Introduction

Tracheobronchomalacia (TBM) is characterized by excessive airway collapsibility due to weakness of airway walls and supporting cartilage. TBM is not an uncommon condition and has an incidence of 1 in 1500 to 1 in 2500 children (1). TBM is often self-limiting and most children will outgrow the condition by 2 years of age. However, in the more severe cases it may result in significant airway trapping that may lead to respiratory failure and even cardiopulmonary arrest (2). Dying spells, the most concerning of all symptoms, is an indication for continued hospitalization and definitive surgical intervention. The surgical correction range from polycaprolactone with the use of a three-dimensional printer was used (Fig 1).

Case Report

The patient is a 3 month old who presented to an outside hospital in respiratory distress and cyanosis and was found to have a compressed left main bronchus secondary to vascular compression. Whilst at the outside hospital the patient had a custom tracheostomy tube placed. Despite placement of a tracheostomy tube, mechanical ventilation, and sedation the child had recurring cardiopulmonary arrests. At that point he was transferred to our institute for definitive surgical management.

For surgical planning a high resolution CT scan and a cardiac MRI were done under general anesthesia to delineate the airway and aortopulmonary anatomy which revealed (fig 1).- Crosscriss orientation of the left and right pulmonary arteries, with a relative hypoplastic right pulmonary artery.
- Dynamic occlusion of the left main bronchus secondary to compression by right pulmonary artery and ascending aorta.
- Air trapping in the left lung during expiration. All of the usual anesthetic concerns for caring for a patient at an offsite location applied however they are confounded by the critical nature of his airway and the need for breath holds during the procedures. The institutional review board of the University of Michigan consulted with the Food and Drug Administration and approved the use of the device under the emergency-use exemption, and written informed consent was provided by the patient's parents.

A custom-designed custom-fabricated airway splint manufactured from polycaprolactone with the use of a three-dimensional printer was used (Fig 1).

A joint surgical planning meeting was held between cardiothoracic surgery and otolaryngology and a plan was made to augment the pulmonary artery and splint the left main bronchus on cardiopulmonary bypass in the following order.

1. Direct Laryngoscopy and bronchoscopy to assess the airway
2. Arterial/PC re-implantation and augmentation of the RPA
3. Placement of the left main bronchus splint bronchus.

Perioperative course

The anesthetic management was complicated by the TBM with dynamic collapse of the trachea as well as left main stem collapse despite positive pressure ventilation. The loss of PSF during bronchoscopy led to immediate airway collapse and inadequate ventilation. In order to prevent barotrauma during the surgery hypercarbia was tolerated as oxygenation was adequate. The main part of surgery was completed on cardiopulmonary bypass. (Fig 2).

There was marked improvement in the ventilator parameters as well as blood gases in the immediate postoperative period (Table 1). After surgical repair the patient was able to be weaned from the ventilator and discharged back to referral hospital with a tracheostomy in place breathing spontaneously via tracheostomy mask on post op day 18.

Table 1: Blood gases and ventilator requirements

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<td>Spontaneous/PC</td>
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Discussion

Pediatric TBM is not uncommon and at the more severe end of the spectrum it causes considerable morbidity and mortality and accounts for significant use of medical resources. Currently no treatment option is ideal and without morbidity however this novel approach using a patient specific customizable splint made with the use of a three-dimensional printer may form part of our future management tree. Knowledge of the anesthetic concerns and their management in these patients will be key to successful outcomes.

References