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Annotation

When to do a lumbar puncture in a neonate

Lumbar punctures or spinal taps are performed for either diagnostic or therapeutic reasons. The procedure in the neonate, however, is not without risk and the costs can outweigh the benefits. Stated indications for lumbar puncture range from routine sepsis work up to a more conservative approach reserving the procedure for the investigation of very ill babies. There is little consensus of opinion and no controlled trials comparing outcomes when different indications for lumbar puncture have been used.

Diagnostic use of lumbar puncture

MENINGITIS

It has been suggested that lumbar puncture should be performed as a routine before antibiotics are started in all babies with suspected sepsis.[1] There is, however, no agreement about what constitutes suspected sepsis, and some centres perform a lumbar puncture on all infants presenting with respiratory distress within 24 hours of birth.[2] Visser and Hall examined more than 500 concurrent blood and cerebrospinal fluid samples obtained from 400 infants with suspected sepsis admitted to their neonatal intensive care unit in Kansas City during a 12 month period.[1] Forty (7·8%) episodes of septicaemia or meningitis were found with organisms isolated from the blood in 39 cases and in only one infant was the cerebrospinal fluid culture positive when blood culture was negative. Only 11 (2·1%) babies had meningitis giving an incidence of meningitis in cases of septicaemia of 11 out of 40 (27·5%). Clinical findings and indications for culture did not distinguish those infants with positive blood or cerebrospinal fluid cultures from those with negative cultures, nor those with meningitis from those who had septicaemia without meningitis. In no cases were different organisms isolated from concurrent blood and cerebrospinal fluid cultures. On the face of it blood culture would appear to be as good as cerebrospinal fluid culture in obtaining the infecting organism during a screen for suspected sepsis.

The same authors, however, also looked at all their positive cerebrospinal fluid cultures over a six and one half year period.[1] They found 39 cases of meningitis based upon positive cultures but in only 33 babies (85%) was the organism also isolated from the blood. Thus in 15% of cases of meningitis the infecting organism would not have been identified by blood culture alone. This discrepancy between blood and cerebrospinal fluid culture was found in both early onset and late onset infections. Visser and Hall concluded that lumbar puncture should not be omitted from the routine assessment for infection in any neonate unless clinical judgment dictates that performance would cause dramatic and irreversible changes in the infant's condition.[1]

In contrast, Eldadah and colleagues reached a different conclusion after studying 238 consecutively admitted babies with respiratory distress syndrome.[2] Routine examination of cerebrospinal fluid in the first 24 hours of life failed to diagnose any case of meningitis in these babies. In 35 cases (14·7%) the lumbar puncture was unsuccessful and in 71 (29·8%) the cerebrospinal fluid was frankly bloody. In 17 babies concurrent blood cultures were positive. The authors conclude that in view of the negative cerebrospinal fluid examinations and the potential complications of lumbar puncture in the sick neonate that this procedure should not be routine in babies with respiratory distress syndrome. They suggest that lumbar puncture be reserved for babies who have additional risk factors such as hypothermia, hyperthermia, or poor feeding after 24 hours of age or for those babies with central nervous system signs such as coma or seizures.[2]

INTRACRANIAL HAEMORRHAGE

In 1979 it was stated that lumbar puncture was frequently required to diagnose meningitis or intracranial haemorrhage in the neonate.[3] With the development of computed tomography and later ultrasound imaging, however, this is no longer true and lumbar puncture is rarely used as a diagnostic aid for intraventricular haemorrhage. One study set out to compare lumbar puncture with computed tomography for the diagnosis of intracerebral haemorrhage in 48 babies of less than 35 weeks' gestation.[4] Computed tomography was performed at 48–96 hours and haemorrhage was present in 15 babies. Serial lumbar punctures were attempted with the initial procedure, which preceded the scan by one to four hours, and was successful in 28 (58·3%) babies. The first lumbar puncture was consistent with the scan diagnosis of haemorrhage in only eight of the 15 babies and in the other seven

babies the initial tap was normal in three, traumatic in one, and unsuccessful in three. Furthermore, spinal taps showed bloody cerebrospinal fluid in 10 of 18 babies whose computed tomograms were normal.[4] The sensitivity of lumbar puncture in diagnosing intracranial haemorrhage was thus 73% and the specificity 44%.

For subarachnoid haemorrhage, however, lumbar puncture may be better than either computed tomography or ultrasound scan.[5] Cerebrospinal fluid protein values correlate quite well with the size of intraventricular haemorrhage on a computed tomogram.[6] Another possible advantage of lumbar puncture is the ability to time the onset of haemorrhage by comparing haemoglobin and bilirubin concentrations in cerebrospinal fluid using spectrophotometry.[7] This method will also distinguish traumatic tap and subarachnoid haemorrhage.

SEIZURES AND HYPOXIC-ISCHAEMIC ENCEPHALOPATHY

Several authorities have stated that a lumbar puncture is mandatory for the investigation of a newborn baby presenting with seizures or hypoxic-ischaemic encephalopathy.[8 9] The reasons given include the importance of determining opening pressure, and exclusion of intracranial haemorrhage and meningitis which may mimic hypoxic-ischaemic encephalopathy.[8 9] Some studies suggest that intracranial infection accounts for about 10% of neonatal seizures,[9 10] but in our experience neonatal meningitis is very rare with an incidence of only 0·5 per 1000 live births.[11]

Furthermore, onset of meningitis in the first week of life is very unusual and presentation with seizures alone even more uncommon.[11] In the investigation of seizures we would reserve lumbar puncture for ill babies or those in whom no obvious cause for the convulsion was present such as hypocalcaemia. We do not recommend lumbar puncture for the investigation of hypoxic-ischaemic encephalopathy without seizures unless there are other signs suggesting intracranial infection and the ultrasound scan is normal. It is possible that the measurement of creatine kinase brain isoenzyme concentration in the cerebrospinal fluid, however, provides a metabolic indicator of brain damage in newborns and this might justify the use of lumbar puncture to predict outcome of babies with hypoxic-ischaemic encephalopathy.[12]

Therapeutic use of lumbar puncture

MENINGITIS

Intrathecal instillation of antibiotics has been recommended for the treatment of meningitis in addition to systemic antibiotics as the latter are believed not to penetrate adequately in the cerebrospinal fluid. In a carefully controlled trial, however, McCracken and Mize found that intrathecal antibiotics given by lumbar puncture in association with systemic antibiotics were no more effective than intravenous antibiotics alone in treating neonatal meningitis.[13]

INTRACRANIAL HAEMORRHAGE

In 1980 Papile *et al* and Chaplin *et al* proposed that serial lumbar punctures were effective in arresting the progress of posthaemorrhagic hydrocephalus.[14 15] These studies were not controlled and did not take into account the natural history of posthaemorrhage hydrocephalus which may undergo spontaneous resolution.[16] A larger study of 48 babies failed to show that daily lumbar punctures prevented hydrocephalus after intraventricular haemorrhage,[6] and an accompanying editorial by Behrman called for a well controlled, short term, randomised study of serial lumbar puncture drainage of a substantial quantity of cerebrospinal fluid from a larger group of babies who are not subjected to any other unproved treatment at the same time.[17] Five years later Anwar *et al*, in a controlled study of 47 babies with either grade 3 or 4 intraventricular haemorrhage found that intermittent lumbar punctures were not effective in preventing posthaemorrhagic hydrocephalus.[18] At about the same time Kreusser *et al* using a Ladd monitor to measure intracranial pressure and ultrasound scanning suggested that two criteria were necessary before lumbar punctures could be effective in at least temporarily benefitting the baby with posthaemorrhagic hydrocephalus.[19] The first criterion was to show communication between the lateral ventricles and lumbar subarachnoid space by finding a reduction in ventricular size and a decrease in intracranial pressure after a removal of cerebrospinal fluid. The second criterion was to establish a critical volume of cerebrospinal fluid that must be removed, usually 10–20 ml before ventricular size and intracranial pressure were reduced.[19]

Repeated removal of cerebrospinal fluid in this fashion does have complications, notably hyponatraemia,[20] meningitis,[21] and epidural abscess with vertebral osteomyelitis[22] so that it should not be undertaken lightly and should only be performed in intensive care units that have ready access to ultrasound scanning and neurosurgical assistance. With current knowledge the efficacy of this treatment is not clear and further controlled studies are required.

Complications of lumbar puncture

The procedure, even in the smallest baby must be

painful and uncomfortable and frequently causes clinical deterioration, which is more likely if both the head and legs are flexed.[23 24] One cause of the clinical deterioration is compression of the diaphragm during flexion rather than upper airway obstruction,[23] and this can be lessened by performing the lumbar puncture with the baby in either the sitting position or with neck extension rather than flexion.[23 24]

Traumatic tap and unsuccessful lumbar puncture are quite frequent occurrences in the neonate with only 45–54% being successfully completed.[2 3] The incidence of traumatic and unsuccessful lumbar puncture was similar whether a needle with a stylet, a butterfly needle without stylet, or a standard venepuncture needle without stylet were used.[3] Epidermoid spinal tumour has, however, been associated with the use of unstyletted lumbar puncture needles,[25 26] and these should probably be avoided when performing a lumbar puncture in the newborn.

As mentioned above repeated lumbar punctures for the treatment of posthaemorrhagic hydrocephalus have been associated with hyponatraemia,[20] meningitis,[21] and vertebral osteomylitis,[22] to which may be added local trauma to the skin of the back.

Conclusions

The indications for lumbar puncture in the newborn are not as clear cut as previously believed. Considerable doubt exists about whether they should be performed routinely in the baby with suspected sepsis or the ill baby with respiratory distress unless there are other pointers towards a diagnosis of meningitis. Reserving lumbar puncture only for the ill newborn will, however, increase the risks of clinical deterioration during and after the procedure, and of not obtaining a satisfactory sample of cerebrospinal fluid. Making a diagnosis of meningitis in a septicaemic baby will of course help with prognosis but is unlikely to aid treatment. As in the older child lumbar puncture can be delayed until the baby's condition is stable and treatment with high dose antibiotics has been allowed to have its effect.[27]

Lumbar puncture for diagnosis of intracranial haemorrhage is rarely needed after the introduction of bedside ultrasonic brain scanning. It should be reserved for the term infant with suspected subarachnoid haemorrhage where the diagnosis is uncertain clinically and the ultrasound scan is normal. Lumbar puncture need not be routine for investigation of seizures and hypoxic-ischaemic encephalopathy, and should be reserved for those ill babies in whom an alternative diagnosis of meningitis cannot be excluded on clinical or ultrasonic findings. The place of serial lumbar punctures for the management of posthaemorrhagic hydrocephalus remains to be clarified and larger controlled studies are needed.

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