



Outcomes of vocal fold immobility after pediatric cardiovascular surgery

Aniruddha Patki MD¹, Marisa A. Ryan MD¹, Anatoli F. Karas MD¹, Patrick A. Upchurch MD², Rose J. Eapen¹, Eileen M. Raynor, MD¹
¹Duke University Medical Center, Durham, NC; ²Boston Children's Hospital, Boston, MA



Abstract

Objective: Cardiovascular surgery is increasingly performed in infants to correct congenital malformations of the heart and great vessels. Observed post-operatively as vocal fold immobility, recurrent laryngeal nerve injury is a well described complication. As overall outcomes improve and these patients live longer, the sequelae of vocal fold immobility amplify in significance. We report on the timing of return of vocal fold motion and requirement for aerodigestive interventions in a series of these children. **Study Design:** Retrospective case series. **Methods:** We reviewed all 65 patients <2 years old who underwent cardiovascular surgery at a tertiary center from 2008-2013 and were diagnosed postoperatively with vocal fold immobility by fiberoptic examination. **Results:** The most common diagnoses included 18 patent ductus arteriosus, 17 hypoplastic left heart syndrome (HLHS), 13 aortic coarctation, 12 interrupted aortic arch, 2 transposition of great vessels, 1 pulmonary atresia, 1 atrioventricular canal defect and 1 Tetralogy of Fallot. The majority (92%) had left, but 4 had right and 1 had bilateral vocal fold immobility. Recovery of motion occurred in 19 (29%). Time to recovery ranged from 30 to 1089 days (median 190 days). Patients with HLHS had a significant negative correlation with recovery. Subsequent aerodigestive surgery was required in 31 (48%) patients. Direct laryngoscopy/bronchoscopy was performed in 14 (22%), tracheostomy in 5 (8%), injection vocal fold medialization in 3 (5%), and surgical feeding tube placement in 29 (45%). The likelihood of regaining mobility was not significantly different in those who required additional aerodigestive interventions. **Conclusion:** Longitudinal evaluation by otolaryngology and speech pathology is imperative in children with vocal fold immobility after cardiovascular surgery, since the majority do not experience recovery of vocal fold motion and many require interventions for airway protection, feeding and phonation.

Introduction

- Cardiovascular surgery is increasingly performed in infants to correct congenital heart and great vessels malformations.
- The recurrent laryngeal nerve is especially prone to injury during procedures requiring aortic arch manipulation and/or reconstruction.
- Cardiovascular surgeries range from PDA ligation with limited dissection around the aortic arch to staged palliation procedures and aortic arch reconstruction for hypoplastic left heart syndrome.
- The reported incidence of vocal fold immobility after pediatric cardiovascular surgery varies from 8.7% to 39%.³
- Risk factors for vocal fold immobility include low birth weight,⁴ younger age at surgery,⁵ and use of electrocautery during dissection around the aorta.⁶
- Data is limited on long-term outcomes of vocal fold immobility in children after cardiovascular surgery.

Methods

- Chart review of all patients <2 years old who underwent cardiovascular surgery at Duke University Medical Center from 2008 to 2013 and were diagnosed postoperatively with vocal fold immobility by fiberoptic exam by otolaryngology.
- Recovery of vocal fold movement defined by either a fiberoptic exam or documentation of a normal cry, feeding status, and breathing in the absence of a fiberoptic exam.
- Secondary measures included the dates and types of subsequent aerodigestive operative procedures
- Pearson's chi squared test with significance set at alpha=0.05.

Results

- 65 patients met inclusion criteria
- 18 patent ductus arteriosus, 17 hypoplastic left heart syndrome, 13 aortic coarctation, 12 interrupted aortic arch, 2 transposition of great vessels, 1 pulmonary atresia, 1 atrioventricular canal defect and 1 Tetralogy of Fallot.
- Mean follow up of 278 days.
- 92% had unilateral left vocal fold immobility, 6% with unilateral right and 1% with bilateral vocal fold immobility
- 29% had recovery of vocal fold mobility (42% based on fiberoptic exam and 58% on return of normal cry, feeding and breathing)
- Time to recovery ranged from 30 – 1089 days (median 190 days)
- Hypoplastic left heart syndrome had statistically negative correlation with recovery (p=0.03)
- 48% underwent secondary surgical procedure involving airway or surgical feeding tube placement
 - Injection vocal fold medialization in 5%
 - Tracheostomy was performed in 8%
 - Surgical feeding tube placement in 45%

Figure 1. Days after cardiovascular surgery to recovery of vocal cord movement with quartiles

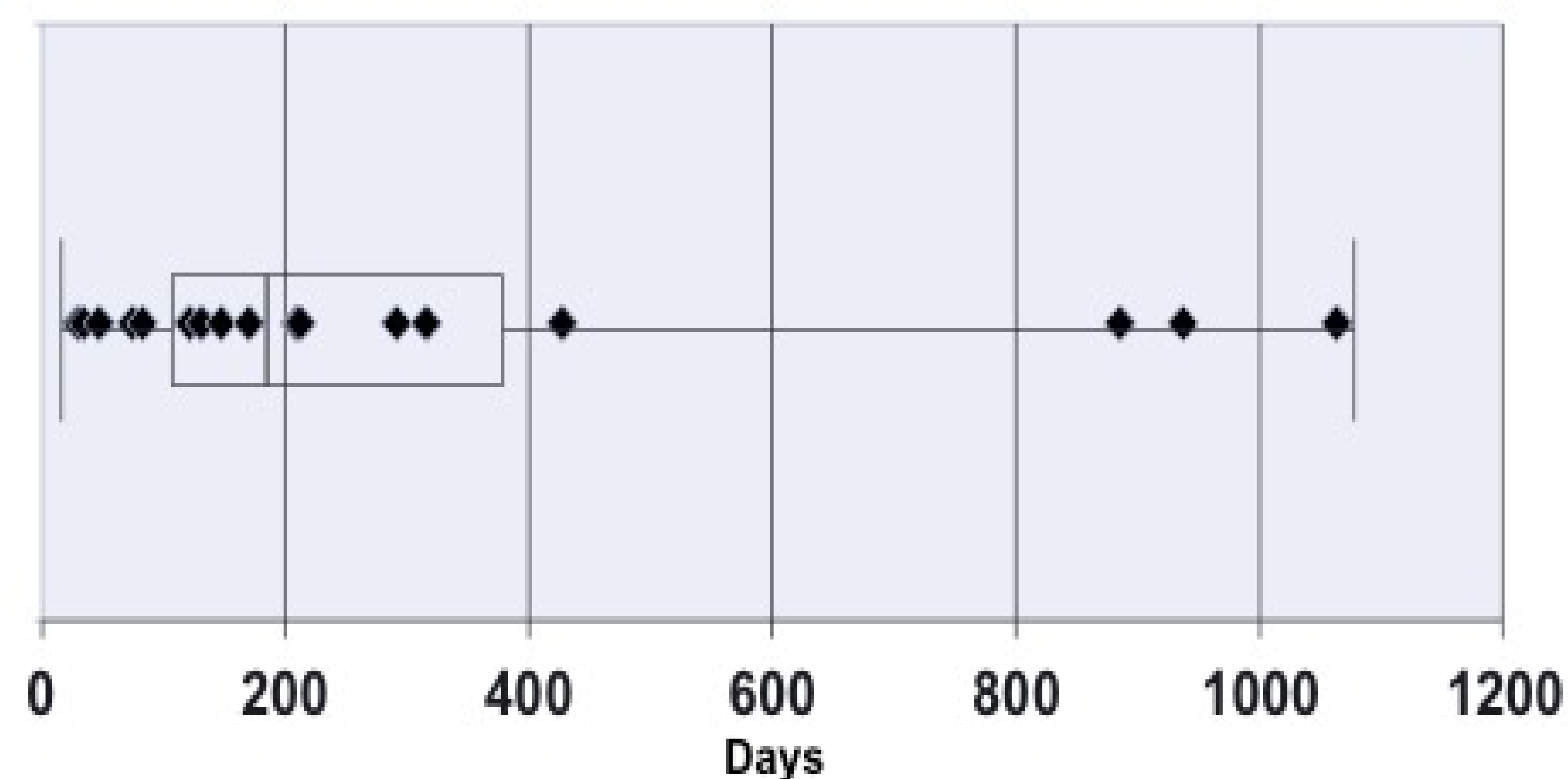
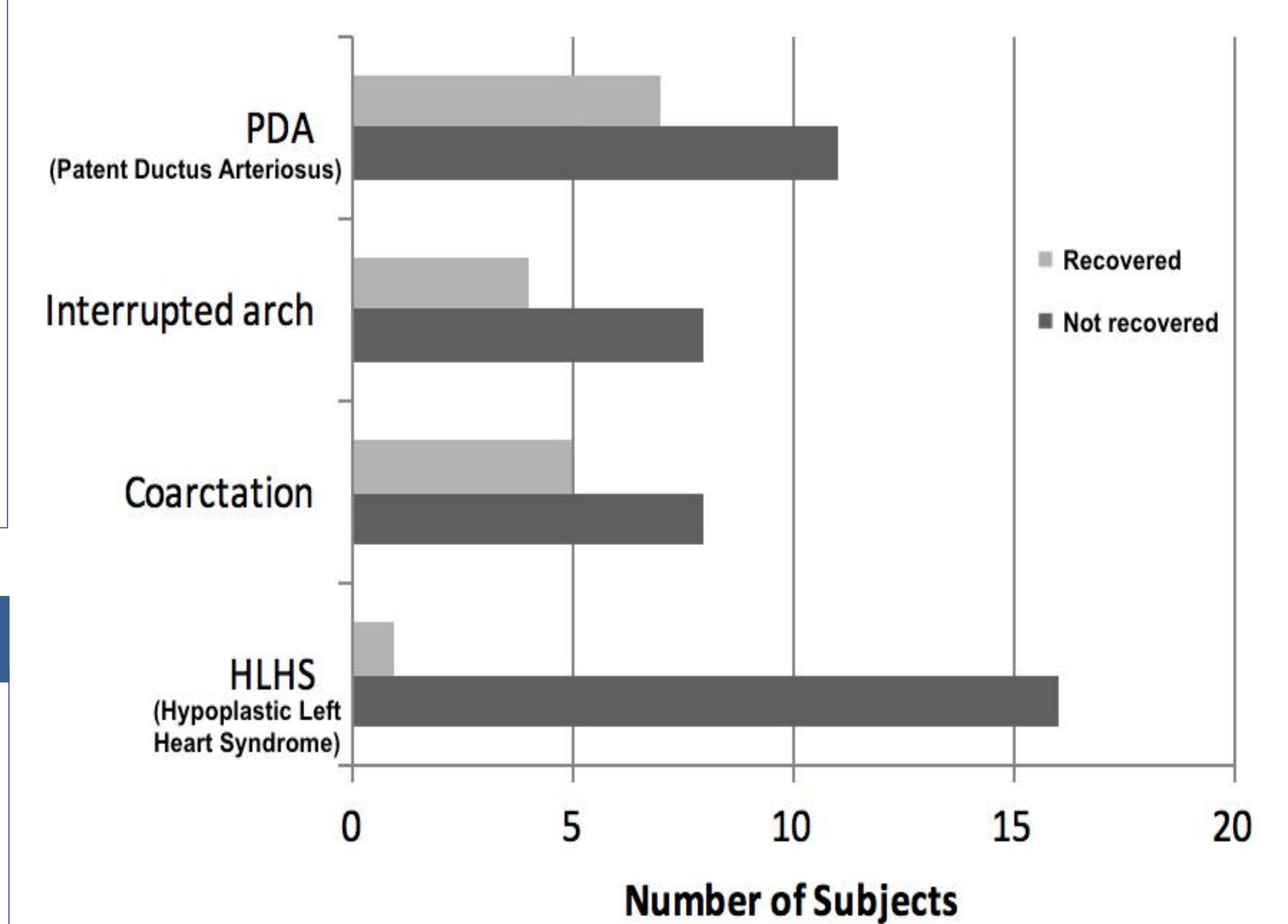


Figure 2. Recovery of vocal fold movement stratified by cardiovascular diagnosis



Discussion

- Iatrogenic injury to the recurrent laryngeal nerve is the most likely presumed etiology of vocal fold immobility after cardiovascular surgery, but extended periods of intubation or underlying neurologic abnormality may contribute.
- 72% of our patients underwent cardiovascular surgery for structural defect other than PDA, which is associated with longer intubation times.⁷
- 29% exhibiting recovery of vocal cord mobility is similar to prior findings of 28%⁸ and 35%.⁹
- Median time of recovery of 190 days was slightly longer than a previously reported 130 days.⁸
- Limitations of the study from retrospective nature include:
 - Delayed documentation of recovery due to intervals between follow-up visits
 - Symptom improvement without confirmatory fiberoptic exam due to medialization of immobile vocal cord or compensation rather than true recovery
- Vocal cord movement recovery negatively associated with hypoplastic left heart syndrome
- High incidence (45%) of feeding tube placement is consistent with prior reports of 55.2% incidence of exclusive tube feeding at time of discharge.³

Conclusions

- Young children with vocal fold immobility after cardiovascular surgery:
 - Should expect return of function in 29% of cases and within 1 year if it occurs
 - Frequently require a surgical feeding tube
 - Require continued follow up with Otolaryngology and Speech Pathology

Contact

Anatoli F. Karas, MD
 DUMC 3805
 Durham, NC
 Email: anatoli.karas@duke.edu

References

1. Egbe A, Uppu S, Lee S, Stroustrup A, Ho D, Srivastava S. Temporal variation of birth prevalence of congenital heart disease in the United States. *Congenital heart disease*. 2015;10(1):43-50.
2. Fyler DC, Buckley LP, Hellenbrand WE, et al. Report of the New England Regional Infant Cardiac Program. *Pediatrics*. 1980;65(2 Pt 2):375-461.
3. Strychowski JE, Rukholm G, Gupta MK, Reid D. Unilateral vocal fold paralysis after congenital cardiothoracic surgery: a meta-analysis. *Pediatrics*. 2014;133(6):e1708-1723.
4. Zbar RI, Chen AH, Behrendt DM, Bell EF, Smith RJ. Incidence of vocal fold paralysis in infants undergoing ligation of patent ductus arteriosus. *The Annals of thoracic surgery*. 1996;61(3):814-816.
5. Carpes LF, Kozak FK, Leblanc JG, et al. Assessment of vocal fold mobility before and after cardiothoracic surgery in children. *Archives of otolaryngology-head & neck surgery*. 2011;137(6):571-575.
6. Averin K, Uzarik K, Beekman RH, 3rd, Willging JP, Pratt J, Manning PB. Postoperative assessment of laryngopharyngeal dysfunction in neonates after Norwood operation. *The Annals of thoracic surgery*. 2012;94(4):1257-1261.
7. Wilson MN, Bergeron LM, Kakade A, et al. Airway management following pediatric cardiothoracic surgery. *Otolaryngology-head and neck surgery: official journal of American Academy of Otolaryngology-Head and Neck Surgery*. 2013;149(4):621-627.
8. Jabbour J, Martin T, Beste D, Robey T. Pediatric vocal fold immobility: natural history and the need for long-term follow-up. *JAMA otolaryngology-head & neck surgery*. 2014;140(5):428-433.
9. Truong MT, Messner AH, Kerschner JE, et al. Pediatric vocal fold paralysis after cardiac surgery: rate of recovery and sequelae. *Otolaryngology-head and neck surgery: official journal of American Academy of Otolaryngology-Head and Neck Surgery*. 2007;137(5):780-784.
10. Skinner ML, Halstead LA, Rubinstein CS, Atz AM, Andrews D, Bradley SM. Laryngopharyngeal dysfunction after the Norwood procedure. *The Journal of thoracic and cardiovascular surgery*. 2005;130(5):1293-1301.
11. Sachdeva R, Hussain E, Moss MM, et al. Vocal cord dysfunction and feeding difficulties after pediatric cardiovascular surgery. *The Journal of pediatrics*. 2007;151(3):312-315, 315.e311-312.
12. Pereira KD, Webb BD, Blakely ML, Cox CS, Jr., Lally KP. Sequelae of recurrent laryngeal nerve injury after patent ductus arteriosus ligation. *International journal of pediatric otolaryngology*. 2006;70(9):1609-1612.