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Craniofacial/Pediatric

Tracheoesophageal Fistula Closure in a Pediatric Patient Using a Supraclavicular Artery Island Flap

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Summary: Acquired tracheoesophageal fistulas can lead to large defects with fatal complications. Surgical management is challenging but necessary to prevent respiratory infections and poor weight gain. Therefore, a reliable and pliable flap like the pedicled supraclavicular artery island flap with its wide arc of rotation and robust vascularization is needed for reconstruction. We highlight the surgical technique and postoperative measures in managing a tracheoesophageal fistula due to button battery ingestion in a 9-month-old boy with the supraclavicular artery island flap. In summary, the supraclavicular artery island flap is a safe and successful tool for closure of large acquired tracheoesophageal fistulas in pediatric patients. *(Plast Reconstr Surg Glob Open 2023; 11:e5250; doi: 10.1097/GOX.0000000000005250; Published online 19 September 2023.)*

CLINICAL QUESTION

Tracheoesophageal fistulas (TEFs) are abnormal congenital or acquired connections between the posterior aspect of the trachea and the anterior wall of the esophagus. The management of TEFs can be challenging, and surgical intervention is necessary to prevent respiratory infections and poor weight gain in affected children.[1,2]

One technique that has gained popularity in recent years in reconstructing defects in the head and neck region in adult patients is the use of the supraclavicular artery island flap (SCAIF).[3–5] As a pedicle tissue flap that is harvested from the supraclavicular region of the neck, the SCAIF does not need to be connected to the vascular structures in a pediatric patient. It provides a large and reliable source of tissue composed of skin and subcutaneous tissue that can be tailored to fit the size of the defect. The risk of complications such as flap necrosis is minimized due to its robust blood supply by the supraclavicular artery.[6]

In this article, we report on the use of the SCAIF for reconstruction of a TEF in a 9-month-old boy after button battery ingestion. The child presented with infection of the upper airway, pneumonia, and stridor with tachydyspnea, which made intubation at a peripheral hospital necessary. Due to increasing oxygen demand and high ventilation pressure, the 9-month-old boy was transferred to the pediatric intensive care unit at the university hospital with acute respiratory distress syndrome for possible veno-venous extracorporeal membrane oxygenation (ECMO) therapy. There, a foreign body in the upper esophagus was identified by diagnostic chest X-ray. A computed tomography (CT) scan of the neck confirmed a button battery in the esophagus and evaluated damage to the vasculature. [**See figure, Supplemental Digital Content 1,** which shows a sagittal CT scan of a 9-month-old boy with a foreign body in the neck region. Black star: foreign body (button battery); white triangle: endotracheal tube; white arrow: feeding tube. **http://links.lww.com/PRSGO/C774**.] The foreign body was extracted by endoscopy. During the procedure, a TEF of 20 mm × 20 mm with erosion of the surrounding mucosa was diagnosed (Fig. 1). [**See Video 1 (online),** which shows an endoscopy of a 9-month-old boy after button battery ingestion, 5 days after battery removal.] After primary wound healing, the defect was closed surgically, 10 days after removal of the foreign body.

SURGICAL TECHNIQUE OF THE SCAIF IN A 9-MONTH-OLD PATIENT

An orotracheal tube was placed with the inflatable cuff placed below the TEF. After a suprajugular collar incision (Kocher incision) and preparation of the cricoid cartilage,

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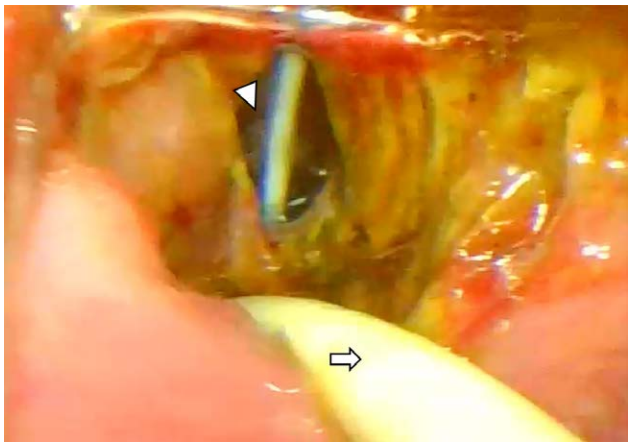

Fig. 1. After removal of a foreign body (button battery) by endoscopy, a tracheoesophageal fistula with surrounding necrosis was detected in a 9-month-old male patient. White triangle: endotracheal tube; white arrow: feeding tube.

Takeaways

Question: Addressing acquired large tracheoesophageal fistulas in pediatric patients.

Findings: This is the first report of the use of a pedicled supraclavicular artery island flap with its wide arc of rotation and robust vascularization for reconstruction of acquired tracheoesophageal fistulas in young pediatric patients.

Meaning: The supraclavicular artery island flap is a safe and successful tool for closure of large acquired tracheoesophageal fistulas in pediatric patients.

the thyroid gland was separated and lateralized to visualize the circumference of the trachea. The N. laryngeus recurrens on both sides were secured by preparation close to the tracheal cartilage. The tracheal cartilage of the patient was intact, but below the cricoid cartilage, the trachealis muscle and the dorsal mucosa were completely consumed by the fistula over the distance of 25–30 mm craniocaudally with a lateral extension of 12 mm. In total, 140 degrees of the esophagus circumference was affected by the fistula (Fig. 1).

After identification of the course of the left A. supraclavicularis by Doppler ultrasound, an SCAIF of 30 × 15 mm was harvested from the left shoulder, as described previously.[4–7] The left side was chosen as the donor side, with the patient expected to be right-handed as both parents were. The lateral end of the flap consisted of two parts, one with skin and subcutaneous tissue, the other with connective tissue and fascia of the M. deltoideus. The flap was rotated on its pedicle into the defect. The fascia of the M. deltoideus replaced the anterior wall of the esophagus; the former skin of the shoulder aligned the luminal side of the trachea (Fig. 2). First, the left lateral part of the flap was

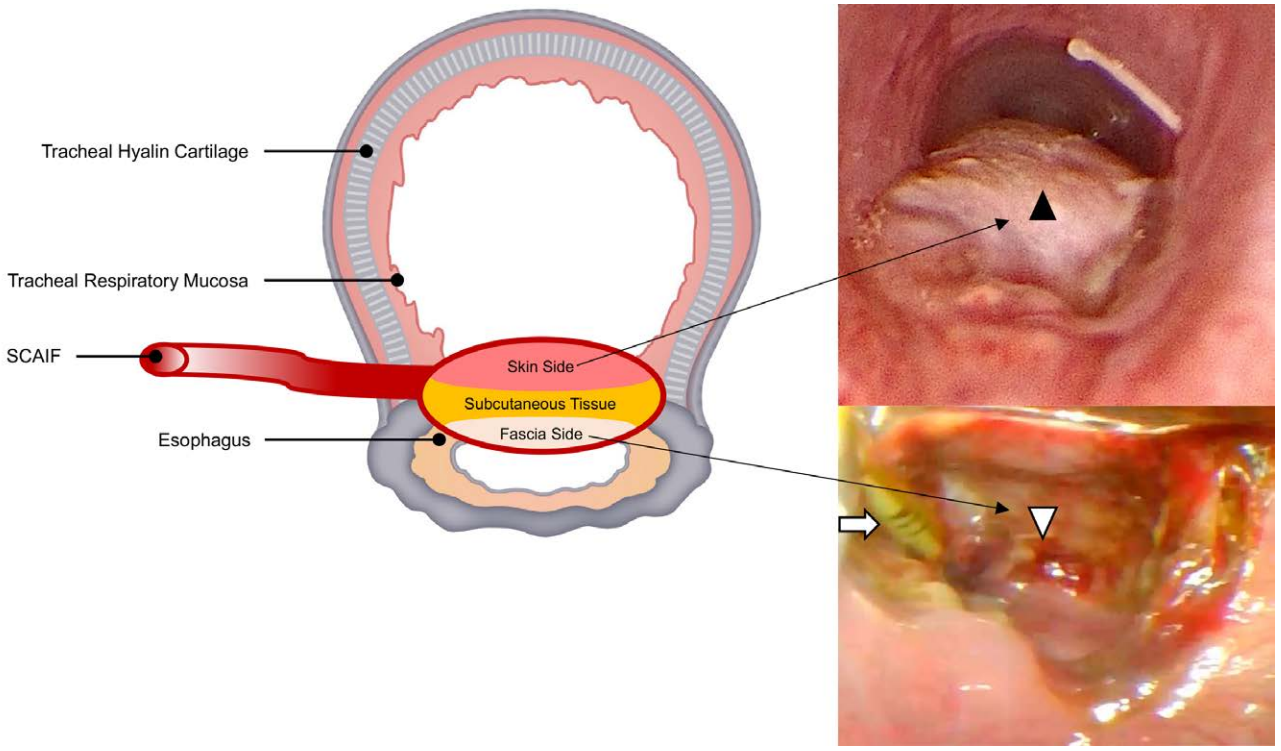

Fig. 2. Schematic for placement of the supraclavicular artery island flap (SCAIF) for closing of a tracheoesophageal fistula with the M. deltoideus fascia side of the SCAIF orientated toward the esophagus, and the skin side orientated toward the trachea. Endoscopy after surgery showing the skin side of the SCAIF (black triangle) orientated toward the trachea, and the M. deltoideus fascia side of the SCAIF (white triangle) orientated toward the esophagus. White arrow: feeding tube.

sutured to the back wall of the trachea and the anterior wall of the esophagus. Before the insetting, sutures were placed in the flap, and the flap was pulled into the lumen of the fistula and fixated with the prepared sutures at the caudal end of the cricoid cartilage, the cranial end of the fistula in the esophagus, and at the lateral wall of trachea and esophagus on the right side. After mobilizing the skin on the shoulder, the donor defect of the SCAIF was closed primarily. The child remained intubated with a 3.5-mm endotracheal tube.

CLINICAL FOLLOW-UP

Endoscopy 4 days after surgery demonstrated a vital flap. [**See Video 2 (online),** which shows an endoscopy of a nine-month-old boy 4 days after SCAIF closure of a tracheoesophageal fistula due to button battery ingestion]. The tracheal tube was removed 7 days postsurgery. Increased pulmonary secretion, stridor, and dyspnea occurred 1 day later. A tracheoscopy showed the volume of the flap blocking the lumen of the trachea by collapsing intraluminally during inspiration. [**See Video 3 (online),** which shows tracheoscopy of a 9-month-old boy 9 days after SCAIF closure of a tracheoesophageal fistula due to button battery ingestion]. The patient remained intubated for 14 days without improvement. Therefore, a tracheostomy was performed 22 days after initial surgery. After the tracheostomy, the child was breathing spontaneously without additional oxygen supplementation. A feeding tube secured nutrition of the child. With logopedic supervision 27 days after initial surgery, oral food intake was feasible. The child was referred to a neuropediatric rehabilitation center 39 days after initial surgery.

DISCUSSION

We report the use of the SCAIF in the management of acquired pediatric TEFs. The effectiveness of the SCAIF in adult patients with TEFs is well established. The flap has a high success rate, wide arc of rotation with minimal donor-site morbidity, and low rates of complications and re-stenosis.[5,6,8] So far, the SCAIF was used successfully in pediatric patients for postburn head and neck reconstruction and large congenital facial lesions.[9,10] Smaller defects, like congenital TEFs, can be addressed endoscopically by de-epithelialization with diathermy, mechanical and chemical abrasion, and submucosal sclerosant injections.[1] Some TEFs close spontaneously, but with a high risk of development of stenosis.[2]

Acquired TEFs due to button battery ingestion lead to fatal complications, like pneumomediastinum, esophageal stenosis with need for stenting and gastrostomy, respiratory insufficiency with need for ECMO treatment, mediastinitis, and recurrent tracheoesophageal fistulas.[2] Therefore, surgical intervention is needed, and closure of a large defect can only be achieved by a reliable and pliable flap. The pedicled SCAIF with its wide arc of rotation and robust vascularization offers these qualities.

The SCAIF can provide a good amount of tissue for reconstruction, but the size of the flap may sometimes be relatively larger compared with the recipient site. In our case, the excess bulk of the flap compromised the lumen of the trachea. Temporary tracheostomy resolved the patient's symptoms. Volume shrinkage of the flap will occur over time and with growth of the child. Other issues to address are the difference in tissue rigidity and differential growth rates between the flap and the surrounding tissues resulting in functional impairment.[7] Longitudinal follow-up is necessary to monitor the outcomes and address growth-related issues. To overcome these challenges, careful preoperative planning, including precise flap design and evaluation of recipient site requirements, is crucial. Surgeons should consider the long-term implications of flap placement in pediatric patients and involve a multidisciplinary team to ensure comprehensive care.

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DISCLOSURE

The authors have no financial interests or conflicts of interest to declare in relation to the content of this article.

REFERENCES

1. Sautin A, Marakhouski K, Pataleta A, et al. Treatment of isolated and recurrent tracheoesophageal fistula in children: a case series and literature review. *World J Pediatr Surg.* 2021;4:e000316.
2. Krom H, Visser M, Hulst JM, et al. Serious complications after button battery ingestion in children. *Eur J Pediatr.* 2018;177:1063–1070.
3. Pallua N, Wolter TP. Moving forwards: the anterior supraclavicular artery perforator (a-SAP) flap: a new pedicled or free perforator flap based on the anterior supraclavicular vessels. *J Plast Reconstr Aesthet Surg.* 2013;66:489–496.
4. Spiegel JL, Pilavakis Y, Canis M, et al. Shoulder morbidity in patients after head and neck reconstruction with the pedicled supraclavicular island flap. *Plast Reconstr Surg Glob Open.* 2018;6:e1711.
5. de Carvalho FM, Correia B, Silva A, et al. Versatility of the supraclavicular flap in head and neck reconstruction. *Eplasty.* 2020;20:e7.
6. Kokot N, Kim JH, West JD, et al. Supraclavicular artery island flap: critical appraisal and comparison to alternate reconstruction. *Laryngoscope.* 2022;132 (Suppl 3):1–14.
7. Granzow JW, Suliman AS, Roostaeian J, et al. The supraclavicular artery island flap (SCAIF) as an ideal option in head & neck reconstruction. *Plast Reconstr Surg.* 2012;130:9–10.
8. Li Y, Zhao Z, Wu D, et al. Clinical application of supraclavicular flap for head and neck reconstruction. *Eur Arch Otorhinolaryngol.* 2019;276:2319–2324.
9. Pallua N, Demir E. Postburn head and neck reconstruction in children with the fasciocutaneous supraclavicular artery island flap. *Ann Plast Surg.* 2008;60:276–282.
10. Kalmar CL, Jackson OA, Low DW. Anterior supraclavicular artery perforator flap for large pediatric congenital facial lesions. *Plast Reconstr Surg.* 2022;150:1363e–1364e.