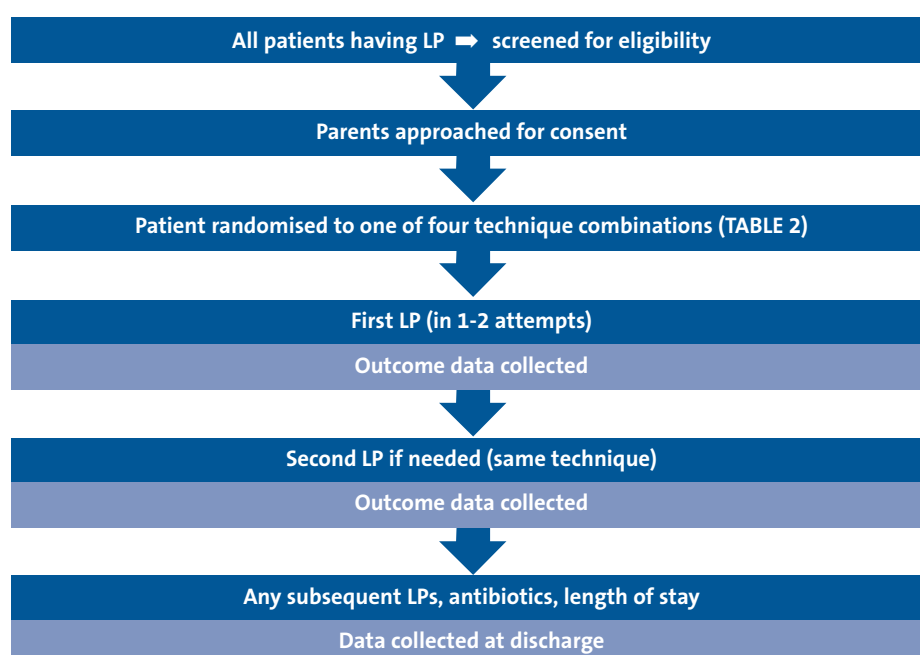


FIGURE 2 Overall flow of trial participants.

these techniques. Outcome data (**TABLE 3**) are collected before and after the LP(s) and at discharge. The primary outcome is the proportion of infants with a successful first LP, ie obtaining a CSF sample with <10,000 red blood cells/mm³.

The pilot phase of NeoCLEAR is underway, involving 10 units in the UK

and aiming to recruit 250 patients by spring 2019. Beyond this, further study sites may be able to join for the remainder of the trial. The overall flow of trial participants can be seen in **FIGURE 2**. Progress updates, study documents, and training videos for different techniques can be found on the NeoCLEAR website

(www.npeu.ox.ac.uk/neoclear). Parents and patient representatives, including colleagues from a local neonatal charity (www.ssnap.org.uk), have been involved in designing this trial. The trial is funded by the National Institute for Health Research Health Technology Assessment (NIHR HTA), co-ordinated by the National Perinatal Epidemiology Unit Clinical Trials Unit (NPEU CTU), and sponsored by the University of Oxford.

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For more information, please visit the NeoCLEAR study website at www.npeu.ox.ac.uk/neoclear or contact the study team at neoclear@npeu.ox.ac.uk

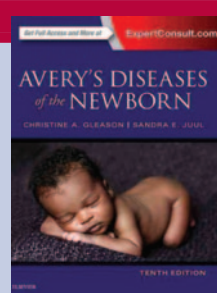
Book review

Avery's Diseases of the Newborn, tenth edition

Christine Gleason, Sandra Juul
Elsevier

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£125.99, hardcover, 1,656 pages



Since its first edition in 1960, *Avery's Diseases of the Newborn* has been one of the recognised textbooks for those in nursing and medical fields pursuing a career in neonatology. This 'American' textbook is still seen as a reliable source of information and an excellent foundation on which to build knowledge in the ever-changing frontier of neonatology. It has an extensive list of 216 contributors – specialists and experts in their own right in the various fields of neonatology. It was one of the textbooks with which I started my neonatal journey.

I am impressed with the updates that have been included in this recent edition, in keeping with the advances and developments in neonatology. The contents of the book address all aspects of the subject area starting with the fetus and maternal health, basic care, the high-risk newborn and then proceeding systematically through the organ systems. As a neonatal cardiac lead, I was pleased with the cardiovascular section of the textbook; it provides an excellent overview from the

development of the heart to the long-term outcomes of children with congenital heart disease. This is crucial since more of our preterm population and neonates with congenital heart disease are surviving into their teens and adulthood, which gives us a better understanding of how our interventions in the neonatal period impact upon these babies. The chapter provides information that parents seek on the possible long-term outcomes for their baby with congenital heart disease.

There are several new chapters. Among these, the chapters on brain injury in both preterm and term infants are a good refresher and clearly outline a crucial component of neonatal care. Intraventricular haemorrhage is one of the commonest causes of long-term morbidity in extremely preterm infants while in term infants there can be a spectrum of causes that can insult the brain, including hypoxic ischaemic encephalopathy, infection and metabolic diseases. These two chapters provide an understanding of the pattern of injury in these groups and what it means

for the infants over the long-term. Neuroprotective strategies for these babies are discussed in the following chapter.

Another key inclusion is the chapter on palliative care. Palliative care has become an important aspect of neonatology beginning with antenatal counselling of a baby with a life-limiting condition. The chapter goes through this model of palliative care and the importance of having a birth plan. It also has a section about end-of-life care with non-pharmacological and pharmacological management. I thought the chapter was rather light but I am sure this will evolve in time in line with further developments in this area.

Overall, the latest edition of *Avery's* is an excellent textbook for any doctor or nurse considering embarking on a journey in neonatology. It is a hefty textbook with 109 chapters and over 1,600 pages but quite rightly so. It is certainly not for the lighthearted. I am old-fashioned and prefer to hold a book and flip through the pages when reading, however for those more IT savvy, there is an e-book version provided with the textbook. Handy to carry around on a smart phone, iPad or tablet, the e-book is readily accessible at our patients' bedside.

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