

# ANTERIOR INTERSCALENE APPROACH TO THE BRACHIAL PLEXUS USING A NERVE STIMULATOR AS RESCUE THERAPY FOR ARTERIAL OCCLUSION DUE TO AN INDWELLING BRACHIAL ARTERY CANNULA IN INFANTS.

Avenant C MB. Ch.B(Stel) DA.(SA) FCA(SA)\*,

\*Anaesthetologist; Multi-disciplinary Chronic Pain Unit; Wilgeheuwel Private Hospital

Kirsten GF FCP(SA)Paed, MMed(Paed), MD.\*\*,

\*\*Head, NICU, Department of Paediatrics, Tygerberg Children's Hospital and the University of Stellenbosch

## Abstract

The brachial artery is infrequently cannulised in newborns as vasospasm or thrombosis may result in ischaemia of the forearm and if not reversed, may lead to loss of a hand or forearm. This study describes the successful restoration of blood flow to the forearms of seven very low birth weight infants (birth weight <1500g) and one four month-old infant with cannula-related brachial artery obstruction by means of axillary brachial artery block and a nerve stimulator. This is a safe procedure with no documented side effects. However, paediatricians and anaesthetists should restrict peripheral arterial cannulation to arteries with a collateral circulation and should only attempt brachial artery cannulation in life threatening situations.

## Introduction

Atraumatic arterial access for blood pressure monitoring and obtaining blood samples has become an integral part of the management of infants requiring intensive care. The umbilical, radial and posterior tibial arteries are most commonly cannulised for this purpose. As many of these infants may require prolonged periods of ventilation coupled with the short lifespan of a cannulised peripheral artery catheter, it is not uncommon for a critically ill infant to have all his available peripheral arteries cannulised at some stage.

The small size of these arteries in premature infants makes cannulation more difficult and complications associated with placement and during use occur more frequently than in children and adults<sup>1</sup>.

Peripheral arterial catheters in infants may result in vasospasm with necrosis of the skin, muscles, fingers or toes distal to the obstruction<sup>3</sup>. Although the umbilical artery is the most easily accessible it has its unique complications such as blanching and ischaemia of the skin of the lower limbs and even sciatic nerve palsy with gluteal muscle and skin necrosis<sup>2</sup>. The brachial artery is infrequently cannulised in newborns as vasospasm or thrombosis may result in ischaemia of the forearm and if not reversed, may lead to loss of a hand or forearm<sup>1</sup>. Cannulation of the brachial artery will only be attempted if none of the peripheral arteries can be cannulised and if the benefits of an indwelling arterial catheter outweigh the possible complications associated with arterial obstruction of this artery<sup>1</sup>.

Management of an ischaemic limb includes the immediate removal of the catheter from the artery, warming of the contra-lateral limb to stimulate parasympathetic induced vasodilatation in both limbs<sup>3</sup>, intra-arterial verapamil<sup>4</sup>, topical nitroglycerine ointment<sup>5</sup> as well as axillary brachial plexus block<sup>6</sup>.

The aim of this paper is to report on the use of axillary brachial plexus block with the use of a peripheral

nerve stimulator as rescue therapy to reverse severe brachial artery catheter-related vasospasm in the forearms of infants.

## Patients and Methods

Seven ventilated newborn infants with birth weights ranging from 750g to 3800g and gestational ages between 28 and 40 weeks and one 4 month old infant presented with compromised arterial blood supply to the forearm and hand associated with an indwelling brachial artery catheter. The involved forearms of all the infants were cyanosed, cold to the touch and no brachial artery pulse could be identified. All the infants were treated in private neonatal intensive care units. An anaesthetist skilled in anterior interscalene brachial plexus blocks in adults was consulted to perform these procedures.

The brachial artery cannula was removed and an anterior interscalene brachial plexus block was performed as a sterile procedure after informed consent was obtained from the parents.

The infant was sedated and placed in the supine position with the affected arm positioned close to the body. The face was turned away from the affected arm. The interscalene space was located at the level of the

cricoid cartilage (opposite C6 vertebra). The posterior border of the sternocleidomastoid muscle was identified by lifting the head of the infant slightly. The middle finger of the anaesthetist's non-dominant hand was used to identify the interscalene groove and to stabilise the skin during needle insertion. The needle was inserted into the skin at the level of the superior thyroid notch at the posterior border of the sternocleidomastoid muscle while the tip of the needle was directed in a latero-posterior and caudal direction.

A 25mm Stimuplex needle, B.Braun A25 (0.55 x 25mm) and nerve stimulator (B.Braun) were used to identify the sympathetic plexus. The initial stimulating current was set at 1mA with a pulse duration of 0.1ms which was decreased to 0.3mA once contractions were noted in the affected wrist and fingers. Two milligram/kg Macaine (Adcock Ingram) was diluted in 1 to 3ml of saline. One ml of the diluted Macaine solution was initially injected but due to a poor response this was increased to 2ml. The transcutaneous oxygen saturation levels in the affected arm were monitored continuously after the injection of the Macaine and a repeat sympathetic block was performed if the oxygen saturation levels decreased again compared to the saturation levels recorded on the normal hand.

The clinical characteristics of the infants are shown in Table1.

Table 1. The clinical characteristics of the infants who developed a cannula-related brachial artery occlusion.

Patient	1	2	3	4	5	6	7	8
Birth weight(g)	750	950	1050	1500	700	1250	3800	1150
Gestational age (weeks)	28	30	32	33	30	30	40	34
Number of axillary brachial plexus blocks	Yes, After 1 hr	Yes, After 1 hr	No	No	Yes, after 24 hrs	Yes, after 24 hrs	Yes, after 24 hrs	No
Restoration of blood flow in affected forearm	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Clinical diagnosis	NEC		NEC				Congenital heart lesion	
Outcome	Survived	Died Septicaemai	Survived	Survived	Died Septicaemai	Died Multi-organ failure	Survived	Survived

## Results

The anterior interscalene brachial block was successful in all 8 infants. Three infants had an immediate response with the skin colour, temperature and saturation levels returning to normal within minutes. These three infants received only one sympathetic nerve block. Two infants required a second block one hour after the initial injection. The poor initial response which occurred in these two infants was attributed to the small initial volume of 1ml of injected Marcaine. The second injection resulted in restoration of blood flow in the affected fore-arm and hand. Three infants required a second injection after 24 hours. All three these infants were critically ill and suffered from septicaemia and multi-organ failure. Although the sympathetic nerve blocks in all three these infants was successful, two subsequently died due to their septicaemia.

No local or systemic complications were documented after the injection of Marcaine in any of the infants.

## Discussion

Peripheral arteries such as the ulnar and radial arteries have collateral circulations and if obstructed by thrombosis or vasospasm, are less likely to result in total limb ischaemia. Peripheral artery cannulation in adults is a relatively safe procedure with a complication rate of less than 1%<sup>7</sup>. This is similar to a rate of 1.3% of major complications in neonates<sup>8</sup>. However, the small diameter of the peripheral arteries in infants and specifically very low birth weight infants (birth weight <1500g), makes cannulation a much more difficult procedure compared to in children or adults<sup>1</sup>.

As the brachial artery does not have a collateral flow, cannula-related occlusion of this artery is a serious condition and should be treated as a medical emergency in an infant. Occlusion may be due to vasospasm which usually occurs within minutes or a few hours after cannula insertion while thromboembolic events usually occur after days<sup>3</sup>. Heparinisation of the infused fluid with as little as 0.25 units/ml of heparin in newborns may prevent occlusion of the cannula<sup>9</sup>.

Very few studies have been reported on the management of catheter-related brachial artery occlusion in

newborns<sup>1</sup>. This may be due to the avoidance by paediatricians and anaesthetists of the cannulation of this end artery.

The immediate management of an occluded brachial artery includes warming of the contra-lateral limb to produce reflex vasodilatation of the affected limb which should be kept in a horizontal position. Care should be taken not to increase the temperature of the ischaemic limb<sup>3</sup>. If no immediate improvement is noted in the circulation of the affected limb, the cannula should be removed immediately.

If vasospasm persists after the use of these basic measures, vasodilating drugs should be used immediately. Baserga<sup>5</sup> described the use of topical 2% nitroglycerine ointment to the hand and fingers of a 660g infant with occlusion of the radial artery by an indwelling radial artery catheter. Within 30 minutes of applying the 2% nitroglycerine ointment perfusion of the fingers improved followed by full recovery of colour in the affected hand. The haemodynamic effects of nitroglycerine may last up to 6 hours<sup>5</sup>. The onset of vasodilatation in their patients occurred one hour after topical application of the nitroglycerine with the haemodynamic effects lasting for 6 hours. No adverse effects were noted in the infants but caution should be applied if repeat applications of the nitroglycerine ointment is indicated<sup>5</sup>.

Vasodilatation can also be achieved by sympathetic nerve block with a local anaesthetic either via the neuro-axial approach or via a peripheral plexus nerve block<sup>6</sup>. Breschan<sup>6</sup> described the successful injection of 0.5ml of 0.125% bupivacaine just above the axillary artery of a 700g infant with peripheral limb ischaemia due to an indwelling radial artery catheter. The correct location for the injection of the local anaesthetic above the axillary artery was obtained by inserting the needle into the axillary region and ensuring that the artery was not entered during the injection of the local anaesthetic<sup>6</sup>.

The use of axillary brachial plexus block in adults and children with or without the use of a peripheral nerve stimulator has been well established<sup>10,11</sup>. This is the first study to describe the use of a nerve stimulator during axillary brachial plexus block in very low birth

weight infants with catheter-related brachial artery occlusion.

None of the infants in this study exhibited any side-effects during the stimulation of the sympathetic nerves with a current of 1mA with a pulse duration of 0.1ms. The best vasodilator response in the present study was obtained by injecting 2mg/kg of Macaine after the 1mg/kg dose did not abolish the peripheral vasospasm. The absence of any local or systemic side-effects associated with the use of Macaine was reassuring. In two infants ischaemia of the forearm recurred after 2 hours for which they required a second axillary brachial plexus block. In both these infants, only 1mg/kg of Macaine was used during the initial nerve block. Three infants required a second axillary brachial plexus block 24 hours later. Despite the restoration of blood flow in the affected arm in the latter three infants, two of them subsequently died from septicaemia.

## Summary

Catheter-related brachial artery occlusion in infants was successfully reversed by axillary brachial plexus block using a nerve stimulator. However, paediatricians and anaesthetists should restrict peripheral arterial cannulation to arteries with a collateral circulation and only attempt brachial artery cannulation in life threatening situations. Once brachial artery occlusion has been diagnosed which does not improve after removal of the catheter, an anaesthetist skilled in axillary brachial plexus block in infants should be urgently consulted.

## References:

1. Schindler E, Kowald B, Suess H, Niehaus-Borquez B, Tausch B, Brecher A. Catheterization of the radial or brachial artery in neonates and infants. *Pediatric Anesthesia* 2005;15:677-682
2. Cumming WA, Burchfield DJ. Accidental catheterization of internal iliac artery branches: A serious complication of umbilical artery catheterization. *J Perinatol* 1994;XIV:304-309
3. Hermansen MC, Hermansen MG. Intravascular catheter complications in the neonatal intensive care unit. *Clin Perinatol* 2005;32:141-156
4. Shindler E, Kowald B, Suess H, Niehaus-Borquez B, Tausch B, Brecher A. *Pediatric Anesthesia* 2005 ;15:677-682
5. Gallacher BP. Intra-arterial verapamil to reverse acute ischemia of the hand after radial artery cannulation. 1991;38:138.
6. Baserga MC, Puri A, Sola A. The use of topical nitroglycerine ointment to treat peripheral tissue ischemia secondary to arterial line complications in neonates. *J Perinatol* 2002;22:416-419
7. Breschan C, Kraschl R, Jost R, Marhoffer P, Likar R. Axillary brachial plexus block for treatment of severe forearm ischemia after arterial cannulation in an extremely low birth-weight infant. *Pediatric Anesthesia* 2004;14:681-684.
8. Scheer B, Perel A, Pfeiffer UJ. Clinical review: complications and risk factors of peripheral arterial catheters used for haemodynamic monitoring in anaesthesia and intensive care medicine. *Crit Care* 2002;6:199-204
9. Randel SN, Tsang BH, Wung JT, Driscoll JM, James LS. Experience with percutaneous indwelling peripheral arterial catheterization in neonates. *Am J Dis Child* 1987;141:848-851.
10. Barrington KJ. Umbilical artery catheters in the newborn: effects of heparin. *Cochrane Database Syst Rev* 2000;2:CD000507
11. Perris TM, Watt JM. The road to success: a review of 1000 axillary brachial plexus blocks. *Anaesthesia* 2003;58:1220-1224.
12. Bosenberg AT, Raw R, Boezaart AP. Surface mapping of the peripheral nerves in children with a nerve stimulator. *Paediatr Anaesth* 2002;12:398-402.

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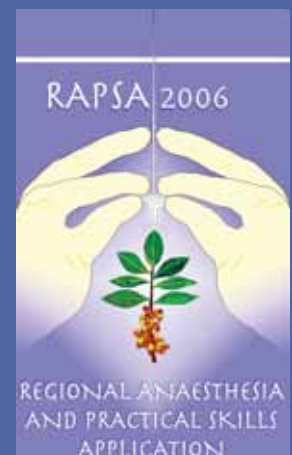
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**CONTRA-INDICATIONS:** Hypersensitivity to local anaesthetics of the amide type. Intravenous regional anaesthesia (Bier's block). Obstetric paracervical anaesthesia.  
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General contra-indication related to epidural anaesthesia, regardless of the local anaesthetic used should be taken into account.

**WARNINGS:** Safety in pregnancy and lactation other than in labour has not been established. In performing NAROPIN blocks, unintended IV injection is possible and may result in cardiac arrest. The potential for successful resuscitation has not been studied. NAROPIN should not be injected rapidly in large doses but rather in incremental doses. It is not recommended for emergency situations where a fast onset of anaesthesia is necessary. Local anaesthetics should only be employed by clinicians who are well versed in the diagnosis and management of dose related toxicity and other acute emergencies which might arise from the block to be employed, then only after insuring the immediate (without delay) availability of oxygen, other resuscitative drugs, cardiopulmonary resuscitative equipment, and the personnel resources needed for proper management of toxic reactions and related emergencies. Delay in proper management of dose related toxicity, under ventilation from any cause and/or altered sensitivity may lead to the development of acidosis, cardiac arrest and possibly, death. Solutions of NAROPIN should not be used for the production of obstetrical paracervical block anaesthesia, retrobulbar block, or spinal anaesthesia (subarachnoid block) due to insufficient data to support such use. Intravenous regional anaesthesia (Bier block) should not be performed due to a lack of clinical experience and a risk of attaining toxic blood levels of NAROPIN. Aspiration for blood, or cerebrospinal fluid (where applicable), must be done prior to injecting the original and all subsequent doses of any local anaesthetics to avoid intravascular or subarachnoid injection.

However a negative aspiration does not ensure against an intravascular or subarachnoid injection. A well known risk of epidural anaesthesia may be unintentional subarachnoid injection of local anaesthetic. NAROPIN should be used with caution in patients receiving local anaesthetics and agents structurally related to amide-type local anaesthetics, since the toxic effects of these drugs are additive.

**DOSEAGE AND DIRECTIONS FOR USE:** For dosage and directions for use see package insert.

**SIDE EFFECTS AND SPECIAL PRECAUTIONS:** Side-effects: Adverse event profile is similar to other long acting local anaesthetics of the amide type. Adults: most frequently reported of clinical importance regardless of casual relationship: Hypotension, nausea, bradycardia, vomiting, paraesthesia, back pain, temperature elevation, headache, urinary retention, dizziness, hypotension, rigors (chills), tachycardia, anxiety and hypoaesthesia. Hypotension and nausea are the most frequent side-effects. In children the most commonly reported adverse events (>1%) are vomiting, nausea and pruritus. Allergic reactions (in most severe instances anaphylactic shock) to local anaesthetics of the amide type are rare. Neuropathy and spinal dysfunction have been associated with regional anaesthesia, regardless of the type of local anaesthetic used. NAROPIN may cause acute toxic effects after high doses or if very rapidly rising blood levels occur due to accidental intravascular injection or overdose.

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INJECTION SHOULD ALWAYS BE MADE SLOWLY WITH FREQUENT ASPIRATIONS TO AVOID INADVERTENT INTRAVASCULAR INJECTION, WHICH CAN PRODUCE TOXIC EFFECTS.

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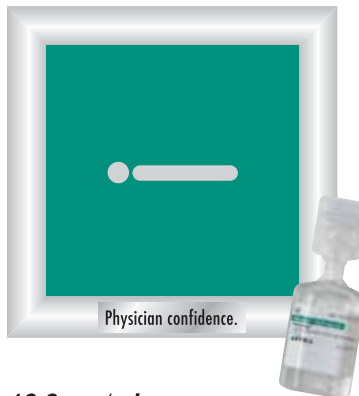
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