The Impact of Air Ambulance Transport on Neonatal Outcomes

Cindy Killion, RNC-NIC, C-NPT and Howard M. Stein, MD

Many referring facilities and transport teams function under the assumption that faster is better. However, data on the benefits of air ambulance (AA) use in neonatal transport are sparse. At our referral hospital in northwest Ohio, we compared the total time from telephone request for transport to arrival in the referral nursery by ground ambulance vs AA for each of our referring facilities and evaluated if this had an impact on patient outcomes. Time from transport call to arrival at the referring hospital was 72 ± 17 minutes by AA and 95 ± 23 minutes by ground ambulance. We demonstrated that although it was approximately 25% faster to fly to a referring hospital compared with traveling by ground, the time saved had no impact on outcome. On the basis of these data, we continue to encourage ground transport whenever possible and reserve the use of the AA for the sickest neonates located in the furthest referring hospitals.

Keywords: Neonatal transport; Air ambulance; Outcomes; Ground ambulance; Transport times

The year 2008 saw a devastating rise in fatal air ambulance (AA) crashes—13 crashes totaling 29 lives lost. This demonstrates an increase of 16 over the average of 13 per year from the previous decade.[1] That alarming statistic raises much controversy among professionals as to whether air medical services outweigh the risks involved. Highly debated for the adult population servicing cardiac emergencies, trauma, and accident scene coverage, critics feel that the risks involved with the increased number of crashes do outweigh the benefits of flight.[2]

However, how does all of this come in to play for the neonatal arena? Previous studies have shown that AA transfer reduces neonatal transport times by one third to one fourth that of ground transport[3]; however, outcomes have not been addressed. Articles that discuss the benefits of air transport suggest that air transport is faster than ground transport, [3–5] but the published data on the impact of outcomes of AA use in neonatal transport are sparse. Despite this paucity of data on the benefit of AA transport in neonates, 35% of unit-based and 75% of dedicated neonatal transport teams use rotor AA services (National Survey to Describe the Workforce of Neonatal Transport in the United States, Kristine A. Karlsen, PhD, NNP-BC, unpublished doctoral thesis, 2008).

From the Toledo Children's Hospital, 2142 N. Cove Blvd., Toledo, OH 43606.
From the neonatal intensive care unit at Toledo Children's Hospital, Toledo, OH, a member of ProMedica Health System.
Address correspondence to Cindy Killion, RNC-NIC, C-NPT, Neonatal Transport Supervisor, Toledo Children's Hospital, 2142 N. Cove Blvd., Toledo, OH 43606. E-mails: cindy.killion@promedica.org, howardstein@bex.net.

1527-3369/09/0904-0331$36.00/0
doi:10.1053/j.nainr.2009.09.008

Background

Our neonatal team in northwest Ohio transports infants from multiple hospitals for neonatal intensive care. Some of these referring hospitals are located in urban areas, whereas others serve large rural communities. Our geographic area covers about 24 000 square miles. Although the terrain is relatively flat, we encounter significant snow in the winter and thunderstorms in the summer that can and do influence our decision to fly.

Our transport team composition is typically a registered nurse and respiratory therapist, but a neonatal nurse practitioner (NNP) or neonatologist is available if required. The decision to send additional personnel is made on a case-by-case basis. A transport is initiated by a telephone request from the referring hospital and is received by one of our neonatologists. All decisions to fly are made in collaboration with the accepting neonatologist, and we use only helicopters for our air transports. Air trips originate at the local airport; therefore, the helicopter is first required to fly to the helipad at the hospital to pick up the neonatal transport team, there in which an inherent delay occurs. Departure time of ground trip is generally quicker because these trips originate from our hospital's emergency department. We have always been judicious in our use of air transport, but the recent increase in fatal AA crashes prompted us to collect and analyze our data concerning the use of air transport.

Purpose

The purposes of our study were to compare the total time from telephone request for transport to arrival in the referral nursery by AA vs ground ambulance (GA) for each of our referring facilities and to measure the impact on neonatal outcomes.

Methods

We retrospectively reviewed the times it took for the neonatal transport team to get to the referring hospital by AA vs by GA for each of our referring facilities from January 2000 to December 2008. Because there were far fewer AA than GA trips, each AA trip was case matched, whenever possible, with a GA trip to the same hospital. This was done within a 2-month time frame to account for variations in seasons and weather. We collected data on neonatal weights, diagnosis, referring hospital, the time the call was accepted, the time of departure from our hospital, and the time of arrival at the referring hospital.

To determine neonatal outcomes, we reviewed the infants' conditions upon hospital discharge (alive vs dead). For the survivors, we evaluated chronic lung disease (CLD), oxygen at hospital discharge, grade 3 or 4 intraventricular hemorrhage (IVH), stage 3 or more retinopathy of prematurity (ROP), length of stay (LOS), and days on the ventilator (DOV). We examined the outcome data on the AA trips and all GA neonates from the same referral hospitals. Although our goal was to collect data on all infants with diagnoses that corresponded to the AA trips, some neonates (ie, those with respiratory syncytial virus, cardiac anomalies, and/or surgical issues) were taken to the pediatric intensive care unit and did not have outcome or comparison data available. Neonates born prematurely with a birth weight between 1000 and 2500 grams were too variable in their presentation to obtain a reliable comparison group. In addition, there were multiple diagnoses within this group that had insufficient numbers to yield meaningful results. We therefore chose to focus on the two sickest groups of neonates that made up almost 40% of our transports. These consisted of (1) neonates weighing less than 1000 grams and (2) neonates with respiratory distress weighing greater than 2500 grams. To match acuity in the group with respiratory distress weighing greater than 2500 grams, we limited the GA group to those who required mechanical ventilation for at least 1 day. We also compared outcomes of inborn vs outborn neonates weighing less than 1000 grams.

Statistics were analyzed using a general linear model using the least square means for effect of air and ground time to distance from our hospital. A two-tailed *t* test and the *Z* test for two proportions were used to compare outcome data. A $P < .05$ was considered statistically significant.

Results

From January 2000 to December 2008, we had 3096 neonatal transports (2957 by ground and 138 by air). Air transport was only provided for 19 of the 33 referring hospitals in our region. Table 1 shows the distance for each referring hospital, the number of AA transports to these facilities, and the average air- and case-matched ground times for each facility. Overall, our time from transport call to arrival at the referring hospital was 72 ± 17 minutes by air and 95 ± 23 minutes by ground ($P < .01$). Table 2 shows the AA time compared with the GA time for referral facilities grouped into distance from our hospital. For most hospitals, it was faster to fly than to go by ground. The closest hospital was the only one where AA and GA times were similar. For the hospitals between 26 and 55 miles away, AA times trended toward being faster. When we grouped the hospitals as either less than or greater than 60 miles, AA transport was significantly faster in both groups (Table 3). The average time from acceptance of a trip to neonatal transport team liftoff by AA was 37 ± 13 minutes and to departure by GA was 24 ± 9 minutes.

The distribution of diagnoses for which the neonatal transport team traveled by AA to the referring hospitals is shown in the pie graph in Fig 1. It should be noted that all neonates with a birth weight of less than 1000 grams also had respiratory distress. The neonates weighing between 1000 and 2500 grams were transported secondary to prematurity and may or may not have had respiratory distress. The neonates weighing greater than 2500 grams either had respiratory distress or one of the other diagnoses displayed on the graph. The neonates weighing less than 1000 grams had similar outcomes in all categories irrespective of the mode of transport (Table 4). When compared with inborn neonates, the outborn neonates had a higher mortality rate (20% vs 34%). There was no difference in CLD, oxygen at discharge, IVH, ROP, DOV, or LOS between the inborn and outborn neonates weighing less than 1000 grams at birth. The neonates with respiratory distress who were born weighing greater than 2500 grams showed no difference in outcomes between AA and GA transports (Table 5) as determined by survival, DOV, or LOS.

Discussion

Our data suggest that although it is approximately 25% faster to fly to a referring hospital compared with travel by ground, the time saved has no impact on outcome. On average, it took 72 minutes to arrive at the referring hospital by AA. Therefore, even if the referring facility initiated the transport at the earliest sign of deterioration, they still needed to manage the patient for more than an hour before the transport team arrived. It was not surprising to note that the referral hospitals were most concerned about infants weighing less than 1000 grams and requested the transport team to travel by air in 38% of cases compared with only 16% of cases in neonates weighing more than 2500 grams with respiratory distress. Our AA was used in only 4% of total transports, and our expectation was that we used this service only for the sickest neonates. Our data demonstrate that despite this attempt to triage appropriately, we did not improve the outcomes of these neonates.

Survival was lower for all outborn neonates weighing less than 1500 grams. The inborn neonates may have benefited from prenatal management available in our tertiary care facility in addition to delivery room management by an NNP and/or neonatologist. In addition, referral hospitals try to transport the premature fetus in utero whenever possible. Usually, referring centers only deliver extremely premature neonates in circumstances where there is insufficient time to transfer the mother to a perinatal center or administer antibiotics or prenatal steroids. Therefore, by circumstances beyond their control, some high-