Editorial

New developments towards the management of severe cases of tracheobronchomalacia

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Tracheobronchomalacia is a severe anomaly that can lead to acute life-threatening events, due to collapse of the upper airways (1). The congenital form is the most frequent occurring, usually in conjunction with esophageal atresia (2), but sometimes acquired tracheobronchomalacia may occur as described by Huang *et al.* (3).

Tracheobronchomalacia knows a spectrum of symptomatology, varying from a typical cough due to the vibration of the tracheal wall, to complete collapse of the tracheobronchial airways (4). Depending on the extension of the anomaly artificial ventilation with high post-expiratory pressures (PEEP) may be necessary to keep the airways open. Many of these patients may need a tracheostomy (5) to maintain a sufficient open airway, but particularly if the malacia extends into the bronchi a simple tracheostomy may not suffice. There are a number of surgical options, of which the aortopexy is the most frequently used technique (2). The aortic arch and trachea are bound by connective tissue. By lifting the aortic arch against the backside of the sternum the anterior wall of the trachea is also lifted, preventing the insufficient tracheal rings from collapsing. This technique is nowadays also possible by thoracoscopy, reducing the trauma from major thoracotomies (6). Recurrence rate varies up to 35% (7).

If the major problem is not the insufficient tracheal rings but instead a floppy pars membranacea on the posterior side, (thoracoscopic) posterior tracheopexy against the prevertebral fascia is a good alternative (4). In normal children the pars membranacea forms 1/3 of the posterior wall of the trachea. In many neonates with esophageal atresia and tracheomalacia the pars membranacea extends over approximately half of the posterior wall and on expiration can easily close off the trachea, causing air entrapment and acute respiratory failure. Sometimes a combination of both is present, requiring both a posterior tracheopexy and an aortopexy (4).

However, mainly tracheal insufficiency can be dealt with in this way. If the anomaly extends further into the bronchi alternative measures will be necessary. There have been several attempts with intraluminal stents (8), but they have the tendency to dislodge or get obstructed, causing acute respiratory distress (9). There have also been attempts with external splinting (10). However as the child grows the splint will lose its function with recurrence of symptoms. Also at some time the splint needs to be removed again.

More recently with development of biodegradable scaffolds it is becoming possible to implant splints that will dissolve in time (11). In acquired tracheomalacia this may help to overcome the time necessary to have the defect be replaced by scar tissue (3). Based on CT-scan and or MRI a 3-D scaffold can be made to be placed externally onto the trachea keeping the trachea open and allowing for sufficient ventilation. In children this is not enough, because the child is growing. The group from Green in Michigan (7) developed a 4-D scaffold which can increase its diameter in time as the child grows, allowing for maintaining an adequate ventilation.

Although this may all seem very exciting there are some downsides as well. The indication for biodegradable scaffolds is very low, both in children and adults (7).

From an economic point this makes the production of biodegradable scaffolds less attractive. These 3-D or 4-D scaffolds will have to be "handmade" each time, which carry the risk of safety- and quality-issues. The United States Food and Drug Administration therefore is reluctant to allow the clinical use (7). To set up a clinical trial a minimum number of participants is necessary and that may be difficult to achieve. A non-interventional control group is not ethical due to the severity of the anomaly. It will need international collaborative studies to gain better insight in the ultimate outcome of this patient group.

Meanwhile other new exiting developments are progressing: nowadays biodegradable scaffold can be seeded with stem cells of different origin to allow tissue ingrowth (12). Multilayer scaffolds will allow better diffusion of nutrients and oxygen to allow the development of more complex structures or even organs in the near future (13,14). Custom designed integrated tissue and organ printing (ITOP) systems are being developed that can deposit 2–50 μm cell-laden hydrogels together with biodegradable polymers (12). With the use of CT or MRI data accurate tissue constructs can be made (13). Transferring these models into production of human tissue will be a next step to come.

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Footnote

Conflicts of Interest: The author has no conflicts of interest to declare.

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