



## Case Report

# Ultrasound Guided Brachial Plexus Anaesthesia for Neonatal Ischaemia of the Upper Limb: A Case Report

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### Abstract

**Background:** Neonatal limb ischaemia is a rare pathology. The main pathogenetic mechanism is thromboembolism and ultrasound guided regional anaesthesia is one possibility for treatment.

**Case Report:** We present one case of a multimorbid 770g preterm neonate with postnatal ischaemia of one upper extremity due to thromboembolism of the brachial artery. A series of ultrasound guided infraclavicular brachial plexus blocks reduced the area of ischaemia significantly and only the fingers remained as necrotic areas.

**Conclusion:** This is the first case of a neonate < 1000g where an ultrasound guided regional anaesthesia technique enables successful therapy of an ischaemic limb. Ultrasound guided regional anaesthesia is a highly precise technique where the local anaesthetic can be exactly administered around nerve structures. Thus, these techniques should be considered as a potential treatment for neonatal limb ischaemia.

**Keywords:** Infant, Premature (Unique ID: D007234); Upper Extremity (Unique ID: D034941); Ischaemia (Unique ID: D007511); Brachial Plexus Block (Unique ID: D065527); Ultrasonography (Unique ID: D014463)

### Introduction

Neonatal limb ischaemia is a rare pathology with an incidence of 1:4.500 births per year [1]. Neonatal limb ischaemia can be divided into pre- and postnatal causes. Thrombosis and embolism are the main reasons due to a hypo fibrinolytic state with an antithrombin III, protein C and S deficiency [2]. In-utero-compression and postnatal iatrogenic causes (e.g. arterial catheterization) are other possibilities causing limb ischaemia.

An extremely rare cause is feto-fetal transfusion syndrome with the subsequent high haematocrit induced hypercoagulable state of the donor twin [3]. Treatment of neonatal limb ischaemia can be performed systemically via hyper hydration, anticoagulation, vasodilation or hyperbaric oxygenation [4]. Local regional thrombolysis with tissue plasminogen activator is a more focused therapeutic option [5]. Nevertheless, all anticoagulatory therapies may be associated with spontaneous intracranial or visceral haemorrhage. Peripheral regional anaesthesia is another therapeutic option, which should be considered in neonatal limb ischaemia. Nerve blockade is associated with sympatholytic effects [6] and provides optimal pain therapy [7]. In addition, local anaesthetics are beneficial in this context due to anti-inflammatory, endothelial protective and antithrombotic effects [8]. Three case reports

describe successful axillary brachial plexus blockade in upper limb ischaemia in neonates > 1000g [9–11]. The authors describe the performance of these axillary approaches to the brachial plexus as subcutaneous infiltration in the axillary region. Ultrasound guidance for brachial plexus blockade was used in two cases where additional microsurgery was performed [12], and another publication describes this technique in a term-born infant [13]. In 1994, our scientific task force described the use of ultrasound guidance in regional anaesthesia [14]. Consequently, we re-described most of paediatric regional anaesthetic techniques with ultrasound guidance [15,16]. The direct visualization of neuronal structures, of the adjacent anatomy, of the tip of the cannula and of the spread of local anaesthetic are the main advantages of ultrasound guidance for regional anaesthesia as compared with landmark-based or nerve stimulator guided techniques. We described ultrasound guided brachial plexus blockade in a large series in trauma surgery [17]. Therefore, with adequate experience, ultrasound guidance of the brachial plexus should be considered as a precise therapeutic option in neonatal upper limb ischaemia.

### Case Presentation

A 770g male neonate, born in the 25th week by caesarean section (APGAR 6/7/7), showed signs of ischaemia of the right distal upper arm and forearm (Figure 1) immediately after birth. The child required mechanical ventilation via a nasotracheal tube due to respiratory distress syndrome, hemodynamic therapy with inotropes and developed a grade IV intraventricular haemorrhage. Thromboembolism of the brachial artery was the underlying diagnosis for ischaemia and was confirmed by ultrasound. The initial systemic anticoagulatory therapy with heparin (300 IU/kg/d) i.v. and epoprostenol (Flolanä) was ineffective, and therefore we considered a loco regional sympatholytic therapy. We performed an ultrasound guided infraclavicular brachial plexus block three days after appearance of the symptoms with a transportable high-end ultrasound machine (SonoSite M-Turbo, Fujifilm SonoSite Inc., Bothell, WA, USA) and a 7-15 MHz linear ultrasound probe with an active area of 25 mm and administered 0.5 mL ropivacaine 0.2% via a 25G cannula with a Facette tip and a pre-filled injection line (Figures 2-4). After performance of the 2nd brachial plexus block, ischaemia improved significantly (Figure 5). Three subsequent ultrasound guided brachial plexus blocks (five in total with time intervals of 24 hours) were performed on the following days, and the local blood circulation improved continuously (Figure 6). Figure 7 illustrates the final situs with only distal necroses of the fingers.



**Figure 1:** Postnatal status of the right upper limb.



**Figure 2:** Performance of the ultrasound guided infraclavicular brachial plexus blockade via an out-of-plane needle guidance technique.



**Figure 3:** Ultrasound image of the infraclavicular portion of the brachial plexus. Vertical arrow: the three fascicles of the brachial plexus; horizontal arrow: pleura. Left side = lateral.



**Figure 4:** Out-of-plane needle guidance technique (arrow = tip of the needle) during the performance of the ultrasound guided infraclavicular brachial plexus blockade. Left side = lateral.



**Figure 5:** Status of the left upper limb after the 2nd brachial plexus block.



**Figure 6:** Status of the left upper limb after the 4th brachial plexus block.



**Figure 7:** Final status of the right upper limb. Only the fingers remained necrotic.

## Discussion

Neonatal limb ischaemia is a rare, but severe pathology with various causes. The common path is thromboembolism in most cases, and the therapeutic approaches are based on systemic or loco regional methods. Systemic therapeutic options include hyper hydration, anticoagulation, vasodilation, or hyperbaric oxygenation. In particular anticoagulation and systemic vasodilation are associated with significant side effects, especially as extremely premature infants are prone to suffer from a complex pathology with intraventricular haemorrhage/periventricular haemorrhagic infarction and the requirement of haemodynamic therapy. Therefore, anticoagulation and vasodilation may worsen co-morbidities. An attempt to establish an algorithm for limb ischaemia in infants only suggests systemic or surgical strategies [18]. Thus, more precise and semi-invasive therapies should be considered for successful treatment without systemic side effects for neonatal limb ischaemia.

Ultrasound guided regional anaesthesia is a precise method that is mainly indicated for perioperative pain therapy. Other proven effects of regional blocks are sympatholytic, anti-inflammation, endothelial protection, and antithrombosis. The summary of these effects can be used for the therapy of neonatal limb ischaemia, and we were able to show the successful implementation of this technique in a 770g multimorbid preterm neonate. Our scientific task force developed many ultrasound guided paediatric regional anaesthesia techniques in all age- and weight groups [7,15,17]. In neonatal patients, we routinely use neuraxial techniques (caudal or epidural punctures) [15], whereas indications for peripheral regional anaesthesia techniques are rare. Experience and hand skills are prerequisites to perform these techniques in the smallest and most immature patients. Novel therapies for rare diseases can

only be described in case reports or small case series. Nevertheless, considerations regarding the pathophysiology of diseases provide important knowledge for the implementation of novel therapeutic concepts. The current case report is an example, where such considerations are used for a therapeutic concept. Sympatholytic and anticoagulatory effects due to the regional anaesthesia technique improved the ischaemic status of our neonatal patient. In addition, effective pain therapy without additional use of systemic opioids shows another therapeutic benefit. We therefore believe that our therapy, despite being only described as a case report, should be implemented in a therapeutic concept for neonatal limb ischaemia.

## Conclusion

Our preterm neonate showed postnatal ischaemia of one upper extremity due to thromboembolism of the brachial artery. We performed a series of five ultrasound guided infraclavicular brachial plexus blocks to induce sympatholysis, which is a focused therapeutic option in this context. This management enabled a significant improvement of ischaemia and only the fingers remained necrotic. We suggest that ultrasound guided regional anaesthesia should be considered as a potential treatment for neonatal limb ischaemia.

**Consent:** Consent was obtained from one parent of the child

**Competing Interest:** The authors have no competing interests to declare. All authors have nothing to disclose.

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