IS GENERAL ANAESTHESIA ESSENTIAL IN CHILDREN UNDERGOING LUMBAR PUNCTURES FOR PAEDIATRIC ONCOLOGY INVESTIGATION AND TREATMENT?

SUMMARY OF KEY POINTS:

- We feel general anaesthesia is not essential to safely complete all lumbar punctures in an oncology setting.
- Virtual reality distraction is well tolerated.
- Awake LP should be the default first choice option in certain patients.

REVIEW OF EVIDENCE

There are 440 children diagnosed with Acute Lymphoblastic Leukaemia each year in the UK **(1)**. Following the ALL-IC-BFM-2009 protocol, these children will need 15-22 lumbar punctures for administration of intrathecal chemotherapy within the first year of treatment. They may also require additional general anaesthetics (GA) for other procedures such as insertion of lines and other surgery.

In paediatric practice we routinely undertake minor painful and distressful procedures under general anaesthesia because this has been perceived as the 'kind' default for our children. Equivalent procedures in adults would routinely be done awake, reserving a GA for the minority of patients who really need it. In practice, most paediatric centres have treatment lists with varying age children and a 'one-size fits all' approach that assumes the child receiving a general anaesthetic enables the list to run smoothly and is felt palatable by clinicians, partly because the patient remains still at the point of injection.

This approach is clearly not without risk. The risks of any GA are furthered within the context of cancer, as well as the sheer number required by the child. By and large these are weak ASA 3 patients, some of whom will have thoracic T-ALL with mediastinal masses and so even a 'quick GA' should not be taken lightly. A GA, especially utilising volatile agents, not only has environmental impacts but risks potential interaction of nitrous oxide and methotrexate leading to possible neurotoxicity. **(2)** Nitrous oxide has unclear effects on methionine synthase and thus potentiation of bone marrow suppression which is particularly deleterious in this patient cohort. Even without nitrous oxide there are potential unquantified neurocognitive and neuroimaging decline from repeated GA **(3)**

Outside of an oncology setting, some paediatric LPs have been completed using conscious sedation. These approaches include chloral hydrate, mouthpiece Entonox, benzodiazepines, propofol bolus/TCI and Dexmedetomidine infusion.

We have taken a different approach in our centre, with the aim of an awake LP being the default, principally with virtual reality distraction. After refining the use of our Oculus and SyncVR gaming systems in clinical environments during anaesthetic inductions we agreed to invite children over the age of 8 years undergoing lumbar puncture and intrathecal chemotherapy to have their procedures done under VR distraction with local anaesthetic. This was with the promise of immediate conversion to general anaesthetic if they desired, and so they arrived appropriately starved on their initial session. Feedback was sought from patients, carers and staff involved after every procedure and the overall process and technique was altered accordingly to refine the 'evolving' Standardised Operating Procedure for our VRLP service. This has been so successful we now have patients regularly having their treatment awake, have reduced our age group to certain children over the age of 5 years and have received celebrity backing **(4)**.

The children are highlighted as appropriate for this service by their base consultant, ideally from diagnosis. They arrive fasted in case of conversion to GA and their back liberally topicalised with AMETOP. They are given a short demonstration of how to use the VR equipment and allowed to play. Parents can watch their child's gameplay on a tablet device and so feel part of the process. At the point the procedure is done they assume a sitting position on the trolley with their feet firmly on a stool (akin to an obstetric epidural) and confirmation that the field of VR view is centred to allow a slight head down position. The game music is made audible to aid an immersive experience (ideally headphones be worn) and the child plays whilst the procedure is completed. This has been successful in more than 90% of cases.

All the successful children requested their next lumbar puncture to be done awake under VR distraction. Some of the older ones have even progressed to simply playing on their smartphone. Interestingly the use of local anaesthetic infiltration was generally less accepted than topical alone as they object to the subcutaneous stinging sensation.

Objectively the procedure itself took no longer but without additional time required for the anaesthetic and recovery, so overall was quicker and less labour intensive.

There is an understandable hesitancy from staff when setting up this service, including the doctors performing the lumbar punctures as they felt under some degree of pressure, however once they had seen how the children benefitted from this technique, they became enthusiasts about awake LP and enhance this changing paradigm.

We have shown that with the right patients, equipment, preparation and protocol, lumbar puncture under VR distraction is effective and improves patient autonomy, choice, and satisfaction. It also affords us the opportunity to improve the safety and efficiency of our oncology lists.

We fully acknowledge that this is not appropriate for all patients. Patients requiring other procedures such as bone marrow trephine are not currently offered awake due to the stimulation involved. Patient selection is key. Although we have had children as young as 5 years old successfully have awake LP, children 8 years and above are best placed to understand and follow instructions.

We believe that these procedures should not be done under GA by default. This exposes the patients to an unnecessary and increased risk profile. If done awake the patient carries a much lighter anaesthetic burden, central lines are accessed less frequently, fasting time is eliminated and recovery time essentially removed. Our patients find this much more tolerable. The disadvantages and pitfalls of GA could arguably be described as unnecessary in the context of a better technique being available. This is recognised by our institution and has also attracted celebrity backing.

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