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Outcome analysis of neonates with congenital diaphragmatic hernia treated with venovenous vs venoarterial extracorporeal membrane oxygenation

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Abstract

Purpose: Venoarterial extracorporeal membrane oxygenation (ECMO) (VA) is used more commonly in neonates with congenital diaphragmatic hernia (CDH) than venovenous ECMO (VV). We hypothesized that VV may result in comparable outcomes in infants with CDH requiring ECMO.

Methods: We retrospectively analyzed the Extracorporeal Life Support Organization (ELSO) database (1991-2006). Multivariate logistic regression analyses were used to compare VV- and VA-associated mortality.

Results: Four thousand one hundred fifteen neonates required ECMO, with an overall mortality rate of 49.6%. Venoarterial ECMO was used in 82% and VV in 18% of neonates. Pre-ECMO inotrope use and complications were equivalent between VA and VV. The mortality rate for VA and VV was 50% and 46%, respectively. After adjusting for birth weight, gestational age, prenatal diagnosis, ethnicity, Apgar scores, pH less than 7.20, $Paco_2$ greater than 50, requiring high-frequency ventilation, and year of ECMO, there was no difference in mortality between VV vs VA. Renal complications and on-ECMO inotrope use were more common with VV, whereas neurologic complications were more common with VA. The conversion rate from VV to VA was 18%; conversion was associated with a 56% mortality rate.

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Conclusion: The short-term outcomes of VV and VA are comparable. Patients with CDH who fail VV may be predisposed to a worse outcome. Nevertheless, VV offers equal benefit to patients with CDH requiring ECMO while preserving the native carotid.

Extracorporeal membrane oxygenation (ECMO) is used to treat severe cardiorespiratory failure refractory to conventional medical management. In newborns, ECMO is commonly used to treat respiratory failure associated with hypoplastic lungs and persistent pulmonary hypertension caused by congenital diaphragmatic hernia (CDH). Up to 20% to 40% of neonates with CDH require ECMO as rescue therapy [1-4]. Although the use of ECMO has resulted in significant improvement in the survival of neonates with respiratory failure [5,6], only modest improvement has been documented in neonates with respiratory failure associated with CDH [2,3,7].

The most common approach used to provide ECMO support in neonates involves cannulation of the right common carotid artery and the right internal jugular vein, which is referred to as venoarterial ECMO (VA). Alternatively, patients can be managed with a double-lumen cannula inserted via the internal jugular vein, which is referred to as venovenous ECMO (VV). The important advantages of VV as compared with VA include the ability to spare the ligation of the carotid artery, selective perfusion of the pulmonary vasculature with enriched oxygenated blood, delivery of oxygenated blood to the coronary arteries, preservation of pulsatile blood flow, decreased incidence of cardiac stun, and minimization of embolic risks to the brain. However, whereas VA can provide full cardiopulmonary support, VV is limited in its ability to fully support cardiac function.

In the care of the neonate with respiratory failure associated with CDH, VA has traditionally been the predominant form of ECMO support [4]. Two case series and an analysis of the ELSO registry have failed to demonstrate convincing evidence of a benefit for VA compared with VV in neonates with CDH [8-10]. These previous studies did not account for disease severity between neonates who underwent VA as opposed to VV. In this study, we sought to perform a disease severity risk-adjusted analysis of VV and VA outcomes for neonates with CDH using the ELSO registry database. We hypothesized that neonates with respiratory failure associated with CDH who are supported with VV have comparable outcomes with those supported with VA after adjusting for their initial illness severity.

1. Methods

1.1. Data source

The ELSO registry database was used to compare VV and VA. Since 1976, the average number of VA cases per year increased steadily and peaked in 1990 (Fig. 1). Therefore, we limited our analysis to 15 years from 1991 to 2006 because, before 1991, VV accounted for less than 1% of the total ECMO cases (Fig. 1). The ELSO registry is composed of more than 170 centers and collects pre-ECMO, on-ECMO, and post-ECMO clinical data, as well as the patient's final disposition (intensive care unit discharge or death). Approval of the institutional review board at

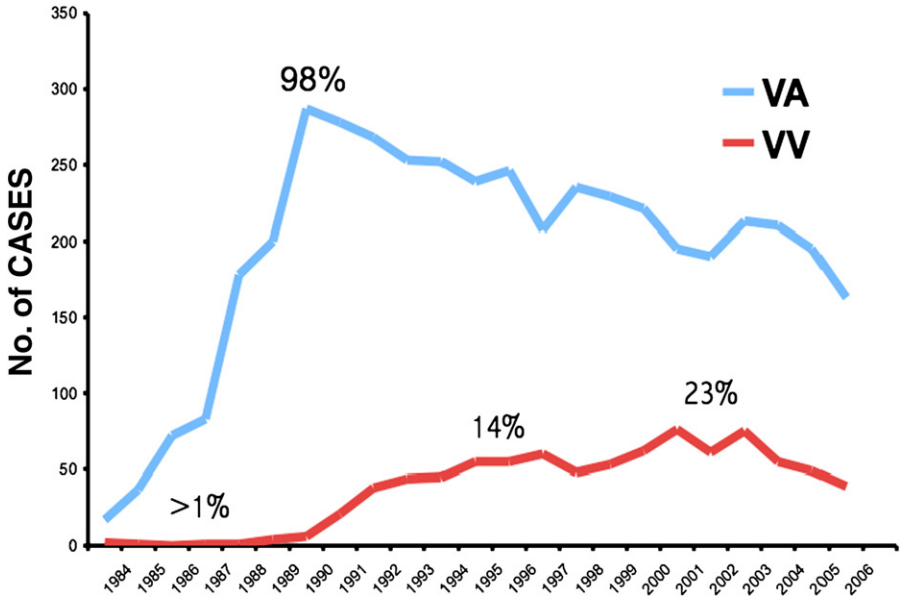

Fig. 1 Types of ECMO cases by year.