

Determination of transport conditions of newborns who were referred to a university hospital in Black Sea region

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Summary

Aim: To analyze transport conditions and management strategies of newborns referred to our unit.

Material and Method: This prospective study was performed in 216 newborns referred to our unit by filling out the forms prepared previously concerning the transport reasons, the transport situations and the other items related to the newborns. Chi-Square or Fisher exact test and Mann-Whitney U test were used for statistical analysis. Ethical committee approval was obtained.

Results: The study group consisted of 216 newborns; referral was informed previously in 154 newborns and not informed previously in 62 newborns. Indication for the transport was prematurity and/or mechanical ventilation support (71.4%) in previously informed newborns and neonatal hyperbilirubinemia (%46.8) in the non-informed group. Ambulance and transport incubator accompanied by a medical person was used for the transfer in 69% of the newborns. Fifty seven percent of the newborns had acidosis ($p < 7.34$), 16% had cyanosis, 15% had inappropriate respiratory support, Twelve percent had hypoglycemia, 8% had hypothermia, bradycardia or hypotension. The most common errors made before or during transportation were lack of intravenous fluid and inappropriate amount and/or type of fluid.

Conclusions: These results show that stabilization of newborns before and during transportation and communication between the centers before transportation were inadequate. Each region should create a communication network and regional transportation teams. Unnecessary referrals must be prevented. (*Turk Arch Ped* 2011; 46: 42-7)

Key words: Newborn, transport conditions

Introduction

In our country, infant mortality rate was found to be 0.29% for a five-year period according to Turkish Population and Health Investigation (TPHI)-2003 data and 59% of these infant deaths occurred during the neonatal period (1). Turkish Population and Health Investigation-1998 data showed neonatal mortality rate was 0.26%, while this rate decreased to 0.17% according to TPHI-2003 data (1). "Neonatal Resuscitation Program (NRP)", work on "supporting breastfeeding", administration of tetanus vaccine to the mother during pregnancy, control of body heat of the baby, prevention of hypoglycemia in the baby, abiding by hygienic conditions were effective in

the reduction of neonatal mortality and deaths were observed to be decreased markedly (2-4). One of the reasons of the fact that neonatal morbidity and mortality rates are still higher in our country compared to developed countries is lack of an efficient transportation system. When it is found prenatally that a baby will require a high-level care, the most appropriate approach is prenatal transportation. However, this is not always possible.

Neonatal transportation requires a very good communication network, high technology and experienced workers. In this study, we aimed to evaluate diagnostic and therapeutic approaches before transportation of newborns who were referred to our hospital and to determine possible errors.

Material and Method

This study was performed prospectively in newborns referred to Karadeniz Technical University Medical Faculty, Farabi Hospital, Department of Neonatology between January 01, 2007 and December 31, 2007.

When external institutions informed us about the transport of a patient, the patient was immediately hospitalized in our unit if place was available for the requirement of that patient. If no place was available for that time, the patients were classified into three categories including patients requiring mechanic ventilation + incubator, patients requiring only incubator and patients requiring baby bed and recorded on the appointment book.

The study group consisted of patients for whom request was made and who were called when a place was available, patients who were referred without informing previously and who were admitted because no other patient waited for a place, patients whose general states were very critical when presented to the emergency department or patients whose treatment (exchange transfusion/dialysis) was not possible in other centers. States of patients who were informed but could not be admitted because no place was available in our unit were also specified.

A form was created to evaluate demographic properties of the patient, the centers where the patient was followed up until he/she presented to our unit, indications for referral, transportation vehicles and transportation conditions, vital signs at presentation, pathologic physical examination and laboratory findings, diagnoses made in our unit, transportation errors and prognoses of the patients admitted.

The following points were interrogated in the patient information form: 1- History of delivery, 2- Maternal history, 3- Procedures and drugs administered if resuscitation was performed, 4- Pathologic physical examination and laboratory findings, 5- Prediagnosis/diagnoses, 6- Medical treatment and interventions performed, 7- Indication for referral, 8- Name, surname and signature of the individual who has referred the patient, 9- Date and time of the referral.

To evaluate transportation conditions, information about transportation vehicles, equipment of transportation vehicles, accompanying medical person, whether accompanying medical person had training for NRP or Pediatric Advanced Life Support (PALS) was recorded.

Gestational ages of the subjects were determined with modified Ballard assessment method (5). Axillary body temperature lower than 36°C was considered as hypothermia, blood glucose lower than 50 mg/dL was considered as hypoglycemia and oxygen saturation in arterial blood gas measurements and/or pulse oxymetric measurements lower than 90% was considered as hypoxia (6).

To evaluate vehicle equipment inadequacy, presence of transport incubator, ventilator, monitor or SpO₂ device, necessary drugs for resuscitation, neonatal blood-mask and neonatal laryngoscope was interrogated.

Errors of intervention were classified as not giving oxygen during transportation, though necessary, not providing balance of body temperature, not using transport incubator for babies who should have been transferred in incubator, not intubating patients who should have been intubated, dislocation, abnormal placing or obstruction of intubation tube, not performing appropriate resuscitation in patients who had developed cardiac arrest during transportation, not inserting an IV line, though necessary, inappropriate amount or type of IV fluid and other errors.

Newborns referred to our unit from external centers were divided into two groups as term and preterm babies and their clinical and laboratory findings at presentation were compared. In addition, prognoses of referred patients and patients who were born in our hospital and hospitalized in our unit were compared.

Statistical analyses: Chi-square test and Fisher exact test were used for comparison of vital signs, laboratory findings, morbidity and mortality rates of referred term and preterm babies with babies born in our hospital. Mann-Whitney U test was used in comparison of gestational ages and birth weights of preterm babies who were referred to our hospital and who were born in our hospital and died while being treated. A p value of <0.05 was considered to be significant.

Results

During the period of the study our unit was called for referral of 316 newborns by external centers. One hundred fifty four of these newborns (49%) could be admitted. Thirty five of these newborns (23%) were admitted when the call was made and 119 (77%) were admitted when place for the requirement of that baby became available. Among patients who could not be admitted when called for referral because no place was available and who were called for when place was available, 37 (12%) were informed to have died in the institution they were found, 81 (26%) were informed to have been treated in the institution they were found and 33 (10%) were informed to have been referred to another center. The prognoses of 11 (3%) newborns could not be determined.

A total of 78 newborns were referred to our unit without informing previously. Sixteen of these (21%) were transferred back to their institution or to another institution where their treatment could be performed, because no place was available in our unit and the general state of the newborns were appropriate for back transfer. The remaining 62 newborns (79%) were admitted to our unit, because place was available at that time, the general

states of the newborns were very critical or they needed treatments including blood exchange/dialysis which could not be performed in other units.

Consequently, this study was conducted in a total of 216 newborns (154 informed newborns (71%) and 62 (29%) uninformed newborns). A total of 4 (1.9%) among these newborns were exitus when they arrived in our unit (three term babies and one preterm baby).

Demographic properties of the newborns in the study group are shown in Table 1. Eighty percent (n=125) of the people who asked for referral to our unit were pediatrician, 11% (n=17) were general practitioner, 6% (n=8) were midwife-nurse and 2% (n=3) were gynecologist. For 1% of the subjects (n=1) the family requested a place without a request from a physician.

The commonest indications for referral in informed newborns were requirement for mechanical ventilation+premature baby care (33.7%) and requirement for mechanical ventilation (27.9%) (Table 2). The commonest indication for referral in uninformed newborns was neonatal jaundice (46.8%) (Table 3).

Sixty nine percent of the newborns (n=148) who were referred to our unit were transported by ambulance in transport incubator and were accompanied by medical personnel. Seventy five percent of these (n=111) were accompanied by a nurse, %10 (n=15) were accompanied by a general practitioner, 8% (n=12) were accompanied by a general practitioner and a nurse, 3% (n=4) were accompanied by a medical officer, 3% (n=4) were accompanied by a midwife and 1% (n=2) were not accompanied by medical personnel. NRP course was received by 55% of the nurses (n=68) accompanying the babies, by 78% of the general practitioners (n=21) and by 20% (n=1) of the medical officers. None of these workers

received pediatric advanced life support course. When vehicle equipment was evaluated, it was found that none of the vehicles contained mechanical ventilator, monitor and neonatal pulse oxymeter device.

For 71% of the referred newborns (n=154) a referral information note was sent and all of these newborns consisted of patients who were informed about previously for referral. A referral information note was absent for newborns who were not informed about before referral. Three percent of the referral information notes included prenatal properties of the babies, 1% included vital signs before referral, 22% included pathologic examination findings before referral, 16% included laboratory findings, 20% included diagnoses and 48% included treatments performed completely and without lacking information.

Vital signs and laboratory tests of the referred newborns (excluding newborns who were exitus at arrival) at presentation in our unit are shown in Table 4. Rates of hypothermia, cyanosis and hypotension in preterm babies were statistically significantly higher compared to term newborns (p<0.05). Mortality rate was found to be 42% in hypothermic preterm newborns and was statistically significantly higher compared to non-hypothermic

Table 1. Demographic properties of newborns included in the study [Mean±SD (min-max)] or n (%)	
Demographic property	
Postpartum age (hours)	136±158 (1-696)
Gestational age (weeks)	36.2±3.8 (24-42)
37-42	123 (57)
36-36 6/7	21 (10)
32-35 6/7	31 (14)
28-31 6/7	21 (10)
<28	20 (9)
Birth weight	2847±940 (700-4700)
>4000 g	22 (10)
2500-4000 g	130 (60)
1500-2499 g	36 (17)
1000-1499 g	18 (8)
750-999 g	9 (4.5)
<750 g	1 (0.5)
Gender	
Male	112 (51.5)
Female	104 (48.5)

Table 2. Indications for referral of the subjects	
Indications for referral	n (%)
Need for mechanical ventilation and premature baby care	52 (33.7)
Need for mechanical ventilation	43 (27.9)
Premature baby care	15 (9.8)
Need for exchange transfusion	7 (4.5)
Other indications	37 (24)
- Neonatal convulsion	10 (6.5)
- Infection	6 (3.9)
- Anomaly	5 (3.0)
- Cardiac problems	4 (2.6)
- Cyanosis	3 (2.0)
- Acute renal failure	2 (1.3)
- Other reasons	7 (4.5)
Total	154 (%100)

Table 3. Indications for referral of the subjects who were referred without informing previously	
Prediagnoses as indications for referral	n (%)
Neonatal hyperbilirubinemia	29 (46.8)
Infection	6 (9.7)
Respiratory distress	6 (9.7)
Acute renal failure	4 (6.4)
Fever and hypernatremic dehydration	4 (6.4)
Anemia	3 (4.8)
Congenital anomaly	3 (4.8)
Cardiovascular pathology	3 (4.8)
Hypoxic ischemic encephalopathy	2 (3.3)
Neonatal convulsion	2 (3.3)
Total	62 (100)

preterm newborns (11%) ($p=0,01$). Although rate of sequela was higher in hypothermic newborns (57%) compared to non-hypothermic newborns (25%), the difference was not statistically significant ($p>0,05$).

Although mortality rate in hypothermic term babies (33%) was found to be higher compared to non-hypothermic babies (10%), the difference was not statistically significant ($p>0,05$). Rate of sequela was statistically significantly higher in hypothermic term newborns (75%) compared to non-hypothermic newborns (12%) ($p=0,008$).

Blood gas measurements revealed metabolic acidosis in 47 newborns (31%), respiratory acidosis in 20 newborns (13%), compensated metabolic acidosis in 13 newborns (9%), mixed acidosis in 18 newborns (12%) and respiratory alkalosis in 6 newborns (4%). In 31% of the newborns ($n=46$) blood gases were normal. Rate of acidosis in preterm babies was statistically significantly higher compared to term babies ($p<0,05$). Hypoglycemia was found in 25 newborns (12%). Of 36 term newborns who were referred to our unit because of neonatal hyperbilirubinemia, 16 had a bilirubin level above 25 mg/dL, 9 had a bilirubin level of 20-25 mg/dL and 22 had a bilirubin level below 20 mg/dL.

Before and during referral the most commonly observed interventional errors were as follows: absence of IV line and inappropriate amount and/or type of IV fluid (61%). Interventional errors related to the respiratory system (including obstruction of intubation tube, dislocated intubation tube, inadequate oxygen support) were the second most commonly observed interventional error (20%).

Comparison of prognoses of the newborns who were referred to our unit from external centers and the newborns who came from the Department of Gynecology and Obstetrics of our hospital is shown in Table 5. During the

period of the study, a total of 430 newborns were hospitalized in our unit and 44 of them died. Although the mortality rate in the newborns referred from external centers (13%) was higher than the mortality rate in the newborns born in our hospital and treated in our unit (8.5%), the difference was not statistically significant ($p>0,05$). Sequela and mortality rates were found to be higher in the preterm newborns referred from external centers compared to newborns born in our hospital, but the difference was not statistically significant ($p>0,5$). Mean gestational age (26.7 ± 2.1 weeks) and mean birth weight (910 ± 273 grams) in preterm babies who were born in our hospital and who died were statistically significantly lower compared to preterm babies who were referred from external centers and who died (29.4 ± 3.3 weeks and 1185 ± 269 grams) ($p<0,05$). Three newborns were referred to other centers because of need for cardiac surgery and one patient was referred to pediatric surgery because of esophageal atresia.

Discussion

Our unit is a referral center for cities including Trabzon, Giresun, Gümüşhane, Bayburt, Ordu, Rize and Artvin and their districts and is the only unit offering tertiary neonatal intensive care. Based on the data obtained from County Health Directorships in our city and surrounding cities, annual number of births in our region is approximately 30000. According to number of births, 31 tertiary neonatal intensive care beds and 124-186 secondary neonatal intensive care beds are needed in our region (2,3). There are seven tertiary neonatal intensive care beds and 11 secondary neonatal intensive care beds in our unit. This represents inadequate conditions in our region. Thus, the fact that 37 critical newborns who needed tertiary care and who could not be admitted to our unit

Table 4. Vital signs and laboratory findings of the referred subjects at presentation [n (%)]

	Premature delivery n=92	Term delivery n=120	Total n=212	p
Hypothermia (<36 C)	12 (13)	6 (5)	18 (8)	0.03
Cyanosis	20 (22)	14 (12)	34 (16)	0.043
Respiratory support				
Inappropriate intubation*	12 (13)	9 (8)	21 (10)	0.18
Heart rate <99/min	8 (9)	9 (8)	17 (8)	0.75
Hypotension	12 (13)	6 (5)	18 (8)	0.037
Blood glucose	92 (100)	120(100)	212 (100)	
<50 mg/dL	12 (13)	13 (11)	25 (12)	0.62
>200 mg/dL	2 (2)	3 (2)	5 (2)	0.87
Blood gases n=150	75 (81.5)	75 (62.5)	150 (100)	
pH ≥ 7.46	2 (3)	4 (5)	6 (4)	0.34
7.35-7.45	24 (32)	35 (47)	59 (39)	0.15
7.30- 7.34	12 (16)	13 (18)	25 (17)	0.88
7.29-7.1	31 (41)	19 (25)	50 (33)	0.037
7.09-6.91	4 (5)	0 (0)	4 (3)	0.042
≤ 6.9	2 (3)	4 (5)	6 (4)	0.34

* Intubation tube has been placed, but it is obstructed or dislocated

because no place was available died in the institutions they were followed up is a reflection of this state.

To decrease mortality and morbidity rates during transportation of newborns, communication between centers should be accurate (2). In studies performed in our country, rates of uninformed transport were reported to be 55-92% (6-9). In our study, this rate was reported to be 29%. Lower rates of uninformed neonatal referral compared to other regions of our country may be explained by the facts that our study was performed more recently, physicians have become conscious on this subject and we have been making efforts on communicating with physicians working in our region.

In studies related to neonatal transport in our country, rate of transport by ambulance was reported to be 9-76.3% (6-9). This rate was found to be 69% in our region. The transport vehicle should be prepared to reply the requirement of the newborn during transport. At the time when the study was performed, only three centers in our country were reported to possess ventilator which can be used during transport (10). It was observed that there was no transport vehicle which included mechanical transport ventilator, monitor and neonatal pulse oxymeter device in our region. Four newborns were admitted to our unit as exitus, although they were transported by hospital ambulance. This suggests that ambulance equipment was inadequate, medical personnel accompanying the transport were disqualified in terms of intervention for neonatal emergency cases or stabilization before the transport had not been performed accurately.

In a multi-center study performed in our country including 30 centers, it was reported that workers involved in the transport had inadequate experience and therefore stabilization of babies during the transport were negatively affected (10). In our region, 68 of 95 patients (72%) referred because of need of mechanical ventilation + preterm baby care and because of need of only mechanical ventilation who required the attendance of both a physician and an assistant medical personnel were accompanied only by a nurse, 12 (12%) were accompanied by a physician, 11 (11%) were accompanied by a physician and a nurse, 2 (2.5%) were accompanied by a health officer and 2 (2.5%) were accompanied by a midwife. Sixty two healthcare workers (58%) had received neonatal resuscitation training. This shows

that number and experience of healthcare workers involved in the transport are inadequate.

The most common indication for referral in our study was need for mechanical ventilation because of preterm birth and respiratory problems which is similar to İzmir and Eskişehir regions (6,8). The most common indication for referral in Ankara has been reported to be neonatal hyperbilirubinemia and preterm birth.

Preterm babies with a birth weight of >1500 g who do not need exchange transfusion for jaundice can be followed up and treated in primary and secondary intensive care units (11). Referral of these cases to tertiary intensive care units causes problems in terms of admittance of other patients who need tertiary intensive care. Therefore, physicians in external centers should receive consultancy from neonatologists to prevent these referrals.

Writing a detailed referral note for the patient who will be transported is fairly useful for planning the diagnosis, investigations and treatment in the referral center. Studies performed in our country have reported the rate of sending a patient information note to be 4-61% (6-9). Although severe deficiencies were present, the rate of sending an information note was found to be 71% in our study.

The main objective in referred newborns should be prevention of hypothermia, hypotension, hypoxia and hypo-hypercarbia (2,12). To protect critical patients from hypothermia, transport incubators should be used during transportation. In cases where transport incubator can not be provided, plastic blankets and head-dresses or disposable thermal blankets or kangaroo method can be used (13,14). The frequency of hypothermia in the transport of newborns has been reported to be 25.4-43.8% (6-8). In our study, hypothermia was observed with a rate of 8%. Rate of death due to hypothermia is 25-70% (15-20). The mortality rate was found to be 39% and morbidity rate was found to be 64% in newborns with a body temperature lower than 36°C in our study. These high rates of morbidity and mortality have been attributed to the fact that hypothermia is effective in increasing the severity of the primary disease.

In two studies performed in our country, rates of hypoglycemia during transportation were reported to be 15-31.2% (6,7). In our study, this rate was found to be 12% (n=25). To prevent hypoglycemia during transportation, an IV line should be open, amount and type of the fluid

Table 5. Prognoses of the subjects who were transferred from the Department of Obstetrics and Gynecology and who were referred from external centers [n(%)]

	Preterm			Term			Total
	Born in our hospital	Referred	p	Born in our hospital	Referred	p	
Healthy discharged	50 (71)	56 (60)	0,13	119 (91)	88 (72)	0,001	313 (75)
Discharged with sequela	9 (13)	22 (24)	0,07	4 (3)	15 (12)	0,002	50 (12)
Exitus	11 (16)	14 (15)	0,9	6 (5)	13 (11)	0,01	44 (11)
Exitus at presentation	-	1 (1)	0,38	-	3 (2)	0,36	4 (1)
Referral	-	-		1 (1)	3 (2)		4 (1)
Transferred	-	-		-	1 (1)		1 (0)
Total	70 (100)	93 (100)		130 (100)	123 (100)		416 (100)

should be appropriate, newborns who can be feeded enterally should be breastfed during transportation and blood sugar measurements should be performed (2).

Sufficient respiration should be provided to prevent hypoxia and hypo-hypercapnia during transportation. In studies performed in our country, rate of hypoxia and/or acidosis has been reported to be 20-80% (6-8,10). In our study, acidosis was found in 53% of the newborns whose blood gases were measured. Cyanosis was found in 16% of the subjects and dislocated or obstructed intubation tube was found in 10% of the subjects. The fact that four subjects presented as exitus suggests that stabilization before transportation and equipment necessary for transport or interventions were insufficient. If there is an insufficiency in terms of giving respiratory support by face mask in newborns with respiratory problems during transportation or there is a problem in placing a tracheal tube, respiratory support by laryngeal mask may be an option (21).

Then most important sign of circulatory insufficiency is hypotension. Blood pressure should be monitored, IV line should be assured and cared for during transport to prevent obstruction, fluid therapy should be performed when necessary and inotropic drugs should be started when necessary in newborns who have critical illness before transportation (22). Hypotension at presentation was observed in 8% of the subjects in our study. In subjects who developed hypotension, the following errors were observed: absence of IV line or obstructed IV line, inappropriate amount and type of fluid, not starting inotropic drugs, though necessary, not measuring blood pressure during transportation.

Mortality rate in patients referred from another center was reported to be higher compared to patients who were treated in the hospital they were born (23). Neonatal morbidity and mortality rates are inversely related to gestational age and birth weight (24,25). The fact that no difference was found between mortality rates of preterm babies who were born in our hospital and who were referred from external centers may be explained by the finding that gestational ages and birth weights of the newborns who were born in our hospital and died were significantly lower compared to newborns born in external centers.

These results suggest that number of patients in our unit exceeds the limit, stabilization of newborns before and during transport is inadequate, communication between centers is inadequate before transportation and education of healthcare workers and technical equipment in the vehicles are under the level which is desired. It is thought that formation of regional transport teams by a good communication network inside each region, prevention of unnecessary referrals, making back-transport system work and formation of specifically educated neonatal transport teams will decrease problems faced during transportation of newborns.

Conflict of interest: None declared

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