

Neonatal limb ischemia: caudal blockade and NIRS monitoring

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Abstract The treatment of neonatal limb ischemia (LI) is challenging for neonatologists. Peripheral nerve blockade (PNB), alone or in association with other therapies, represents a valid therapy in case of vascular spasm or thromboembolic events responsible for LI. In the present case report, we describe the clinical history of a preterm neonate with catheter-related thrombosis of the left leg. PNB was not performed according to the traditional technique but rather by a peridural catheter left in situ for 9 days with a continuous infusion of ropivacaine. In conclusion, the effectiveness of this approach was confirmed by the contemporary near-infrared spectroscopy monitoring, documenting gradual improvement of leg perfusion.

Keywords Arterial spasm · Neonatal thrombosis · Caudal blockade · NIRS

Introduction

The therapeutic approach to neonatal limb ischemia (LI) still represents a challenge for neonatologists. Prenatal LI can be secondary to in utero compression, thrombosis, and embolism, whereas postnatal LI is mostly of iatrogenic origin [1]. Both vasospasm and thrombosis may present with the same early symptoms, such as pallor, cyanosis, and/or weak/absent peripheral pulses. Arterial spasm, usually lasting less than 4 h, is often

secondary to intravascular catheterization or arterial blood sampling. Vascular spasm may represent the triggering event leading to thrombosis, a partial or complete long-lasting arterial obstruction. Early diagnosis and treatment are crucial to prevent the severe tissue necrosis potentially associated with LI.

In the present case report, we document the successful and safe use of caudal blockade, atypically performed by a peridural catheter left in place for 9 days, for the treatment of catheter-related vascular thrombosis. The effectiveness of this approach was confirmed by the contemporary near-infrared spectroscopy (NIRS) monitoring, documenting gradual improvement of leg perfusion.

Case report

A 960-g male neonate was born by spontaneous delivery at 26 weeks' gestation to a gravida 1 para 0 woman. Pregnancy was medically assisted and complicated at 20 weeks' gestation by cervical incompetence, treated with emergency cervical cerclage. At birth, the neonate showed cardiorespiratory depression, was intubated, and received surfactant. An umbilical venous catheter was introduced, and mechanical ventilation was continued due to persisting respiratory distress. On the tenth day of life, the umbilical venous catheter was removed, and a percutaneous catheter was positioned from the right leg. The correct position of the catheter tip was confirmed by abdominal X-ray. On the 12th day of life, the baby showed discoloration of the left foot due to arterial spasm (Fig. 1a). Cutaneous discoloration resolved after 1 h but was followed by marked ischemia of the distal phalanges of the 1-2-3-4 left toes, which did not resolve after 24 h (Fig. 1b,c).

At this timepoint, the neonate was transferred to our Neonatal Intensive Care Unit. Since fibrinolytic therapy was not allowed due to grade II intraventricular hemorrhage at the cerebral ultrasound, low molecular weight heparin (LMWH)

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Fig. 1 Arterial spasm followed by ischemia of the distal phalanges of the 1-2-3-4 left toes



was started (170 UI/kg, twice a day, s.c.). Suspecting iatrogenic genesis, the position of the percutaneous catheter was investigated by Doppler ultrasound: the catheter, visualized in the femoral artery, was promptly removed. Considering the extreme prematurity and the severity of clinical presentation, we decided to perform caudal blockade not according to the classical technique [5] but rather by a peridural catheter left in place for 7 days with a continuous infusion of ropivacaine 0.2 mg/kg/h. Before beginning caudal blockade, we started NIRS monitoring of the left leg. A near-infrared spectrometer (INVOS; Somanetics, Troy, MI, USA) was used for rSO_2 measurement via a sensor applied on the left leg. Measurements were recorded throughout the whole period of treatment. A significant increment in NIRS value was defined as variation of more than 20 % from basal value. Ischemia progressively improved (Fig. 1d) until complete resolution without any residual injuries after 1 week. Interestingly, resolution of LI was associated with gradual improvement of leg rSO_2 values: after ropivacaine infusion, NIRS values improved of more than 20 % and after 24 h, they remained permanently above rSO_2 40, with oscillations probably due to a mechanism of vasospasm until complete resolution after day 4 of life. Treatment with LMWH was discontinued after 15 days.

Discussion

Peripheral nerve blockade (PNB), alone or in association with other therapies, represents a valid therapeutic strategy in the presence of vascular spasm or thromboembolic events

responsible for LI [1, 4]. First, PNB has a direct vasodilatory effect on the peripheral vessels due to sympathetic blockade. Second, it acts indirectly by stopping afferent impulses—thereby inhibiting peripheral vasoconstriction—and by reducing the pain-induced release of catecholamines, cortisol, and antidiuretic hormone [1]. PNB has also been proposed as alternative therapy in case of neonatal thrombosis when standard fibrinolytic treatment is contraindicated or in case of severe neonatal arterial ischemia [2].

In the present case, the catheter placed in the arterial route probably provoked a reflex vasospasm in the contralateral leg, responsible for a subsequent development of arterial thrombosis. We did not perform caudal blockade according to the classic technique [5] due to the extreme prematurity and LI severity. The use of a peridural catheter for the administration of ropivacaine, left in situ for 7 days, was safe and leads successfully to vessel recanalisation.

NIRS (rSO_2) provides an estimate of oxygen delivery and a measure of optimized systemic perfusion. Since each patient has different basal values for rSO_2 according to individual variability [3], it is important to evaluate rSO_2 trend rather than a punctual level. The present case suggests that this technique, besides its well-known usefulness in cerebral and renal oxygenation monitoring, might be also appropriate for the monitoring of neonatal LI.

In conclusion, this report underlines the need for extreme caution when positioning a venous percutaneous catheter and, especially if arterial spasm occurs, the need for a strict monitoring of catheter position. It also suggests a possible new therapeutic approach in the management of neonatal arterial thrombosis by using an in situ peridural catheter. Furthermore,

it suggests the validity of NIRS monitoring to investigate vessel recanalisation after LI.

Conflict of interest The authors declare no conflict of interest.

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