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Kangaroo Transport Instead of Incubator Transport

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ABSTRACT. *Objective.* **Compared with in utero transport, incubator transport for preterm infants has several disadvantages including instability during transport with increased mortality and morbidity, lack of adequate systems for securing the infant in the event of an accident, and separation of mother and infant. As a new kind of postnatal transportation that bears some analogy to in utero transport and may be safer than incubator transport, we investigated kangaroo transport, transporting the infant on the mother's or other caregiver's chest. This article presents a description and preliminary data for kangaroo transport.**

Design. **We conducted kangaroo transports of 31 stable preterm and term infants in different settings and recorded data regarding transport conditions and cardiorespiratory stability. Eighteen transports were back transfers, and 13 were transfers in. Twenty-seven transports were conducted by the mother, 1 by the father, 2 by nurses, and 1 by a doctor. Transport distance was 2 to 400 km.**

Results. **Heart rate, respiratory rate, oxygen saturation, and rectal temperature remained stable during all kangaroo transports lasting 10 to 300 minutes. Weight at transport was 1220 to 3720 g. Parents felt very comfortable and safe and appreciated this method of transport.**

Conclusions. **Kangaroo transport promotes mother-infant closeness and might ameliorate several of the risks associated with incubator transport.** ***Pediatrics*** **2004;113: 920–923;** ***kangaroo, transport, incubator, preterm, back transfer.***

Very low birth weight infants who are transported directly after birth have an increased risk of intraventricular bleeding compared with infants who are not transported. This may be explained by mechanical effects such as shaking or vibration of the head and by instability of temperature and blood pressure during the incubator transport.[1] Moreover, the organization and safety of the transport system has been questioned in a recent overview by Field et al,[2] who summarized the experiences in the United Kingdom and stated that most of the available transport systems have serious problems, especially in the event of an accident. They reported that the standard devices used to secure transport incubators are totally inadequate and that there are no adequate safety devices for securing the infant within the incubator during the journey.

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Kangaroo care (skin-to-skin, chest-to-chest holding of the infant between the mother's breasts) of preterm infants in the hospital has been shown to improve or maintain cardiorespiratory stability,[3–6] oxygen and energy expenditure,[7] confidence and psychological stability of the mother,[8] and preterm infant behavior development.[9,10] According to a Cochrane review,[11] kangaroo care seems to reduce severe infant morbidity, but well-designed, randomized, controlled trials of this intervention are still needed.

Because kangaroo transport means continuous kangaroo care during transport, the cardiorespiratory system might be more stable than during incubator transport. During incubator transports, the transfer of the infant in and out of the transport incubator (and especially the transfer and securing of the heavy transport incubator into and out of the ambulance) is often connected with swift and rough movements. Kangaroo transport might ameliorate much of this jarring motion. In addition, kangaroo transport might improve the security of the infant by fastening the infant to the mother and the mother to the emergency gurney. Kangaroo transport might be a possibility to maintain mother-infant contact after birth and to improve parent-infant bonding. However, it might not be appropriate for critically ill infants, who need repeated handling and therapeutic interventions during transport.

The purpose of this article is to describe our procedure and present results of our kangaroo transports of stable preterm and term infants in different settings.

INFANTS

From April to October 1997, 11 premature infants were transported in Heidelberg, Germany, in the kangaroo position with their mothers (transports 1, 2, 5, 7, 8, 10–12, and 17) or female nurses (transports 9 and 16) when parents were not available. In Wernigerode, Germany, from November 2000 to January 2003, 20 preterm and term infants were transported in the kangaroo position by their mothers, the father (transport 3), or one of the authors (D.S., transport 21). Two transports were by helicopter (transports 14 and 18), and all other transports were by ambulance. All parents provided informed consent before transport.

The gestational age of the infants ranged from 26 to 41 weeks, the age at transport ranged from 1 hour to 79 days, and the weight at this time ranged from 1220 to 3720 g (Table 1). Eighteen kangaroo transports were back transfers to regional children's hospitals closer to their parents' home (transports 1, 3–6, 8, 13, 14, and 18), within Heidelberg (transports 2, 7, 9–12, 16, and 17), or within Wernigerode (transport 15). Thirteen transports were transfers in from either the Women's Hospital in a neighboring town without neonatology (transports 19, 20, 22–25, and 27–31) or the Women's Hospital in Wernigerode (transports 21 and 26) to the neonatal unit in Children's Hospital in Wernigerode.

The transport distance was >50 km for 9 transports, 35 to 40 km

TABLE 1. Range and Median of Gestational Age, Weight and Age at Transport, and Distance and Time of Transport for All Infants (n = 31)

	Range	Median
Gestational age	26–41 wk	35 wk
Weight at transport	1220–3720 g	1970 g
Age at transport	1 h to 79 d	17 d
Distance of transport	2–400 km	35 km
Time for transport	10–300 min	40 min

for 11 transports, 4 km for 3 transports, and 2 km for 8 transports (Tables 2 and 3). The longest journey was 400 km (transport 13); the family had just changed their place of residence.

The time needed for transport was 10 to 20 minutes for the short transports and 60 to 300 minutes for the 9 long-distance transports. During transport, infants 1 and 2 received 25% to 30% oxygen because of bronchopulmonary dysplasia; infants 2, 7, 8, 10, 13, 16, and 28 received intravenous fluids; and 13 infants had a nasogastric tube in place (during 2 long-distance transports [8 and 13], formula was given slowly through this tube [40 mL in 20 minutes]).

METHODS

The mother, father, nurse, or doctor was positioned 10° to 60° semiupright on a portable gurney. Under the back of the caregiver laid a long, broad piece of fabric (infant-carrying sling by Didymos), with the ends left out to both sides. The caregiver then was secured to the gurney by straps, preferably in a suspender-like arrangement (Figs 1–6). The infant was placed on the chest of the caregiver in kangaroo position. The fabric was wrapped around the caregiver and infant in a sling-like fashion such that it covered the whole body of the infant securely. It was tied in a firm knot on the side to the mother (Figs 1–3). An additional blanket was placed over the mother and infant during transport to provide warmth (Figs 3 and 4). All infants were accompanied by a neonatal nurse and a neonatologist. Two transports were by helicopter (Fig 6), and 29 were by ambulance.

Infant monitoring of heart rate and respiratory rate was performed continuously with electrodes placed on the infant's back.[12] Oxygen saturation was measured continuously by pulse oximetry. Intravenous fluids and additional oxygen were given if needed (Fig 1). Physiologic parameters were recorded manually every 5 minutes throughout transport according to standard transport protocols. Rectal temperature was measured for most of the cases before starting and directly after arriving (and monitored continuously during transports 12, 16, and 17).

Caregiver-infant pairs were transported in a standard, unheated ambulance or in standard helicopter environment; the environmental temperature was 16°C to 30°C.

RESULTS

All infants were kept in the kangaroo position on the chest of their mothers, fathers, nurses, or doctors during the entire transport. Heart rate, respiratory rate, and oxygen saturation remained stable during the transport (Tables 2 and 3). In infant 8, heart rate increased from 130 to 165 beats per minute after 1 hour of transport. This was probably caused by increased body temperature, because the heart rate dropped to the initial level after removal of the additional blanket. Rectal temperature after arrival was between 36.5°C and 37.4°C for all infants. During 3 transports, temperatures were measured continuously, and regulation of the body temperature was accomplished easily by either adding or removing a blanket.

Crying and agitated behavior was never observed by the attending neonatologist. In 3 cases, a neonatologist or a nurse held the infant for kangaroo transport. No substantial differences were observed for these special conditions (transports 9, 16, and 21). Like the parents, the health care professionals reported that the shaking motion of the car during transport seemed greatly decreased for the infant through the position on the adult body. All parents appreciated being able to stay with their infants during the transport, reporting that they felt comfortable, safe, and happy to be able to provide personal transport for their infants.

DISCUSSION

Because of better outcome for inborn infants, regionalization of perinatal care with in utero transport is common when special care is needed immediately after birth. Neonatal transports are still required, however, when transport in utero is not possible or if

TABLE 2. Kangaroo Transport for Back Transfers of Infants (n = 18)

Case No.	Gestational Age, wk	Birth Weight, g	Age, d	Weight, g	Distance, km	Time, min	Heart Rate, min^{-1}	Respiration Rate, min^{-1}	Oxygen Saturation, %	Temperature (Start), °C	Temperature (Arrival), °C
1	26	870	43	1970	110	100	135–155	40–50	91–99	36.8	37.2
2	27	790	31	1220	2	15	140–150	40–60	92–99	36.9	36.9
3*	28	1000	32	1580	90	80	145–175	50–80	92–98	36.5	37.2
4	28	1290	31	1740	90	80	135–155	45–75	96–100	37.1	37.4
5	28	1390	26	1640	60	60	130–160	35–45	93–100	36.5	37.1
6	29	540	79	1340	94	70	150–180	60–80	97–99	···	36.9
7	29	1320	18	1510	2	10	135–165	35–50	94–98	36.6	36.7
8	29	1410	22	1550	180	150	130–165	40–50	95–98	36.8	36.9
9†	30	1520	4	1480	2	10	140–160	50–60	92–99	36.6	36.5
10	31	1470	8	1530	2	10	130–145	40–55	95–99	36.5	37.0
11	32	1320	17	1400	2	10	150–160	40–60	95–100	36.7	37.1
12	32	1660	5	1650	2	10	140–150	45–55	94–98	36.6	36.7
13	34	1760	9	1690	400	300	125–150	40–55	94–99	36.8	36.8
14	34	2530	21	2740	110	30	130–145	40–60	96–99	36.6	37.1
15	35	1740	15	1940	4	20	120–140	40–50	96–99	···	···
16†	35	1890	7	1785	2	10	140–155	35–45	92–96	36.8	36.9
17	36	1710	8	1635	2	10	130–150	45–55	96–99	36.4	36.9
18	39	3470	17	3700	180	40	110–130	30–40	96–100	37.0	37.4

··· indicates that data were not available. All transports were with the mother except where noted.
* Transport was with the father.
† transport was with a nurse.

TABLE 3. Kangaroo Transport for Transfers in of Infants (n = 13)

Case No.	Gestational Age, wk	Birth Weight, g	Age, d	Weight, g	Distance, km	Time, min	Heart Rate, min^{-1}	Respiration Rate, min^{-1}	Oxygen Saturation, %	Temperature (Start), °C	Temperature (Arrival), °C
19	35	2070	1	2070	35	40	130–160	50–75	95–100	37.0	37.2
20	36	2710	18	2540	35	40	130–145	40–60	97–100	36.8	36.9
21*	36	2850	1	2850	4	20	125–150	55–80	93–97	36.7	37.0
22	37	2980	8	2780	35	40	120–140	45–60	96–99	···	···
23	38	3060	24	3000	35	40	115–130	40–55	98–100	37.1	36.8
24	39	2950	1	2950	35	40	100–125	35–45	97–100	···	···
25	39	3400	27	3260	35	40	90–120	30–50	96–100	···	36.9
26	39	3440	5	3500	4	20	95–115	30–50	97–99	···	···
27	39	4120	36	3720	35	40	140–155	35–55	95–100	37.0	37.3
28	40	2720	9	2720	35	40	90–120	45–70	93–99	···	36.8
29	40	2990	12	2835	35	40	80–110	30–50	96–99	36.9	37.3
30	40	3900	72	3670	35	40	95–110	35–50	97–100	37.0	37.0
31	41	3700	4	3430	40	50	100–125	30–50	97–100	36.6	36.7

··· indicates that data were not available. All transports were with the mother except where noted.
* Transport was with a doctor.

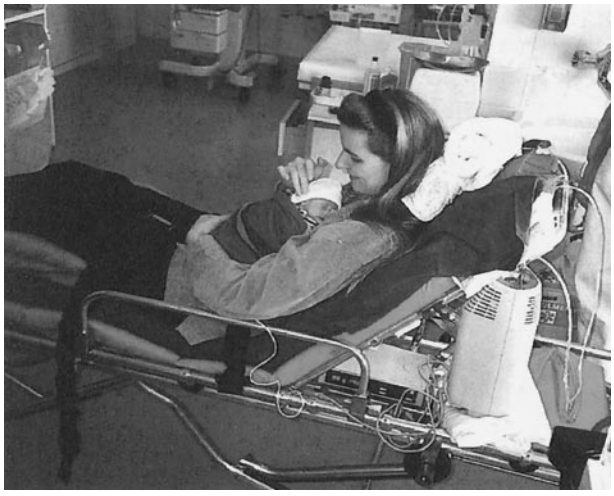

Fig 1. Mother with infant before kangaroo transport. The mother is fixed to a portable gurney by straps, with the upper part of her body at 60° semiupright. The infant is fixed to her with a broad infant-carrying sling, with liquid oxygen and the monitor positioned on the head end of gurney.

Fig 2. Mother with infant before kangaroo transport (back transfer from a neonatal intensive care unit). The infant is in kangaroo position on the mother's chest. The fabric is wrapped around the caregiver and infant in a sling-like fashion such that it covers the whole body of the infant securely.

the infants have to be transported from the perinatal center to a continuous care unit in another children's hospital (back transfer). Although kangaroo care has been implemented in several countries with very promising outcomes,[13–15] kangaroo transport as an alternative to incubator transport has not been documented before.

Our preliminary results show that kangaroo transport of stable preterm and term infants can be performed over a short or long distance without compromising the physiologic stability of the infant. It provides a secure form of transport that simultaneously promotes maternal-infant closeness. Continuous monitoring is performed as reliably as in an incubator. The finding of cardiorespiratory and thermal stability during transport was not surprising, because the infants were in a stable condition before transport, and previous studies have shown that kangaroo care at home or in the hospital is safe.[16,17] Additional studies on larger groups of infants can determine whether other physiologic parameters (eg, energy expenditure) of the infants remain as stable during kangaroo transport as they are during routine kangaroo care.

Fig 3. Mother with infant at arrival after kangaroo transport in an ambulance over a long distance (400 km, 5 hours).

The infants were secured with caregivers during the transport. In the event of an accident, kangaroo

Fig 4. Mother with infant after kangaroo transport (40 minutes). An additional blanket is placed on top of the mother and infant. Shown is a transfer in 1 hour after birth because of tachydyspnea (35 weeks' gestational age, 2070 g).

Fig 5. Father and infant after kangaroo transport (back transfer, day 32, 1580 g, 90 km, 80 minutes).

Fig 6. Mother with infant during kangaroo transport in a helicopter (back transfer after abdominal surgery).

transport seems to be safer than the usual incubator transport without safety devices for the infant.

Our preliminary results with 31 kangaroo transports in different settings are promising, and kangaroo transport might be considered as a safe, effective, and inexpensive method of transport, promoting parent-infant bonding. To make a conclusive statement on the advantage of kangaroo transport compared with incubator transport, additional studies with well-defined groups need to be conducted to control for different variables.

All infants in our study were in stable condition before transport. In the near future, kangaroo transports possibly could be done even with neonates who are ventilated, because kangaroo care has been conducted successfully with ventilated infants.[18,19]

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