CASE STUDY

Laryngotracheal Reconstruction With Cryopreserved Aortic Allograft as a Salvage Technique When Cricotracheal Resection Complications Occur in Paediatrics

Reconstrucción laringotraqueal con aloinjerto de aorta criopreservada como rescate de una complicación de resección cricotraqueal en pediatría

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Case Report

We report the case of a female patient who underwent tracheotomy and suffered severe laryngotracheal stenosis secondary to prolonged intubation. At the age of 4 years she was treated by extended cricotracheal resection (CTR) with a split of the cricoid cartilage, interposition of posterior cartilage of the thyroid ala and placement of a number 8 T-shaped tube. The resection involved the anterior side of the cricoid and the 3 affected tracheal rings, whilst the mucosa of the posterior tracheal wall was preserved (Fig. 1).

During the evolution, the patient presented abundant mucous secretions, nausea and vomiting. On the eighth day she suffered partial dehiscence of the suture and, due to an impossibility to carry out termino-terminal reanastomosis, even after performing thoracic and suprathyroid release manoeuvres, we carried out a laryngotracheal reconstruction (LTR) with a 10 cm long, cryopreserved aortic allograft, as a salvage technique (Fig. 2). The graft was covered with a thymopericardial flap and the nasotracheal tube was left in place. A tracheotomy cannula and suprastomal endoprosthesis were placed after 20 days.

A progressive transformation of the white internal surface of the graft into a pinkish, well-vascularised conduit was observed. No rejection phenomena took place despite the lack of immunosuppressor treatment.

At 21 months follow-up, the patient does not present any complications at the graft site. She still carries the tracheotomy cannula and is being monitored by the respiratory endoscopy service.

Discussion

The most common causes of laryngotracheal stenosis are postintubation lesions. A wide variety of surgical techniques have been developed to address these lesions, although the treatment must be tailored to each patient.

Successful restoration of the airway after extended CTR with division of the cricoid cartilage and insertion of a posterior cartilage flap has been documented previously in the literature. The procedure is always carried out in 2 stages. It requires the placement of an endoprosthesis to stabilise the cartilage graft and the posterior mucosal flap. The procedure is indicated in cases of Cotton grade III and IV subglottic stenosis, associated to abnormal glottis or supraglottis, ankylosis of the cricoarytenoid joint and LTR failure.

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The complications of this surgical technique include dehiscence at the site of anastomosis and lesion of the recurrent nerves. Dehiscence of the anastomosis occurs most frequently when there is tension at the site due to an excessively long resection, insufficient tracheal mobilisation or laryngeal release, or due to forced reintubation. In our case, we believe that the postoperative evolution with nausea, vomiting and abundant secretions was the triggering factor of the suture dehiscence.

The extension of the segment to be resected must be limited based on the location of the lesion and the elasticity of the trachea. In cases where the resection is greater than 1/3 of the length of the trachea in children, reconstruction with termino-terminol anastomosis without tension would not be possible.\textsuperscript{2,3}

The literature includes reports of the use of aortic grafts for tracheal replacement with promising results. Although the results are limited to a majority of experimental studies in animals,\textsuperscript{2,4,5} with very few reports in humans,\textsuperscript{3,6,7} the technique is presented as a new therapeutic option for patients undergoing extensive tracheal resection.

Several researchers have tried to find an ideal tracheal substitute using prostheses and biological materials. Unfortunately, no sufficiently consistent results have been obtained to standardise their clinical application, as they have been associated to multiple complications and technical difficulties.\textsuperscript{2,4,5}

Tissue engineering is presented as a therapeutic solution approaching the ideal. There are no consistent results,\textsuperscript{4} but some successful human cases have been published recently.\textsuperscript{7}

Although it may be the best option in patients with extensive tracheal lesions in whom airway reconstructions are planned and time is available, the use of aortic allografts is probably more easily accessible in emergency situations.\textsuperscript{7}

The advantages of aortic allografts include: a diameter similar to the trachea, resistance to infection, absence of antigenicity and need for revascularisation, and not presenting mucosal secretions or peristalsis.\textsuperscript{3} The main drawback is their tendency to collapse.\textsuperscript{3} Cryopreservation is a tissue preservation technique which maintains the integrity of tissues, decreases their antigenicity and offers the possibility of establishing a tissue bank. This facilitates clinical application by allowing adequate availability of grafts\textsuperscript{4} and avoiding the morbidity entailed by graft obtention.\textsuperscript{2,3}

The reports describe a progressive transformation of fresh, cryopreserved aortic grafts into a tissue resembling

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{figure1.png}
\caption{(A) Resection of affected cricoid arch and tracheal rings. (B) Thyrotracheal anastomosis.}
\end{figure}

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{figure2.png}
\caption{(A) Cryopreserved aortic homograft. (B) Suture of distal trachea to the homograft.}
\end{figure}
the tracheal, with mucociliary epithelium and cartilage neo-
formation, at about 6 months after implantation. This
induced biological regeneration had never been observed
with other biological substitutes. A significant contraction and calcification of the graft
have also been observed in several cases. So far, these
phenomena were not observed in our patient.

The graft must be surrounded by a well-vascularised flap
in order to prevent complications such as erosion of adja-
cent tissues and fistulas, as well as to promote angiogenesis
within the graft.

An endoprosthesis must be placed in the lumen of the
graft to prevent airway collapse and stenosis. Cartilage for-
mation would be necessary to prevent airway collapse at the
time of endoprosthesis removal.

We present the first case of LTR in Argentina with cryo-
preserved aortic allograft in a paediatric patient. This case
leads to significant hope in airway reconstruction following
extensive resection in emergency situations. Although the
graft became transformed into a well-vascularised conduit,
we do not know if cartilage rings will be formed in its in-
terior, as is the case in animal models, or when the patient
may be decannulated.

References