

Long-distance Relay Transportation of a Patient with Twin-Twin Transfusion Syndrome Requiring Early Delivery by Doctor-Helicopters

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In Japan, there has recently been a severe shortage of physicians in regional core hospitals, limiting the acceptance of emergency patients. Searching for available medical institutions over an extended area beyond the regular regional medical area should increase the possibility of finding medical institutions capable of accepting patients. Physician staffed helicopter ambulance system, so called the Doctor-Helicopter service is highly effective in saving patients life, since emergency doctors start to treat patients at the scene. It may be also useful to transport the critically ill patients for a long distance. A 29 year old female diagnosed twin fetus with twin-twin transfusion syndrome needs urgent delivery at about 29 weeks of gestation. The patients had to be transported to the perinatal care center which is 160 km from the hospital to where the patient was admitted because of a lack of NICU. During transportation, the maternal vital signs were stable without cervical dilatation. After arrived at the perinatal center, the patient underwent Caesarian section. Both babies had respiratory distress syndrome and admitted to NICU. With increasing cases in which medical institutions cannot accept peripartum emergency patients, it needs to search for medical institutions over an extended area and transport patients by Doctor-Helicopter.

Key words: Doctor-Helicopter, Twin-Twin Transfusion syndrome, Obstetric emergency, Transport

INTRODUCTION

In Japan, there has recently been a severe shortage of physicians in regional core hospitals, limiting the acceptance of emergency patients as well as regular outpatients. This has become a significant social problem especially after the occurrence of several incidents in obstetric practice. The Fire and Disaster Management Agency of the Ministry of Internal Affairs and Communications, together with the Ministry of Health, Labour and Welfare, carried out an urgent survey of the emergency medical transportation system and medical institutions accepting emergency admissions for pregnant women in the perinatal period [1].

It was revealed that the number of pregnant patients in the perinatal period requiring emergency transportation was 39,015, which was 0.8% of all 4,889,398 emergency transportation cases in 2006. Among the emergency cases of transporting pregnant patients in the perinatal period, 53.4% were inter-hospital transfers.

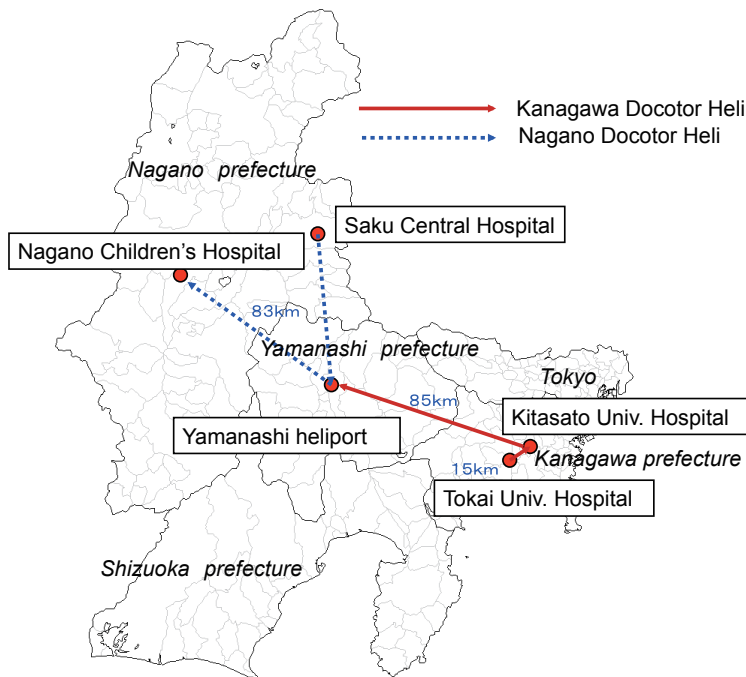
With respect to the number of attempts made to find definitive care facilities, 667 cases (1.9% of total) were rejected more than three times, and there were 220 and 45 cases that were refused more than five and ten times, respectively. Approximately 3% of total cases spent more than 30 minutes at the site, in which 907 cases spent less than 60 minutes and 105 cases spent 60 minutes or longer.

Thus, this nationwide problem of emergency patients not being accepted remains unsolved.

“The Doctor-Helicopter” which is physicians staffed helicopter ambulance system was commenced as a Japanese governmental project in 2001 and a total of 23 helicopters have been put in place in 19 prefectures as of July 2010. In the Doctor-Helicopter system, a helicopter is standing by at the emergency medical center and sent to the sites of emergency in response to the request from the fire department, carrying doctors and nurses specialized in emergency care.

The Doctor-Helicopter system is highly effective in saving patients life, since emergency physicians are able to start treating patients at the site of emergency and patients can be transported to medical institutions in a short period of time [2].

Regular ambulance vehicles run at 50 km/hour while helicopters fly at 200 km/hour. This means that, by simple arithmetic, helicopters can transport patients over a distance 4 times longer than can ambulance during the same length of time. In the present case, the pregnant woman was transported over a long distance of 160 km in linear distance from Kanagawa to Nagano by relay transportation by Doctor-Helicopters from both prefectures. Air transportation of peripartum emergency patients requires consideration of whether or not the transportation causes a negative effect on the mother or fetus.



Flight courses of Kanagawa and Nagano Doctor-Helicopter. A solid arrow represents flight course of Kanagawa Doctor-Helicopter, a dashed arrow represents flight course of Nagano Doctor-Helicopter.

CASE REPORT

Patient: 29 year old, female

Diagnosis: twin fetus (monochorionic diamniotic twin), no prior history of pregnancy

Past medical history: allergy to soba, egg and cow milk

Clinical course: natural pregnancy

In November 2007, at 8 weeks and 6 days of gestation, the patient was referred by a general practitioner with twin fetus. In March 2008, at 24 weeks and 1 day of gestation, uneven amniotic fluid accumulation with fetal body weights of 686 and 851 g was detected at a regular checkup. Three days later the patient was admitted to Kitasato University Hospital for detailed examination of twin-twin transfusion syndrome (TTTS). With no increase in the difference in the body weight and amniotic fluid volume between the two fetuses, the patient was discharged from the hospital after 9 days. The patient was then followed every 1 week on an outpatient basis.

In April 2008, at 28 weeks and 1 day of gestation, the fetal body weights were 1100 and 1200 g, respectively, with no difference in amniotic fluid volume.

At 29 weeks and 1 day of gestation, uneven amniotic fluid accumulation began to appear, with a maternal blood pressure of 121/84 mmHg, urinary protein (+) and edema (+). Twin 1 weighed 1101 g and had no amniotic fluid, with an umbilical arterial resistance index (UA-RI) of 0.815, a middle cerebral arterial resistance index (MCA-RI) of 0.78 and a middle cerebral arterial blood velocity (MCAV max) of 35.7 cm/sec. Twin 2 weighed 1588 g with an amniotic fluid depth of 8.6 cm, UA-RI of 0.633, MCA-RI of 0.761 and MCAV max of 36.5 cm/sec. The urinary bladder was visualized in both fetuses. A diagnosis of TTTS Quintero Stage I was made. Twin 2 had mild hepatomegaly.

The above findings suggested the need for the ter-

mination of pregnancy. Although delivered newborns should be monitored in NICU, no bed in NICU was unable to be secured at the hospital. Mother thus had to be transferred to another perinatal care center. NICUs with available beds around Kanagawa and Tokyo area, which was the regular regional medical area were searched, but could not find any hospital capable of accepting our patient. The search over a further extended area identified a pediatric hospital in Nagano 160 km away from Kanagawa as a hospital capable of accepting the patient. Due to concerns over the length of time required for transportation by ambulance and burden to the pregnant patient, air transportation by Kanagawa helicopter which was standing by at the Emergency Medical Center of Tokai University Hospital was proposed.

Although transportation by the Kanagawa helicopter alone was possible, a relay transportation by two Doctor-Helicopters from Kanagawa and Nagano was considered a more efficient option for such reasons as that long-distance transportation by a single helicopter would result in long-term unavailability of helicopter in Kanagawa and require refueling halfway through to Nagano.

A flight operation company proposed a plan for relay transportation using a heliport in Yamanashi, nearly the middle point between Kanagawa and Nagano, as the relay point and asked a Doctor-Helicopter base hospital in Nagano (Saku Central Hospital) for approval, and the hospital approved the plan.

Then two Doctor-Helicopter systems from both prefectures were activated (The flight courses of both Doctor-Helicopters and the time-course were shown in the Figure and Table).

When Kanagawa Doctor-Helicopter landed at the heliport to adjacent to Kitasato University, the maternal physical findings were as follows:

consciousness alert, respiratory rate 22 /min, pulse rate 102 /min, blood pressure 150/78 mmHg, SpO₂

Table Time course of Kanagawa and Nagano Doctor-Helicopters

TIME	EVENT on Kanagawa Doctor-Helicopter	EVENT on Nagano Doctor-Helicopter
11:30	A request for Kanagawa Doctor-Helicopter call-out was made	
11:35		Decision of Nagano Doctor-Helicopter call-out was made
11:50	Took off from Tokai University Hospital	
11:59	Landed on a heliport adjacent to Kitasato University Hospital	
12:09		Took off from Saku Central Hospital
12:10	Took off from the heliport of Kitasato University Hospital	
12:27		Landed on Yamanashi heliport
12:36	Landed on Yamanashi heliport	
12:48		Took off from Yamanashi heliport
12:54	Took off from Yamanashi heliport	
13:19	Landed at Tokai University Hospital	
13:20		Landed at Nagano Children's Hospital
13:26		Took off from Nagano Children's Hospital
14:18		Landed at Saku Central Hospital

99% and no cervical dilatation. Based on these physical findings, we decided that it is possible to transfer the patient by a helicopter. The helicopter took off carrying the patient with the patient's obstetrician from Kitasato University Hospital. With cooperation of both Doctor-Helicopter systems, the patient was transported from Kanagawa to Nagano in only 70 minutes.

At Nagano Children's Hospital, the fetal findings were as follows; the amniotic fluid depth of the one twin was 8.2 cm and that of the other twin was 0 cm, which seemed to be stuck twin. A diagnosis of TTTS stage 1 was made because the bladders of each were able to be identified. The mother was diagnosed with gestational hypertension, with a blood pressure of 140/86 mmHg, urinary protein (-), edema (+) and urinary acid of 7.1 mg/dl.

On the same day, the patient underwent Cesarean section under general anesthesia. Twin 1 was a boy weighing 1110 g, with an Apgar score of 2 (at 1 minute) /6 (at 5 minutes), an umbilical arterial pH of 7.31 and a hemoglobin level of 22.0 g/dl. Twin 2 was also a boy weighing 1603 g, with an Apgar score of 2/6, an umbilical arterial pH of 7.27 and a hemoglobin level of 22.5 g/dl. Both babies occupied equal areas of the placenta, with a few small shunts observed macroscopically.

Both babies had respiratory distress syndrome and thus underwent tracheal intubation and administration of a surfactant. Babies 1 and 2 underwent extubation 2 and 3 days after birth, respectively, and were transferred to Kitasato University Hospital 52 days after birth with an eventless clinical course. They were discharged 71 days after birth. The mother was discharged from hospital on day 13.

DISCUSSION

The appropriateness of peripartum emergency air transportation should be judged by considering its impact on both newborns and mothers. In terms of its impact on newborns, comparison of cases in which mothers were transferred to perinatal care centers

where they gave birth to their babies (maternal transport group) with those in which mothers gave birth to their babies followed by transportation of newborns to perinatal care center (newborn transport group) has shown that the maternal transport group achieved a higher survival of newborns, higher Apgar scores, shorter length of stay at NICUs and shorter duration on respiratory support than the newborn transport group [3, 4].

Major maternal conditions requiring air transportation to perinatal care centers include threatened premature delivery, placenta previa and premature separation of the placenta, eclampsia, HELLP syndrome and multiple pregnancy [3, 5, 6]. Maternal air transportation commonly occurs at a mean gestation of 31-32 weeks [3, 6].

One of the problems associated with maternal air transportation is fetal hypoxia caused by high-altitude flying. However, it has been suggested that air transportation at an altitude of up to 7500 feet does not affect fetuses during normal pregnancy, with maternal PaO₂ maintained around 80 mmHg. For mothers with any abnormalities of the placenta, it is preferable to administer oxygen even when flying at an altitude of less than 7500 feet. At an altitude of more than 15,000 feet, maternal PaO₂ can be decreased to 46 mmHg. Even under such conditions, air transportation should not cause any problem to fetuses unless the flight exceeds 30 minutes [7].

Since Doctor-Helicopters fly in most cases at an altitude of less than 7500 feet, it is unlikely to cause fetal hypoxia. In case of abnormal placenta, safe transportation can be achieved by monitoring maternal oxygen level and administering oxygen on an as-needed basis.

It is important to perform pre-transport examination by an obstetrician to avoid delivery during transportation. Elliott conducted a retrospective study of 1080 patients and found that 54 patients (7%) had a cervical dilatation of 7 cm or more at pre-transport examination, of whom 5 delivered their babies at their hospitals and the remaining 49 were transported.

None of the patients had delivery during transportation. Obstetrician judgment should preferably be made based on distance between hospitals, duration of transportation, gestation period, rate of labor progress and other factors. If delivery is expected to start during transportation, the mother should not be transported and be allowed to deliver her baby [8].

In another retrospective study of 80 cases of long-distance maternal air transportation, nausea and vomiting were reported in 80% of the pregnant patients, increased uterine contraction in 8.8%, hypertension in 1.3% and hypotension in 1.3% [9]. The presence of an obstetrician on board is also preferable in case of emergency.

In Japan, there have recently been many cases in which pregnant women are forced to transfer to different hospitals in a distant medical area due to shortage of prenatal care centers, and helicopters have been increasingly used in these cases.

Ohara *et al.* studied 26 cases of air transportation of pregnant women over a period of 1 year from 2005 and reported that transportation was completed in 24 minutes on average by helicopter, compared with an estimated transportation time of 125 minutes on average by ambulance. The reasons for transportation in the 26 patients were threatened premature delivery in 8 patients, premature rupture of membranes in 5 patients, cervical incompetence in 5 patients, eclampsia in 3 patients and other medical reasons in 5 patients. Transportation occurred at a mean gestation of 26 weeks while delivery occurred at a mean gestation of 31 weeks. They concluded that safe maternal transportation was achieved by the use of helicopters [10].

We have experienced 3 cases of maternal air transportation, including 2 cases of threatened premature delivery and 1 case of membrane rupture during normal pregnancy. The present case was TTTS requiring early delivery, which is a rare condition among the previously reported cases of peripartum emergency air transportation by helicopter. Moreover, transportation was carried out over a long distance and thus took a long time to complete. There has been no report of relay transportation by Doctor-Helicopter, except the present report.

The patient's attending obstetrician from the hospital from which the patient was transported accompanied the patient throughout transportation to the final destination. Fetal oxygenation is an important issue during maternal air transportation. In the present case, maternal SpO₂ was stable at 97-99% throughout transportation and the time required for transportation was also short, 26 minutes for the first half and 32 minutes for the second half of the relay transportation. Although it was estimated to take several hours

by ambulance to transport the patient to the perinatal care center which was about 160 km away in linear distance, it actually took only 70 minutes to complete transportation by helicopter.

Further reinforcement of the peripartum emergency care system is demanded. In the meantime, it is useful to search for perinatal care centers capable of accepting new patients through the wide-area network and, if long-distance transportation is required, transport the patient by Doctor-Helicopter.

CONCLUSION

A 29-year-old primipara with TTTS requiring early delivery was transported by relay transportation with Doctor-Helicopters called out from Kanagawa and Nagano. With an increasing number of cases in which medical institutions incapable of accepting peripartum emergency patients, it may be useful to search for such medical institutions over an extended area and transport patients by Doctor-Helicopter.

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