CASE REPORT

Awake caudal anaesthesia in neonates/young infants for improved patient safety

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Accepted 12 May 2017

SUMMARY

Caudal epidural block in a conscious infant is a recognised technique that allows the avoidance of general anaesthesia and risks associated with it. It is also technically easier to perform reliably compared with an awake subarachnoid block in skilled hands.¹ While local anaesthetic systemic toxicity is a rare complication of caudal anaesthesia, this case illustrates the potential for caudal anaesthesia done awake in enhancing patient safety through early recognition of local anaesthetic systemic toxicity.

BACKGROUND

Caudal anaesthesia is frequently performed in our institution due to its extensive safety record and relative ease of technique,² usually under general anaesthesia. Less commonly, it is used as a sole anaesthetic only in young infants. It is known that complications after caudal block are more common in younger children and include block failure, blood aspiration and intravascular injection.² We present a case of local anaesthetic systemic toxicity (LAST), a rare complication, in an infant who received a caudal block fully awake. Central nervous system (CNS) signs in the awake infant allowed us to suspect LAST before the onset of cardiovascular complications, prompting rapid treatment. This case illustrates the potential for caudals done awake in enhancing patient safety.²

CASE PRESENTATION

A 2-month-old well full-term infant weighing 4800 g was scheduled for elective bilateral inguinal hernia repair. No premedication was administered. Standard anaesthesia monitoring and peripheral venous access were established. Awake caudal anaesthesia was performed with the child in the left lateral position with a 22G cannula. No difficulty was encountered. Keeping the toxic dose of bupivacaine in mind,^{3 4} 6 mL of 0.17% bupivacaine without epinephrine (ie, 2.125 mg/kg) was given in divided doses over 3 minutes with negative aspirations for blood during the procedure. There was no resistance encountered at all during the administration. There were no changes in ECG morphology such as T-wave elevation during the administration of the local anaesthetic, and the child remained in sinus rhythm.

After the infant was turned supine, seizure-like activity was noted with uncoordinated movements and blank staring. Local anaesthetic toxicity was suspected. A code was activated and the local anaesthetic toxicity kit was called for. Although not apnoeic,

the infant was given 100% oxygen and assisted ventilation. The infant's blood pressure was 78/55 mm Hg, heart rate 151–155 beats/minute in sinus rhythm and oxygen saturation was 99%–100% on oxygen administered via a facemask. IV midazolam 1 mg was given to abort the possible seizure. IV Intralipid 20% 6 mL bolus was administered within 5 minutes of seizure onset. Within a minute of Intralipid administration, the uncoordinated movement stopped. Regular breathing returned and the infant looked around, but the heart rate increased to 238 beats per minute with a supraventricular tachycardia (SVT) pattern noted on the ECG monitor. Blood pressure dropped from 95/66 to 53/34 mm Hg, but oxygen saturation remained at 100%. The cardiac rhythm self-reverted within 2 minutes before adenosine could be administered and the blood pressure returned to normal. An Intralipid infusion was commenced at 75 mL/hour and stopped when the maximum recommended dose was achieved, as per AAGBI (The Association of Anaesthetists of Great Britain and Ireland) guidelines. The patient remained stable.

After discussion with the team and parents, surgery proceeded under general anaesthesia with intra-arterial blood pressure monitoring. The infant was transferred to the intensive care unit postoperatively. Other than initial acidosis, recovery was uneventful and the patient was discharged home on postoperative day 2.

DIFFERENTIAL DIAGNOSES

Alternative causes of seizures include:

- ▶ Electrolyte abnormalities (deranged sodium and glucose levels)
- ▶ Epilepsy
- ▶ Brain tumour
- ▶ Infection
- ▶ Oesophageal reflux
- ▶ Drug error
- ▶ Breath holding spells

TREATMENT

IV Intralipid 20% 6 mL bolus was administered within 5 minutes of seizure onset. An Intralipid infusion was commenced at 75 mL/hour and stopped when the maximum recommended dose of 10 mL/kg was achieved, as per AAGBI guidelines.

OUTCOME AND FOLLOW-UP

The infant was transferred to the intensive care unit postoperatively. Recovery was uneventful and the patient was discharged home on postoperative

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To cite: Lim WY, Wijeratne SA, Lim EHL. *BMJ Case Rep* Published Online First: [please include Day Month Year]. doi:10.1136/bcr-2016-218500

day 2. Follow-up via phone consult with the patient's parents at 2 years old was uneventful.

DISCUSSION

The use of regional anaesthesia in children is associated with a low rate of morbidity, despite the fact that the majority of regional anaesthetics are done under general anaesthesia or deep sedation to enhance patient cooperation.² There is less risk of injury when placing a needle in an immobile child compared with one who is struggling or may move unpredictably.³ Life-threatening complications like LAST are rare but possible. Neonates are thought to be more susceptible to LAST than older children because of lower alpha 1 acid glycoprotein and immature liver metabolism, leading to higher local anaesthetic plasma concentration.^{5,6} LAST can occur despite negative aspiration for blood and keeping to the recommended dosages for local anaesthetic.⁷

LAST is typically recognised by CNS signs and/or haemodynamic instability that usually manifest within 1–5 minutes of injection due to high plasma concentrations of local anaesthetics.⁸ CNS toxicity generally manifests before cardiovascular system (CVS) toxicity as evidenced by the fact that reported LAST cases rarely presented with only CVS signs and symptoms.⁵ However, general anaesthesia or sedation can mask CNS toxicity signs and symptoms. Being able to recognise these in an awake patient would be an advantage because early intervention like the use of a lipid emulsion can potentially prevent the onset of potentially lethal cardiac arrhythmias that can be resistant to the usual resuscitative measures like defibrillation. In reports on the use of lipid emulsion in children, lipid emulsion was administered in children who had already developed cardiovascular arrhythmias and compromise^{4,8,9} because the CNS signs had been masked by general anaesthesia. They had successful reversions to stable haemodynamics. The prognosis of recovery from LAST without significant neurological deficit is good provided that oxygenation, ventilation and cardiac output have been maintained throughout.

This was the first case of LAST in our institution. There were multiple factors that contributed to the successful management and outcome in this case. First is vigilance and early recognition. Although alternative causes of seizures were possible, LAST was most likely given the temporal relationship between the onset of seizure and the caudal administration in our patient. Second is the availability of a local anaesthetic toxicity kit containing Intralipid and AAGBI guidelines, within our operating theatre complex. Third, prior simulation training for operating theatre staff allowed for effective teamwork and communication during this actual crisis. Fourth, our choice of awake caudal as the sole anaesthetic technique allowed for early detection of CNS signs, which would otherwise have been masked by general anaesthesia. Intralipid should be administered as soon as possible, once available in cases of suspected LAST, and should not be adopted as a last rescue therapy.¹⁰

The recommended dose of bupivacaine as a sole anaesthetic technique in infants is 1–1.2 mL/kg of 0.25% bupivacaine.¹¹ In our patient, the administered dose was within the recommended limits. Epinephrine 0.5 µg/kg as a caudal adjunct can be used to aid detection of inadvertent intravascular injection by observing for changes such as tachycardia, increase in blood pressure by 15 mm Hg and ECG changes like T-wave elevation and ST segmental changes, but it is not a perfect indicator.^{1,7,11} First, signs such as tachycardia can be non-specific and unreliable in children, especially if they are sedated or under general anaesthesia.^{12,13} Second, the use of an additive may contribute to an

additional source of drug error. In view of these considerations, the choice of omitting epinephrine in caudal blocks was standard practice within our institution. There are other measures that may enhance the safety of caudal anaesthesia such as the administration of the local anaesthetic as a slow incremental rather than rapid bolus, the use of potentially less cardiotoxic levonamtiomer local anaesthetics and aspirating the needle or catheter before each injection.¹² Although ultrasound may be useful in preventing vascular injection in other blocks and ultrasound of the epidural space is possible, it is not possible to rule out intravascular injection for caudals under ultrasound guidance.

Awake caudals may not be suitable for all children because they can be technically challenging to perform in an uncooperative child. This is why it is recommended only in young infants who can be more easily immobilised through firm hold and should be attempted only by skilled practitioners. Opponents of awake caudals suggest that this technique has a significant failure rate and may be stressful for the child.¹⁴ However, it is still technically easier to perform reliably compared with an awake subarachnoid block in skilled hands.² In skilled hands and in selected patient groups, particularly the premature neonates and young infants, awake caudals can enhance patient safety by avoiding the risks of general anaesthesia and allowing the early detection of rare complications like LAST. In addition, regional anaesthesia as a sole technique improves postoperative outcomes for neonates who are susceptible to complications such as postoperative apnoea and mechanical ventilation in preterm-born neonates.¹⁵ This indirectly leads to reduced costs associated with postoperative monitoring and hospitalisation.¹⁵

There are limited studies on awake caudals, but it is clear that systemic CNS side effects in patients receiving awake caudal anaesthesia have been observed at high doses such as 3 mg/kg bupivacaine.^{16,17} The use of sedative agents such as midazolam may influence the clinical pattern of LAST as CNS manifestations may go unnoticed, resulting in late recognition when signs of cardiovascular toxicity appear.^{5,8,9}

The use of lipid emulsions is not without adverse effects. Lipid emulsions have been used as an antidote for lipophilic drug toxicity other than local anaesthetics, and complications that have been associated with its use include pancreatitis, lipidaemia, acidosis, acute respiratory distress syndrome and asystole in patients who had overdosed on beta blockers.^{18,19} Our patient developed SVT soon after administration of Intralipid that resolved spontaneously, but the cause of the supraventricular

Patient's perspective

We cannot be thankful enough for everything—that prompt and effective medical assistance was rendered to my son during and after the procedure... even to date, we shudder at the incident that has clearly imprinted in our minds. We are grateful for the excellent team in KKH for saving him, a 1 month+ infant then. He is doing very well as a toddler now. Your clear and detailed account is important in helping us understand what really happened (I guess my husband and I were too shocked and traumatised to make sense of the explanations given to us verbally then and the discharge report given thereafter was too brief for us to make sense of). I am grateful that you contacted us that we can clarify on this and also contribute as a case study to benefit relevant medical personnel and future patients. Thank you so much, doctor, for the noble work which patients and their families will be so grateful for!

Learning points

- ▶ Local anaesthetic systemic toxicity (LAST) is rare.
- ▶ Neonates are thought to be more susceptible to LAST than older children because of lower alpha 1 acid glycoprotein and immature liver metabolism.
- ▶ Early recognition and management of LAST is associated with good neurological outcome provided that oxygenation, ventilation and cardiac output have been maintained throughout.
- ▶ Our choice of awake caudal as the sole anaesthetic technique allowed for early detection and management of LAST through CNS signs, which would otherwise have been masked by general anaesthesia.
- ▶ Use of epinephrine additive as a caudal test dose may potentially allow early detection of inadvertent intravascular injection.
- ▶ Regular simulation training for crisis management allowed for effective teamwork and communication during an actual emergency.
- ▶ The use of lipid emulsions in LAST is effective, but overdose is not without adverse effects.

tachycardia is unclear. Conversely, supraventricular and ventricular arrhythmias have been described with LAST that resolved with the administration of lipid emulsion.^{4 5 8 9 20} While the use of lipid emulsions like Intralipid has proven useful in the management of LAST, overdose should be avoided to reduce the incidence of associated complications.²¹

Contributors WYL has produced the report and literature review and was involved in the care of the patient. SAW assisted with the report and was also involved in the care of the patient. ELHL oversaw the creation of the report and was additionally involved in the care of the patient.

Competing interests None declared.

Patient consent Obtained.

Provenance and peer review Not commissioned; externally peer reviewed.

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