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## Discussion

### Presenter: Dr Kyle W. Riggs



**Dr Charles B. Huddleston** (*St Louis, Mo*). Registry and database studies provide a powerful tool for clinical investigation just because of the sheer numbers that are available for analysis. In this case, there were approximately 200,000 patients total, of whom 7000 had airway anomalies identified. But

there are some inherent weaknesses to these sorts of studies. These include the accuracy of the data entry, the lack of consistency in a diagnosis or treatment, and the skills of each center in making these particular diagnoses and establishing these treatments.

On top of that, in studies like this where noncardiac diagnoses are kind of front and center, the STS database offers only a drop-down menu with limited options to choose in terms of the type of airway disease that the patients have. To that end, I'd like to focus on 2 of those diagnoses: tracheomalacia and unspecified airway disease, because these 2 diagnoses (or categories, if you will) comprise approximately 90% of the 7000 patients you study.

The diagnosis of tracheomalacia can range, at least in my experience, from the clinical impression of a neonatologist to a fairly well-documented diagnosis provided by an otolaryngologist using bronchoscopy. Do you know how often this diagnosis was actually confirmed with bronchoscopy in this group of 7000 patients?



**Dr Kyle W. Riggs** (*Manhasset, NY*). I think that's an important question because that makes up a great number of our patients, as you pointed out. Unfortunately, for the STS reports, which we all submit, it doesn't require that bronchoscopy was performed; it simply requires checking of the box of trachea or laryngeal or bronchomalacia. That's unfortunately as specific we can be and how the center's diagnosed it.

**Dr Huddleston.** But I thought that any procedure performed on a patient during their hospitalization such as bronchoscopy would be entered into the database; is that not correct?

**Dr Riggs.** I believe it is entered, but it may be on a different form and may be a different submission within that same hospitalization. We didn't look for all bronchoscopies performed in the same hospitalization; perhaps we could go back, and that could give us more insight as to if that was performed in all patients with malacia. However, it could have been performed in prior outpatient studies as well. So that definitely is a hang-up in our data analysis.

**Dr Huddleston.** Now, for this other category of "other airway anomalies," do you have any idea what is included in that? Tracheoesophageal fistula is one of those potentially—but what else?

**Dr Riggs.** Yes, I think that could be one of them. This is a newer diagnostic category for them, and it's at the surgeon's discretion. Unfortunately, there's nothing more specific. It could be someone with tracheomalacia, and they didn't specify what the airway disease was and just checked the box for "airway anomaly." So that is a big category, but it is up to the surgeon to determine if there was a significant airway anomaly.

**Dr Huddleston.** The tracheal interventions included repair of tracheal stenosis and repair of tracheal esophageal fistula, but yet there were other tracheal interventions—another "other" category. I don't suppose you have any idea what those other interventions were?

**Dr Riggs.** Again, similar to my prior responses and as you pointed out, the database doesn't specify further, so we're left to speculate but I do think a significant amount of them were tracheoesophageal fistula repairs, possibly some tracheopexy, but we can't comment further with the data that we have.

**Dr Huddleston.** I presume that this study included patients with the more common vascular rings such as double arch or right aortic arch, anomalous left subclavian artery, and so forth. Virtually all those patients have tracheomalacia. Were those patients included in your study? Do you have any idea how many of the 7000 came from that diagnosis?

**Dr Riggs.** They were included in our inclusion criteria. We didn't ask the Duke data center to specifically separate them out. But again, before presenting the manuscript perhaps that's something we could ask them—who had tracheal surgery for a ring and did they have associated malacia—and that might be an important cohort to capture.

**Dr Huddleston.** About 4 years ago, a publication appeared in the *Annals of Thoracic Surgery* regarding tracheostomies after congenital heart surgery. This was also an STS Database–driven study. The factors associated with the need for tracheostomy in that study (and again, a fairly robust study) included injuries to the recurrent laryngeal nerve, phrenic nerve injuries, neurologic deficit (presumably hypoxic ischemic encephalopathy), delayed sternal closure, major mechanical assistance, and on and on; interestingly, there was no mention of airway anomalies in that analysis. Do you have a comment about that?

**Dr Riggs.** That is a good point. I reviewed that article and even discussed it with our statisticians. They said that in that study (from ~6 years ago now), airway anomaly was not a category within the STS report form. So our study is somewhat of an update on that, I believe. Additionally, we found similar postoperative complications with increased incidence of phrenic nerve injury and everything you said, so I think it's just something that wasn't fully captured within their study, but was probably true back at that time.

**Dr Huddleston.** I found it interesting that you didn't include that in the references of your article.

**Dr Riggs.** I agree, we could have included it, but I think it was a bit different than what we started out looking for.

**Dr Huddleston.** My final comment and question is that many registry studies that look at these large groups of patients tend to confirm, in an objective way, what a lot of us have already been suspicious of from the more subjective sort of overview of something like this. I don't think anyone would be particularly surprised that patients with the concomitant airway problem would have worse outcomes with congenital heart surgery than those who did not. And this study I think confirms my and perhaps others' suspicions about that. Was there anything in this study that surprised you at all or was there something that you found that was unexpected?

**Dr Riggs.** It's a good point. I agree with what you're saying, that many of our findings may seem obvious. But there really wasn't a whole lot in the literature confirming them, which is why we investigated this in the STS database. I think part of the value is quantifying the risk; it's increased, but how much increased within different categories is what we elucidated. One of the strangest findings to us and the statisticians was the protective effect of malacia on the airway groups.

But further analysis, as I pointed out, shows that's probably a confounding finding, and I wouldn't necessarily say that those patients have a protective effect. But overall, I think our findings were intuitive, and we were happy to confirm what we were seeing clinically.

**Dr Huddleston.** Great. Very nice job.