

Peroneal Nerve Palsy: A Complication of Umbilical Artery Catheterization in the Full-Term Newborn of a Mother With Diabetes

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ABSTRACT. Umbilical artery catheters are an essential aid in the treatment of newborn infants who have cardiopulmonary disease. However, it is well-known that umbilical artery catheterization is associated with complications. The most frequent visible problem in an umbilical line is blanching or cyanosis of part or all of a distal extremity or the buttock area resulting from either vasospasm or a thrombotic or embolic incidence. Ischemic necrosis of the gluteal region is a rare complication of umbilical artery catheterization.

We report the case of a full-term infant of an insulin-dependent diabetic mother with poor blood glucose control who developed a left peroneal nerve palsy after ischemic necrosis of the gluteal region after umbilical artery catheterization. The infant was born weighing 5050 g. The mother of the infant had preexisting diabetes mellitus that was treated with insulin from the age of 14 years. The metabolic control of the mother had been unstable both before and during the pregnancy.

The neonate developed respiratory distress syndrome soon after birth and was immediately transferred to the neonatal intensive care unit. Mechanical ventilation via endotracheal tube was quickly considered necessary after rapid pulmonary deterioration. Her blood glucose levels were 13 mg/dL. A 3.5-gauge umbilical catheter was inserted into the left umbilical artery for blood sampling without difficulty when the infant required 100% oxygen to maintain satisfactory arterial oxygen pressure. Femoral pulses and circulation in the lower limbs were normal immediately before and after catheterization. A radiograph, which was taken immediately, showed the tip of the catheter to be at a level between the fourth and fifth sacral vertebrae. The catheter was removed immediately. Circulation and femoral pulses were normal and no blanching of the skin was observed. Another catheter was repositioned and the tip was confirmed radiologically to be in the thoracic aorta between the sixth and seventh thoracic vertebrae. The catheter was continuously flushed with heparinized solution. Three days after umbilical arterial catheterization, bruising was observed over the left gluteal region. The catheter was immediately removed despite its correct position. Over the next few days, the bruised skin and underlying tissues became necrotic. The area affected was 3 × 4 cm in diameter, with central necrosis surrounded by a rim of dark, red skin, which, in turn, was sharply demarcated from normal skin by a narrow, pale zone. Surgical excision of the gluteal necrosis was performed, but a deep ulcer 3 cm in

diameter was left. The gluteal ulcer required 1 month to heal completely with extensive scar tissue formation. Throughout this period, the infant showed active movements in all of her limbs. At 4 weeks of age deterioration of all movement below the left knee with a dropping foot was observed. Severe peroneal nerve palsy was confirmed through nerve conduction studies, and there was electromyographic evidence of degeneration of the muscles supplied by the peroneal branch of the sciatic nerve. A Doppler study, which was also conducted, revealed no vascular damage. Treatment with physiotherapy and night-splinting of the left ankle was instituted. Repeated examination and nerve conduction tests at 3 months showed slow improvement with the left peroneal nerve remaining nonexcitable. At the time of this writing, the infant is 6 months old, and muscular strength below the left knee is still weak and atrophic changes in the form of muscle-wasting are already present. The rest of her motor development is normal.

In our case, gangrene of the buttocks and sciatic nerve palsy followed displacement of the tip of the catheter into the inferior gluteal artery, a main branch of the internal iliac artery supplying the gluteus maximus, the overlying skin, and the sciatic nerve. The gangrenous changes were probably caused by vascular occlusion resulting from catheter-induced vasospasm of the inferior gluteal artery. Sciatic nerve palsy associated with umbilical artery catheterization has been postulated to be caused by vascular occlusion of the inferior gluteal artery. Infants of diabetic mothers may exhibit changes in coagulation factors and be at increased risk of thrombotic complications in utero and postnatally. In addition, maternal diabetes mellitus is associated with an increased incidence of congenital abnormalities, the incidence of which is 3 to 5 times higher than that among nondiabetic mothers. Although no particular or specific abnormalities have been associated with maternal disabilities, abnormalities of the cardiovascular system, including the development of umbilical vessels, frequently occur.

This complication of umbilical artery catheterization has not been widely reported. We describe the first case that refers to gluteal gangrene and peroneal nerve palsy after umbilical artery catheterization of a newborn infant of a diabetic mother with poor blood glucose control. It should be noted that there were no contributing factors except that of the displacement of the catheter into the inferior gluteal artery. We speculate that the displacement of the tip of the catheter, with no difficulty in the present case, was associated with the maldevelopment of normal branching patterns of arteries after exposure of the fetus to hyperglycemia.

In conclusion, umbilical artery catheterization is possibly associated with vascular occlusion, particularly in infants of diabetic mothers. Frequent inspection after the procedure has been performed is of the utmost impor-

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Received for publication Jun 26, 2001; accepted Dec 13, 2001.

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PEDIATRICS (ISSN 0031 4005). Copyright © 2002 by the American Academy of Pediatrics.

tance especially in these neonates who often suffer from cardiopulmonary disease and require catheterization of their umbilical artery. *Pediatrics* 2002;109(4). URL: <http://www.pediatrics.org/cgi/content/full/109/4/e66>; newborn, umbilical artery catheterization, peroneal nerve palsy, diabetes mellitus.

Umbilical artery catheterization is an accepted procedure for continuous monitoring of arterial blood gases, measuring arterial blood pressure, and infusing fluids and medication to sick newborn infants. It is associated with various complications, such as hemorrhage, thrombosis or embolism, arterial spasm with blanching of the legs, infection, necrotizing enterocolitis, hypertension, and vascular perforation.¹ Ischemic necrosis of the gluteal region is also a recognized complication of umbilical artery catheterization.² In 1978, Purohit et al³ reported a case of gangrene of the buttock and sciatic nerve palsy after displacement of the tip of the catheter into the internal iliac artery associated with infusion of hypertonic glucose and other drugs and systemic hypotension.

We present the case of peroneal nerve palsy as a complication of umbilical artery catheterization in a full-term newborn infant of a mother with insulin-dependent diabetes and poor blood glucose control.

CASE REPORT

A female infant of 36 weeks' gestational age was delivered by cesarean section because of cephalopelvic disproportion. Her birth weight was 5050 g. The mother of the newborn had preexisting diabetes mellitus, treated with insulin from the age of 14 years. The metabolic control of the mother had been unstable both before and during pregnancy; with fasting, serum glucose concentrations had exceeded 250 mg/dL on certain daily tests. Moreover, in the ninth week of gestation, she was hospitalized in the maternity clinic because of hyperglycemia, with plasma glucose levels of 363 mg/dL and glycosylated hemoglobin levels of 10.4%.

The neonate developed respiratory distress syndrome soon after birth and was immediately transferred to the neonatal intensive care unit. Mechanical ventilation via endotracheal tube was quickly considered necessary after rapid pulmonary deterioration, and pulmonary surfactant was administered. A 3.5-gauge umbilical catheter was inserted into the left umbilical artery for blood sampling without difficulty when the infant required 100% oxygen to maintain satisfactory arterial oxygen pressure. Femoral pulses and circulation in the lower limbs both were normal immediately before and after catheterization. A radiograph, which was performed immediately, showed the tip of the catheter to be at a level between the fourth and fifth sacral vertebrae (Fig 1). The catheter was removed immediately. Circulation and the femoral pulses were normal, and no blanching of the skin was observed. Another catheter was repositioned, and the tip was confirmed radiologically to be in the thoracic aorta between the sixth and seventh thoracic vertebrae (Fig 2). The catheter was continuously flushed with heparinized solution. Laboratory evaluation revealed a peripheral white blood cell count of $12.9 \times 10^9/L$, with 33% neutrophils, 39% lymphocytes, 16% monocytes, 8% eosinophils, and 4% basophils. Blood hemoglobin was 17.4 g/dL, Ht was 51.4%, and platelet count was $250\,000/mm^3$. Blood glucose levels were 13 mg/dL. Blood, cerebrospinal fluid, and tracheal aspirate cultures did not grow any organisms. Antibiotic treatment with intravenous vancomycin and gentamicin was started.

Three days after umbilical arterial catheterization, bruising was observed over the left gluteal region. The catheter was immediately removed despite its correct position. During the next few days, the bruised skin and underlying tissues became necrotic. The area affected was 3×4 cm in diameter, with central necrosis surrounded by a rim of dark red skin, which in turn was sharply demarcated from normal skin by a narrow pale zone. Concurrently, her pulmonary condition began to improve and the infant

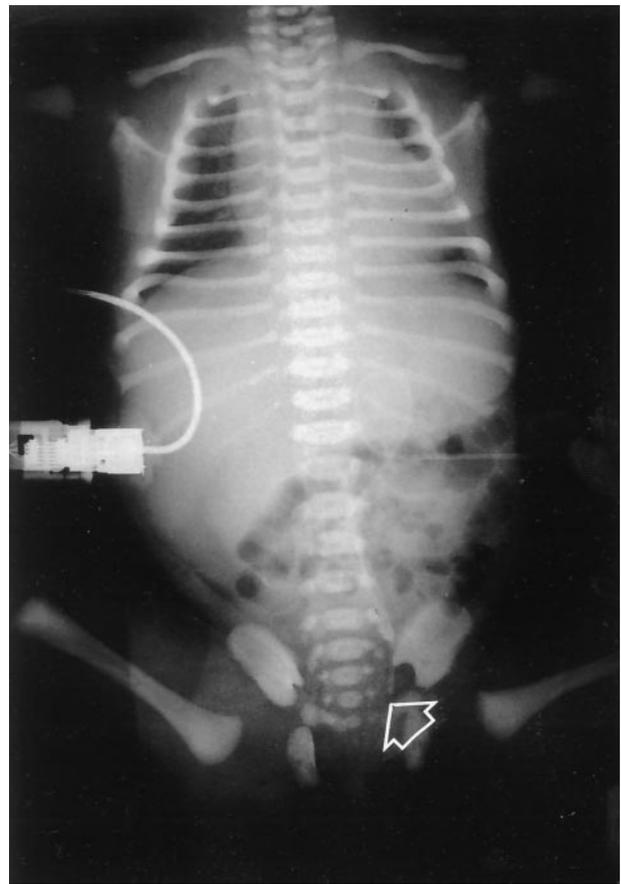


Fig 1. Abdominal radiograph film showing the tip of the umbilical artery catheter, between S4 and S5 vertebrae level.

was weaned off the respirator on day 3; oxygen therapy was discontinued on day 7. Surgical excision of the gluteal necrosis was performed, but a deep ulcer 3 cm in diameter was left (Fig 3). The gluteal ulcer required 1 month to heal completely with extensive scar tissue formation. Throughout this period, the infant showed active movements in all of her limbs.

At 4 weeks of age, deterioration of all movement below the left knee with a dropping foot was observed (Fig 4). The entire foot became insensitive to pain. Severe peroneal nerve palsy was confirmed through nerve conduction studies, and there was electromyographic evidence of degeneration of the muscles supplied by the peroneal branch of the sciatic nerve. A Doppler study revealed no vascular damage. Treatment with physiotherapy and night splinting of the left ankle was instituted. Repeated examination and nerve conduction tests at 3 months showed slow improvement with the left peroneal nerve remaining nonexcitable. At the time of writing, the infant is 6 months old, and muscular strength below the left knee is still weak and atrophic changes in the form of muscle wasting are already present. The rest of her motor development is normal.

DISCUSSION

Umbilical artery catheters are an essential aid in the treatment of newborn infants who have cardiopulmonary disease. However, it is widely known that umbilical artery catheterization is associated with complications. The most frequent visible problem in an umbilical line is blanching or cyanosis of part or all of a distal extremity or the buttock area, resulting from either vasospasm or a thrombotic or embolic incident.

Infants of mothers with diabetes may exhibit changes in coagulation factors and be at increased risk of thrombotic complications in utero and post-

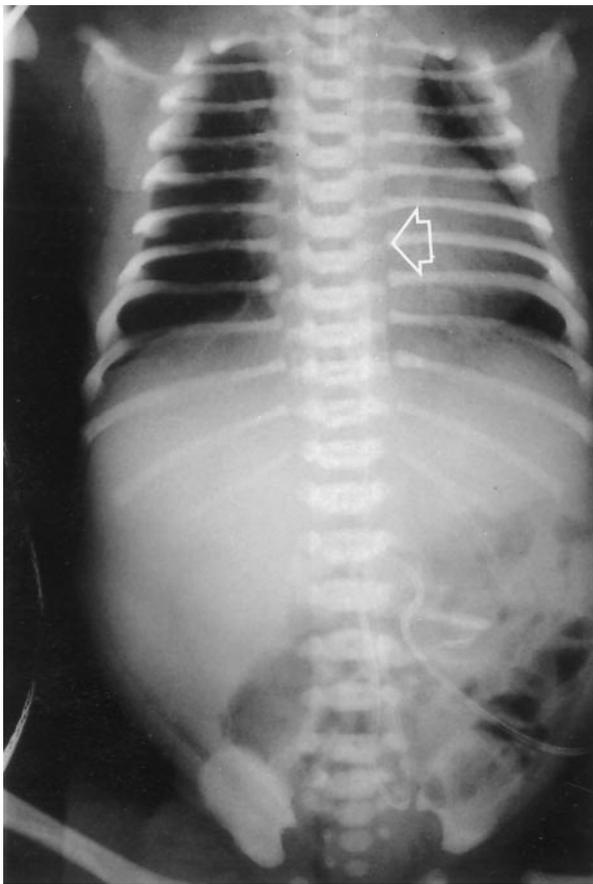


Fig 2. Radiograph film of the repositioned umbilical arterial catheter. The tip of the catheter is between T6 and T7 vertebrae level.

nately.⁴ In addition, maternal diabetes mellitus is associated with an increased incidence of congenital abnormalities, which is 3 to 5 times higher than that among mothers without diabetes.^{5,6} Although no particular or specific abnormalities have been associated with maternal diabetes, abnormalities of the cardiovascular system, including the development of umbilical vessels, frequently occur.⁵

A number of causative factors have been proposed to explain the increased rate of congenital anomalies in infants of mothers with diabetes. These factors

include genetic influences, teratogenic agents, maternal vascular disease, and metabolic effects of maternal diabetes.⁷ The basic pathogenesis is believed to be fetal hyperinsulinemia.⁵ The frequency of congenital abnormality is significantly increased in the newborns of mothers with poor metabolic control antepartum, as in the present case. Accordingly, it is essential in both gestational and preexisting diabetes to achieve the level of sustained glycemic control necessary to prevent congenital malformations before and after conception.⁶

In our case, gangrene of the buttock and sciatic nerve palsy followed displacement of the tip of the catheter into the inferior gluteal artery, a main branch of the internal iliac artery that supplies the gluteus maximus, the overlying skin, and the sciatic nerve (Figs 5 and 6). The gangrenous changes were probably caused by vascular occlusion resulting from catheter-induced vasospasm of the inferior gluteal artery. Sciatic nerve palsy associated with umbilical arterial catheterization has been postulated to be caused by vascular occlusion of the inferior gluteal artery.^{3,8}

Rehabilitation of the paralyzed muscles, which consists of massage, electrotherapy, and strengthening exercises, is essential to prevent fibrosis of the involved muscles and to prevent contracture with consequent retraction of the uninvolved muscles. The final results for the muscles involved secondary to sciatic nerve palsy are 76% good and fair and 24% poor.⁸

This complication of umbilical artery catheterization has not been widely reported. Our case is the first in the literature that refers to gluteal gangrene and peroneal nerve palsy after umbilical artery catheterization of a newborn infant of a mother with diabetes and poor blood glucose control.

Purohit et al³ reported the case of a neonate who developed similar complications after umbilical artery catheterization. The clinical features of the neonate described by them suggests the infant of a mother with diabetes. However, the cause of the complication in their case was multifactorial, being related to the displacement of the catheter tip; the

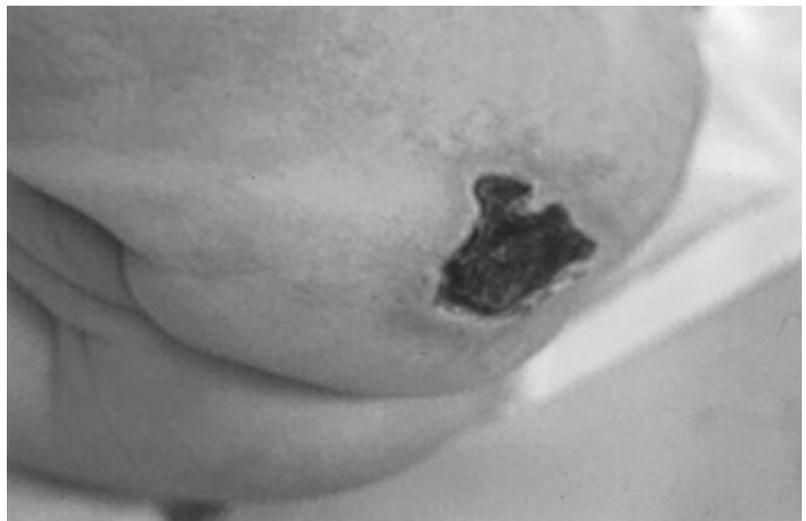


Fig 3. Necrotic area in the left gluteal region.

Fig 4. Photograph showing left foot drop, compatible with peroneal nerve injury, as compared with right foot.

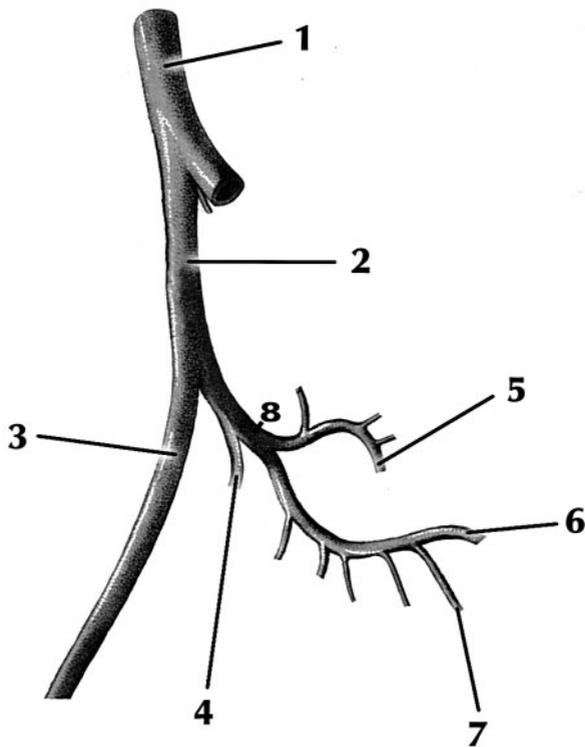


Fig 5. The relation between the umbilical artery and gluteal arteries. 1, aorta; 2, common iliac artery; 3, external iliac artery; 4, umbilical artery; 5, superior gluteal artery; 6, inferior gluteal artery; 7, internal pudendal artery; 8, internal iliac artery.

duration of the malplacement, which might have been as long as 30 hours; the occurrence of hypotension; and the infusion of hypertonic glucose and multiple medications via the umbilical catheter.

In contrast, in our case, the duration of the malposition of the tip of the catheter was only approximately 40 minutes, and no drugs or other hypertonic solutions were administered intraumbilically. It should be noted that there were no other contributing factors except that of the displacement of the catheter into the inferior gluteal artery. We speculate that the displacement of the tip of the catheter, with no difficulty in the present case, was associated with

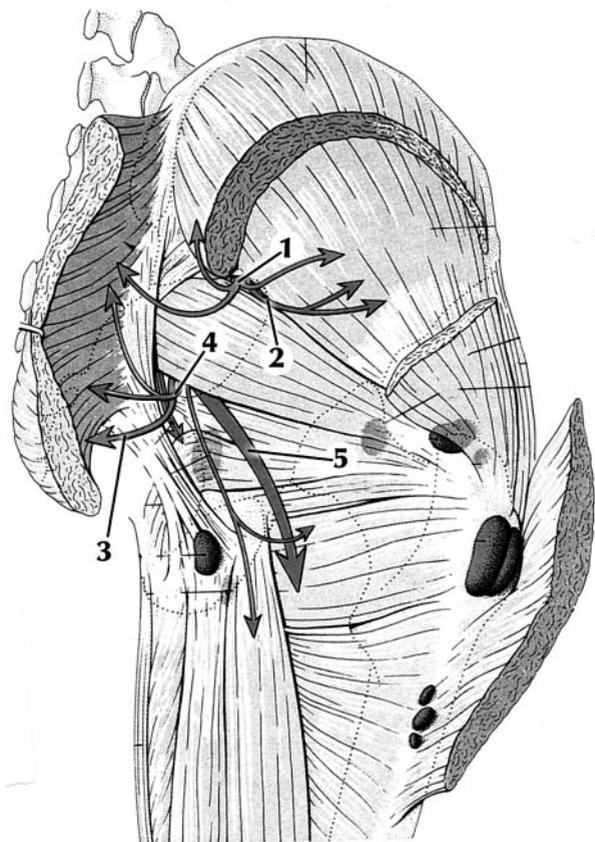


Fig 6. Diagram of the neurovascular supply to the gluteal region. 1, superior gluteal artery; 2, superior gluteal nerve; 3, inferior gluteal artery; 4, inferior gluteal nerve; 5, sciatic nerve.

the maldevelopment of normal branching patterns of arteries after exposure of the fetus to hyperglycemia.⁵

CONCLUSION

Umbilical artery catheterization is possibly associated with vascular occlusion, particularly in infants of a mother with diabetes who frequently present with thrombotic complications as a result of polycythemia and changes in coagulation factors. Another

possibility of occlusion is displacement of the catheter, which may be attributable to abnormalities in vascular development of these newborns. Frequent inspection after the procedure has been performed is of utmost importance, especially in these neonates who often experience cardiopulmonary disease and require catheterization of their umbilical artery.

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DOI: 10.1542/peds.109.4.e66

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