

Reperfusion Injury as a Complication Associated with Peripherally Inserted Central Catheters

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Abstract : Peripherally inserted central catheters (PICCs) are usually used for patients who require long-term intravenous therapy. Various complications have been reported with the use of PICCs, such as occlusion, infection, dislodgement, and leakage. Phlebitis, pericardial effusion, and pleural effusion are relatively rare complications that can sometimes lead to death.¹⁾²⁾ There have so far been no previous reports of reperfusion injury due to the use of PICCs. Reperfusion injury is an injury that occurs when blood circulation is restored to previously ischemic tissues. The following report describes a case with hyperkalemia and multiple organ failure suspected to be due to reperfusion injury as a complication of a PICC.

Key words : PICC, Neonate, Hyperkalemia, Ventricular tachycardia, Thrombosis

Case report

The patient was a one-day-old female neonate, whose thirty-year-old mother with gravida 3, para 0, was diagnosed to have a discordant twin with Twin to Twin Transfusion Syndrome at 24 weeks gestation. The findings at 29 weeks gestation revealed that the recipient baby was receiving an excessive amount of blood. The baby, whose birth weight was 1,280 g, was delivered at 30 weeks by an elective Caesarean section. The Apgar scores were 8 at one minute, and 9 at five minutes. She and her twin sister “the donor” were transferred to our Intensive Care Unit. There was a 39% weight discordance and 1.1 g/ul hemoglobin difference between the two babies. The patient “the recipient” developed dyspnea and was immediately mechanically ventilated for Respiratory Distress Syndrome. A PICC line, consisting of a 25-gauge, 30-cm double lumen catheter, which is routinely used, was inserted for intravenous access. The insertion site was the saphenous vein through the left medial malleolus. The tip of the catheter was placed in the left groin (Fig. 1). The tip of the catheter could not be placed beyond her groin be-

cause the tip was stuck in her femoral vein. Her respiratory condition, vital signs, urine output and laboratory data were stable. Her left lower limb where the catheter had been inserted demonstrated an extreme degree of passive congestion 14 hours later. The color of the limb had changed to deep purple, and it was enlarged, however, it showed a normal pulse. The catheter was immediately removed. She suddenly developed ventricular tachycardia (VT) 4 hours later, while her congestive left lower limb had dramatically improved (Fig. 2). Lidocaine hydrochloride was not effective for the VT. The patient’s serum potassium level was 9.9 mEq/l at that time. She was diagnosed to have nonoliguric hyperkalemia, and was therefore immediately administered intravenous glucose and insulin. The VT lasted for nearly 90 minutes until it completely disappeared on the electrocardiogram. The potassium level normalized on day 3. The glutamic-oxaloacetic transaminase (GOT) and lactate dehydrogenase (LDH) levels were both significantly high on day 1. The blood urea nitrogen (BUN) and creatinine levels were also significantly high on day 4. The creatinine phosphokinase (CPK) level was not significantly elevated (Table 1). A follow-up MRI brain

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Fig. 1 The tip of the PICC line. The tip of the 25-gauge, 30-cm double lumen PICC line through the left medial malleolus was placed in the left groin. (↑)



Fig. 2 ECG at the onset of ventricular tachycardia. Ventricular tachycardia due to hyperpotassemia developed on the day of the neonate's birth.

Table 1 Patient clinical data

Laboratory data	Day 0	Onset	Day 1	Day 2	Day 3	Day 4	Day 5	1 Month
K (mEq/l)	4.3	9.9	6.8	6.9	4.8	4.1	3.5	4.4
GOT (IU/l)	26	753	>1,000	>1,000	862	359	124	24
GPT (IU/l)	5	166	259	375	389	208	198	10
LDH (IU/l)	804	>2,900	>2,900	>2,900	2,742	2,621	2,310	572
BUN (mg/dl)	5	15	18	24	32	34	35	3
Cr (mg/dl)	0.5	1.0	1.2	1.3	1.7	2.1	2.3	0.4
CPK (IU/l)	455	458	536	618	288	197	172	130

scan 2 months later showed multicystic encephalomalacia as a sequela (Fig. 3).

Discussion

Reperfusion injury is caused by oxygen-derived free radicals, which are produced when the blood circulation is restored to previously ischemic tissue. Tissue injury occurs predominantly in the secondary phase of postischemic reperfusion rather than during the period of ischemia. This type of reperfusion injury is usually observed in the intestine, heart and brain. It is also related to compartmental syndrome and crush syndrome.

Compartmental syndrome is local muscle ischemia and contracture resulting from massive compartmental hypertension and edema. Crush syndrome is associated with systemic manifestations, such as shock, myoglobinuria, renal failure and arrhythmia with hyperkalemia after reperfusion.³⁾ In this case, the catheter in the femoral vein may have disturbed the venous return, thus causing her left lower limb to develop massive enlargement. The patient developed hyperkalemia with arrhythmia 4 hours after the catheter displacement. It could be that a venous thrombus was formed by the insertion of the PICC, obstructing the femoral vein, and the abrupt patency of the femoral vein at the time

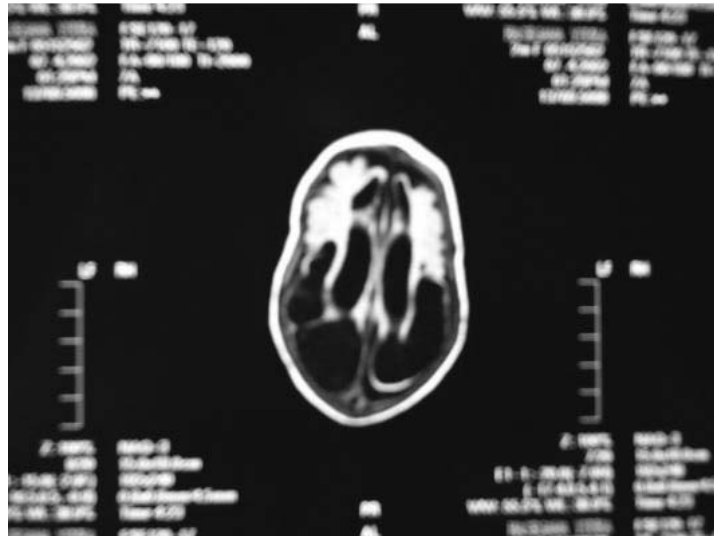


Fig. 3 Follow-up MRI brain scan. Follow-up MRI brain scan of the patient at the age of two months showed multicystic encephalomalacia

of catheter removal or thrombus resolution may have caused reperfusion injury and hyperkalemia. Thereafter, she experienced multiple organ failure including hepatic insufficiency, renal failure and heart failure. Although no muscle necrosis was observed in association with the mild creatine kinase elevation, it is possible that either cellular breakdown or hemolysis caused potassium to enter the circulation after reperfusion.

PICCs have been frequently used for the infusion of parenteral nutrition and critical medications in neonates. However, severe device-related complications may sometimes occur during such insertion, and it can therefore sometimes become a serious problem. The device-related complication rate ranges from 0% to 33.6%.¹⁾²⁾ The most common complications are occlusion, infection, dislodgement, and leakage. Pleural effusion and pericardial effusion are rare but serious complications that may lead to death. Catheter-related thrombosis accounts for up to 1% of the reported complications.²⁾ Kearns et al. hypothesize that the curving anatomy and the lower blood flow of neonates may contribute to their higher incidence of thrombosis.⁴⁾ Prospective screening showed the incidence of venous thrombosis to significantly increase when the catheter tip was located in the axillo-subclavian-innominate vein rather than in the superior vena cava (61% vs. 21%).⁴⁾ Thrombotic complications are more common when the catheter

is inserted in a lower extremity than in an upper extremity.⁵⁾ The tip of the catheter may have caused the thrombosis in the current case because of the curving anatomy and the lower blood flow in the flexible groin. We therefore recommend that the tip of the catheter should be placed beyond the groin.

Conclusion

This report presented a case with hyperpotassemia and multiple organ failure suspected to be due to reperfusion injury as a complication related to a PICC. Particular care should thus be taken to ensure that the tip of the catheter is placed beyond the groin in order to prevent reperfusion injury.

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