Case Report

Tracheal Stenosis Treated by Division of the Brachiocephalic Artery: Report of a Case

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Abstract
Tracheal stenosis of the brachiocephalic artery (BCA) is rare, and no definitive treatment protocol has yet been established. Brachiocephalic artery compression of the trachea is also relatively rare. This report presents a case of tracheal stenosis treated by division of the BCA. A 29-year-old woman was admitted because of stridor. Computed tomography (CT) revealed tracheal stenosis caused by compression of the BCA. Brachiocephalic artery suspension or aortopexy was not indicated because she had a thoracic deformity. Therefore, the BCA was divided. The operation was achieved without complications such as ischemia of the right arm or stroke. The stenosis of the trachea was improved. Division of the BCA can be an effective alternative procedure when the tracheal stenosis is caused by the BCA.

Key words Tracheal stenosis · Brachiocephalic artery · Division of brachiocephalic artery

Introduction
Tracheal stenosis may be attributed to several causes, such as a tracheotomy, endotracheal tube, trauma, infection, tumor, vascular diseases, or congenital problems. The brachiocephalic artery (BCA) is another cause. This report describes a case where dividing the BCA improved the compression that caused stenosis of the trachea.

Case Report
A 29-year-old woman was admitted because of stridor and dysphagia. She had been afflicted with cerebral palsy from infancy and had scoliosis. She was often admitted to the hospital for respiratory infections, and had previously undergone a tracheotomy. She was diagnosed with tracheal stenosis during the induction of anesthesia prior to an operation for esophageal reflux, and therefore the operation was stopped. Bronchoscopy revealed that her trachea deviated about 90° counterclockwise and was compressed from the ventral side (Fig. 1, left). Her trachea was compressed with each vascular pulsation. In preparation for the operation, her airway was kept open by a long endotracheal tube extending beyond the stenosis, as a temporary treatment.

Computed tomography (CT) revealed tracheal stenosis at the endotracheal tube's inferior pole, and her BCA was in front of the stenosis (Fig. 2). Her thorax was severely deformed. Magnetic resonance imaging (MRI) revealed that her left hemicerebrum was atrophied. Her blood flow in the contralateral hemisphere was evaluated with the Matas test, which showed a good bilateral flow.

A skin incision was made after the induction of general anesthesia. Her sternum's manubrium was incised in an L shape and her left first rib was also transected. The tracheal stenosis did not improve with the sternum's decompression. The patient received a right axillofemoral bypass, and the BCA was ligated and divided. The tracheal stenosis improved after the procedure (Fig. 1, right), and she did not need an endotracheal tube. She did not experience either stroke or ischemia in her right arm.

Discussion
Treatment of tracheal stenosis via the BCA is reported relatively rarely. There are two basic approaches to relieving tracheal stenosis: endotracheal stenting and surgical intervention.1 Surgical intervention includes...
aortopexy, aortotruncopexy, BCA suspension, reimplantation, and artificial tracheal implantation. Aortopexy or BCA suspension is the first choice in tracheal stenosis via the BCA, based on the number of reports. Recently, a new technique for tracheal compression including reinforcement and suspension has been reported.\(^2\) Although many articles have reported these treatments, the treatment strategy is not standardized because of the heterogeneity of these patients’ conditions.

The distance between the aorta and the sternum or between the trachea and the sternum is shorter than normal in patients with a severe thoracic deformity; therefore, suspending the BCA is not sufficient to relieve compression.\(^5\) Reimplantation is not standard and carries the risk of early bleeding and stroke, as well as the potential for late stenosis at the anastomotic site.\(^4\) Artificial tracheal implantation causes anastomotic stenosis, luminal stenosis, infection, dislocation, and migration.\(^7\) Endotracheal stenting carries a risk of developing an arteriotracheal fistula. Dividing the BCA for tracheomalacia also has been reported as a treatment option, but its long-term results have not been reported.\(^1\) The frequency of complications by division or acute occlusion of the BCA is also unclear; however, some authors have noted that division or acute occlusion of the BCA could cause stroke, transient ischemic attack, and arm claudication.\(^5,6\)

A long endotracheal tube improved the tracheal stenosis in the current patient, but there was a risk of developing an arteriotracheal fistula; therefore, she required some type of surgical procedure. Aortopexy and reimplantation were impossible because of her thoracic deformity. Grillo et al.\(^7\) reported using thoracoplasty to treat a thoracic deformity, for example, sternoplasty, sternal division, reimplantation of BCA, but these maneuvers were also unsuitable for the current patient for the same reason. Reports by Kim et al.\(^8\) and Grunenwald and Spaggiari\(^9\) indicated a suitable surgical approach, and a minimized sternotomy using three-dimensional (3D) CT was planned.\(^10\) The decompression of the sternum did not improve our patient’s tracheal stenosis during the operation, so her BCA was divided after constructing a right axillofemoral bypass. The patient’s cerebrum was right dominant because of her severe left cerebral atrophy, so we wanted to maintain a sufficient flow from her right subclavian artery, although contralateral flow was confirmed by a Matas.