

Risks of Ancient Practices in Modern Times

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ABSTRACT. Swaddling, ie, wrapping the child to restrict movement, is an ancient practice. In the Netherlands, it is becoming increasingly popular as an intervention for excessive crying in infants. However, one must be well aware of the potential risks. We present the case reports of a twin boy and girl who had been swaddled and kept in a heated room for several days. On admission to the hospital, both infants suffered from severe hypovolemic shock, hyperthermia, and secondary respiratory insufficiency. The girl developed multiple organ dysfunction syndrome and died, whereas the boy had an uneventful recovery. When swaddling is being considered as an intervention for excessive crying in infants, parents have to be well-informed about the possible side effects and about additional measures that they may have to take to make it a safe intervention. *Pediatrics* 2002; 110(6). URL: <http://www.pediatrics.org/cgi/content/full/110/6/e78>; *swaddling, hyperthermia, complication, risk, excessive crying.*

ABBREVIATIONS. bpm, beats per minute; PICU, pediatric intensive care unit.

Swaddling, ie, wrapping the child to restrict movement, was practiced by the ancient Greeks, Romans, and Jews.¹ People believed that swaddling prevented deformities of the legs and spinal column and that it strengthened the skin of an infant. In many countries, for example, Russia, Turkey, and China, swaddling is still commonly practiced. In the Netherlands, it is becoming increasingly popular as an intervention for excessive crying in infants. However, one should be aware that swaddling may carry serious risks and potentially fatal side effects. This is illustrated by our case histories.

CASE REPORTS

The infants presented in the following cases are a twin brother and sister. They are the parents' first-born children. Both parents are Roma gypsies. The Roma gypsies originally came from the Balkan area; from there they have spread over different European countries. In the Netherlands, they are a minority group; most of them live together in small communities in mobile homes. They have strong family traditions, and the groups in which they live can be characterized as very family-centered with a strong social cohesion.

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The children were born after an uncomplicated pregnancy. They were born by means of a cesarean section because the mother had mild fever during labor; an infection, however, could not be demonstrated. Both children stayed in the hospital with their mother. After the mother had recovered, the 3 of them were discharged from the hospital.

At home, the boy did very well, but the girl often cried, was restless, and seemed to have minor feeding problems. Visits to a well-infant clinic and a check-up by the pediatrician did not reveal any abnormalities. Because of the problems with the girl, the mother felt insecure and went to live in the mobile home of her own mother. The grandmother advised, in agreement with the family tradition, to swaddle both infants and keep them inside in a well-heated room.

At the age of 10 weeks, the children presented to the emergency department of a general hospital. They had both been found in bed early in the morning by their parents with obvious hypotonia and cyanosis.

Case 1

On arrival in the emergency department, the boy showed an irregular breathing pattern and a sinus tachycardia of 250 beats per minute (bpm) with severely compromised circulation. His rectal temperature was 41.0°C. Resuscitation was started immediately. He was intubated, and mechanical ventilation was started. His heart rate decreased to 170 bpm after initiation of ventilation with 100% oxygen and intravenous administration of 20 mL/kg normal saline. Blood and cerebrospinal cultures were taken before the administration of antibiotics. After stabilization, he was transferred to the pediatric intensive care unit (PICU) of a university hospital.

On arrival in the PICU, the boy had a rectal temperature of 37.2°C with a peripheral temperature of 30.8°C. There was a sinus rhythm of 155 bpm with an instant capillary refill time and a blood pressure of 73/52. Additional physical examination was completely normal. Laboratory results all were in the normal range except for slightly raised levels of urea (5.2 mmol/L), creatinine (43 µmol/L), and sodium (155 mmol/L). This hypertonic dehydration was treated with intravenous fluid replacement and supplemental sodium. Artificial ventilation was only supportive and could be stopped after 24 hours. The next day, the boy was transferred to the medium care ward in good condition. Follow-up in the outpatient clinic showed a healthy child with a normal psychomotor development.

Case 2

On admission, the girl was in a worse state than her brother: she was totally pale, hypotonic, and without any reaction to stimulation. On arrival in the emergency department, she had no spontaneous breathing and a sinus bradycardia of 80 bpm with severely compromised circulation. Her rectal temperature was 39.7°C. Resuscitation was started immediately. She was intubated, and mechanical ventilation was started. Her heart rate rose to 220 bpm after initiation of ventilation with 100% oxygen. Intravenous administration of 20 mL/kg normal saline further improved her circulation. Blood and cerebrospinal cultures were taken before the administration of antibiotics. After stabilization, she was transferred to the same PICU as her brother.

On arrival in the PICU, she had a rectal temperature of 38.6°C with a peripheral temperature of 28°C. There was a sinus rhythm of 180 bpm, capillary refill time was 4 seconds, and there were weak peripheral pulsations. Blood pressure was 55/30. Physical examination did not reveal any additional abnormalities.

Initial laboratory results showed severe lactate acidosis (arterial pH: 7.21; Pco₂: 31 mm Hg; Po₂: 222 mm Hg; BE: -15 mmol/L, serum lactate: 13.6 mmol/L), disturbed renal function (urea: 6.2 mmol/L; creatinine: 115 μmol/L), signs of tissue damage (CK: 760 U/L; lactic (acid) dehydrogenase: 7600 U/L; aspartate aminotransferase: 442 U/L; alanine aminotransferase: 89 U/L) and severe diffuse intravascular coagulation (activated partial thromboplastin time: >120 seconds; partial thromboplastin time: 90 seconds; fibrinogen: <0.1 g/L, D-dimers: >20 mg/L). Platelet count was low (48 × 10⁹/L) probably as a result of diffuse intravascular coagulation. Blood glucose level initially was decreased (2.8 mmol/L) but remained normal afterwards. Serum electrolytes were normal.

The girl was also treated for severe hypovolemic shock with secondary respiratory insufficiency. In contrast to her brother, however, she developed multiple organ dysfunction syndrome. The most severely affected organ seemed to be the brain with a dramatic encephalopathy presenting as a status epilepticus unresponsive to phenytoin, phenobarbital, and high doses of midazolam. Somatosensory evoked potentials of the right ulnar nerve showed absent cortical responses with normal peripheral responses. For technical reasons, it was not possible to perform somatosensory evoked potentials of the left ulnar nerve. Computed tomographic scans of the brain (1 on the second day and 1 on the fifth day of admission) showed progressive ischemia of the supratentorial brain with hypodensity of both cerebral hemispheres and total loss of gray-white differentiation. The prognosis of this encephalopathy was deemed infaust. Artificial ventilation was stopped, and the girl died a few minutes later.

General Considerations and Diagnosis

Both patients experienced hypovolemic shock, hyperthermia, and secondary respiratory insufficiency. At presentation in the emergency department, both infants were swaddled and wrapped in several blankets. In each infant, the whole body including the head was covered, only the face was left free. The blankets were completely wet as a result of profuse sweating. Additional anamnesis revealed that the infants had been swaddled and kept in the heated room for the past 7 days. The room had been heated to an ambient temperature of 25°C. Every morning, the infants' clothes were soaked from sweating. Unfortunately, core temperature was never measured during that period. There was no diarrhea, vomiting, or coughing in the days before admission to the hospital. No other family members had been ill. During admission, both infants were tested extensively for infectious and metabolic diseases and for intoxications. All results were negative. Therefore, no other explanation could be given for the clinical picture in these infants than that they both had been heavily swaddled and covered with blankets in a high ambient temperature for a prolonged time.

Physiologically, heat is lost from the body mainly by radiation and evaporation. Clothing and blankets decrease heat loss from the body, especially when the head is covered, because heat loss occurs mainly from the head. An increasing ambient temperature makes all mechanisms to dissipate heat even more ineffective. Peripheral vasodilation and sweating will improve heat loss but will lead to increased water loss and eventually dehydration. When heat-dissipating mechanisms fail, body temperature will rise. At high core temperature levels, direct tissue damage arises as a result of protein and enzyme denaturation. Structural changes in cellular membranes occur and will lead to cell death. Oxygen consumption will be vastly increased at high body temperatures. Anaerobic metabolism, systemic acidosis, and vascular endothelial breakdown ensues and may lead to additional intravascular volume loss, cardiovascular collapse, and eventually multiple organ failure.

DISCUSSION

In the literature, several advantages of swaddling have been described: it is said to reduce excessive crying² and encourages the infant to sleep longer.³ It can help infants in coping with painful or stressful procedures.⁴⁻⁷ Because it is easier to place swaddled infants to sleep in a supine position, it could reduce sudden infant death syndrome.⁸ One study reported a beneficial effect of swaddling on psychomotor de-

velopment of infants who were admitted to a neonatal intensive care unit.⁹ However, serious negative side effects have been reported as well. Hyperthermia has been reported to be a risk of swaddling,^{10,11} especially when the head also is covered or when a child is having an infection. This is all the more important because 1 study demonstrated that infants who had been swaddled were more likely to develop a respiratory infection compared with infants who had not been swaddled.¹² When swaddling is practiced in very warm houses, it could contribute to a higher incidence of sudden infant death syndrome.¹³

Swaddling is still commonly practiced in many countries. In the Netherlands, it has recently gained popularity as an intervention for excessive crying in infants. Therefore, it is important that potential risks of swaddling be brought to the attention of the practicing clinician by case histories such as ours. However, it should be noted that swaddling practices differ worldwide. Some infants are gently wrapped or bundled, whereas others are completely and firmly swaddled, restricting any gross motor movements. The arms can be swaddled in various positions, and different materials can be used to swaddle an infant. There is still little known about which practice is potentially beneficial and which is potentially detrimental, although it is generally advised not to cover the head. It seems appropriate, therefore, that more epidemiologic studies be done on the effects of different swaddling practices before recommendations for clinical practice are made.

It is likely that social and ethnical circumstances of the parents played an important role in the described cases.¹⁴ Respect for older people and the adherence to traditional habits in combination with the inexperience of the mother created the circumstances for the dramatic course. The grandmother's advice to swaddle the children and keep them in a well-heated room may have been good advice traditionally. Nowadays, however, the circumstances in which the Roma gypsies live are different from the past: their mobile homes are well-insulated, all have central heating, and winters in the Netherlands are moderate compared with winters in the Balkan area. This requires additional measures when a child is swaddled, such as regular checks of rectal temperature and supplemental fluids for the child.

It is doubtful whether regular health education programs would have reached the family of the described patients, given their specific social circumstances. However, the described cases surely point out that swaddling is not without risks. It stresses the conclusion that parents have to be well-instructed when swaddling is being considered as an intervention for excessive crying and that additional measures may have to be taken to make it a safe intervention.

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