SHORT REPORTS

Penetration of the subarachnoid space by fetal scalp electrode

Fetal scalp electrodes of various designs are used widely for continuous intrapartum fetal heart rate monitoring. Minor lacerations of the scalp are common, and 1.0-4.5% of infants may develop scalp ulceration or abscess.^{1 2} We describe two cases in which there was penetration of the subarachnoid space with leakage of cerebrospinal fluid associated with the use of a scalp electrode of the single helix type.

Case reports

Case 1—A 20 year old primigravida was admitted in spontaneous labour at 38 weeks of gestation. A fetal scalp electrode was applied at 4 cm cervical dilatation with the fetal head in the left occipitoanterior position. Spontaneous vaginal delivery of a mature boy weighing 3130 g occurred four hours later. The baby was in good condition with Apgar scores of 9 and 10 at one and five minutes respectively. Three hours after delivery we noted leakage of clear cerebrospinal fluid from the scalp electrode site over the posterior fontanelle. Conservative treatment with a dry dressing, prophylactic antibiotics, and nursing of the baby in a sitting position resulted in resolution of the leak within 48 hours without any apparent complications.

Case 2—A 20 year old primigravida was admitted in spontaneous labour at 39 weeks. A fetal scalp electrode was applied at 3 cm cervical dilatation with the fetal head in the right occipitoanterior position. Spontaneous vaginal delivery of a mature girl weighing 3050 g occurred seven hours later. The baby was in good condition with Apgar scores of 9 and 10 at one and five minutes. Routine examination after birth disclosed leakage of clear fluid from the electrode site over the right parietal bone, 2.5 cm behind the posterior edge of the anterior fontanelle. As in case 1 there was rapid resolution of the leak (in this case within 24 hours) without any neurological complications. The position of the injury suggested that there had been penetration of both bone and dura resulting in the leak.

body creates a wedge within which fetal scalp hair and tissue may become entrapped (figure). The effect of these design features is such that any traction applied to the electrode during its removal may cause the wire to straighten and thereby increase its potential depth of penetration. Any oscillating rotation which may be used to free the electrode carries the risk of deeper penetration of the tip through the fetal scalp. We think that this is the most likely mechanism for the penetration of the parietal bone in case 2.

In view of these potentially serious injuries we believe that the use of the single helix scalp electrode should be abandoned in favour of either the double helix or Copeland pattern, whose design features prevent the type of injuries that we describe.³

1 Ashkenazi S, Metzker A, Merlob P, Ovadia J, Reisner SH. Scalp changes after fetal monitoring. *Arch Dis Child* 1985;60:267-9.

2 Okada DM, Chow AW. Neonatal scalp abscess following intra-partum fetal monitoring: prospective comparison of two spiral electrodes. *Am J Obstet Gynecol* 1977;127:875-8.

3 Department of Health and Social Security. Helical foetal scalp electrodes. *DHSS Safety Information Bulletin* 1985; No 21.

(Accepted 17 July 1985)

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Exchange transfusion and quinine concentrations in falciparum malaria

We were asked to admit a patient with an 80% falciparum parasitaemia, hyperventilation, and tachycardia. From her description she sounded moribund, so we decided to do an exchange transfusion as soon after admission as possible.

Case history

In 1985 a white woman aged 38 was referred with falciparum malaria and a parasitaemia of 80%, hyperventilation, and tachycardia after a holiday in Kenya. She had had fever for two weeks, followed by confusion and deafness, before her husband called the doctor. She was drowsy and very weak. Temperature was 39.5°C, heart rate 127/min, respiratory rate 24/min, weight 82 kg, blood urea concentration 45.3 mmol/l (273 mg/100 ml), bilirubin 31 µmol/l (1.8 mg/100 ml), and platelet count $19 \times 10^3/\text{mm}^3$.

Ten units of blood were cross matched and a two hour infusion of 500 mg base quinine dihydrochloride (6.1 mg/kg) in 500 ml isotonic saline started on admission to the intensive care unit at 2130. A colleague confirmed that the parasitaemia was about 70%, so an exchange transfusion was begun three hours after admission (at 0030) in an attempt to save the patient's life. The blood was transfused into a vein in the right antecubital fossa. Because of difficult peripheral venous access a right subclavian cannula was inserted and 7 units of blood (3.5 l) withdrawn over 130 minutes before the cannula blocked (table). During this time 7 units of stored donor blood were transfused, followed by 2 units of fresh frozen plasma and 6 units of platelets to replenish clotting factors. After the exchange we rechecked the parasitaemia in the blood taken on admission and found it to be 22%. Haemoglobin concentration changed little during the procedure (from 85 to 81 g/l). The 7 units of blood showed a steadily decreasing parasitaemia (from 26% to 5%) and plasma quinine concentration (18.2 to 6.5 mmol/l; 5.9 to 2.1 µg/ml). The patient became more alert during the procedure.

Whole blood exchange (7 units) over two hours

Time*	Unit of blood withdrawn	Parasite count in unit (%)	Quinine concentration in unit (mmol/l)
0045	1	26	18.2
0100	2	19	13.9
0125	3	14	12.3
0140	4	10	9.2
0155	5	8	9.5
0230	6	7	7.7
0240	7	5	6.5

*Exchange began at 0030.

Conversion: SI to traditional units—Quinine: 1 mmol/l $\approx$ 0.32 µg/ml.

Fetal scalp hair and tissue entrapped between electrode wire and plastic body of device.

Comment

Penetrating injuries of the skull may lead to infection and meningitis and to intracranial haemorrhage due to vascular injury. There may be a long term risk of epilepsy due to cortical injury and scarring.

In each of these two cases the electrode was applied without difficulty by an experienced midwife. In one the application was unsatisfactory as it was over the posterior fontanelle, but in the other the application was in an ideal position over the parietal bone. Our staff have reported several instances of difficulty in removing these electrodes, and we think that the injuries were sustained during removal rather than application.

There are two important design features of the single helix electrode which contribute to the difficulty of removal. Firstly, the attachment of the helical electrode wire close to the perimeter of the plastic body causes the axis of rotation of the electrode to be indeterminate and variable during both application and removal. Secondly, the narrow angle of insertion of the electrode wire into the plastic