

subxiphoid group for up to 30 days.^{2,3,9,10} Due to the retrospective nature of the study, we were unable to collect subjective pain scores or perform a more in-depth analysis of pain medication requirements postdischarge.

We found no significant clinical difference between our groups, except for age and duration of chest tubes (1 vs 2.5 days; $P = .02$). We believe the shorter chest tube duration in our ST group is more likely a reflection of our evolving practices than a real clinical difference. In recent years, we have moved toward a more deliberate removal of chest tubes on postoperative day 1 for most of our thoracic operations.

We acknowledge the limitations of our study. Our sample size limits the potential for definitive conclusions. Our TT group is much smaller and over a longer period of time compared with the ST group and this makes the comparison more challenging. The difference in group size and age could be explained by a change in referral patterns after the 2016 publication of the randomized clinical trial showing that thymectomy improved clinical outcomes in patients with nonthymomatous myasthenia gravis.²¹ The TT group is a historical control group in this study. Our evolving practices have affected our length of stay, chest tube duration, and other postoperative parameters and this could have influenced our comparative data to a certain extent. We also believe that our experience reflects our learning curve, which likely explains our operative times and our conversion rates to sternotomy. Specifically, we had 4 surgeons at different points in the learning curve through the study period and do not have surgeon-specific data.

CONCLUSIONS

Our experience with ST suggests that it is a safe and feasible alternative to TT. We find this approach to be advantageous to visualize the entire course of both phrenic nerves and for optimal exposure in patients with obesity.

Conflict of Interest Statement

The authors reported no conflicts of interest.

The *Journal* policy requires editors and reviewers to disclose conflicts of interest and to decline handling or reviewing manuscripts for which they may have a conflict of interest. The editors and reviewers of this article have no conflicts of interest.

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Discussion

Presenter: Madhuri Rao

Unidentified Speaker 1. The discussion will be opened by Dr Joshua Sonett from Columbia University Medical Center.



Dr Joshua Sonett (*New York, NY*). I thank the American Association for Thoracic Surgery for the privilege of discussing this paper. Thank you for an excellent presentation and corresponding so effectively before with videos. There is no 1 best approach to thymectomy, but the tool or technique of any use to produce reliable, safe results must strive to preserve the actual surgical intent of that operation, and your group designed a technique toward that end. Complete extended thymectomy, visualizing the entirety of both phrenic nerves and enabling complete dissection of tissue in the neck as well as both pericardial fat pads bilaterally. So, I congratulate you on being thorough. In particular, this could be a very useful approach for all surgeons to considering borrowing aspects of this approach, in morbidly obese populations that can be a particular challenge in thymic surgery. I appreciate your efforts to objectively compare this to your historical controls, but as you already noted, it is a questionable endeavor to really objectively compare this with stats from 2 disparate populations over a long period of time, and I'd be dubious about using those results.

Four questions. One you've already answered. So really 3 questions. You state that subxiphoid is safe or noninferior. However, you had 3 conversions to sternotomy and 3 significant bleeding events: 1 returned to the operating room for hemothorax in the subxiphoid, and none in the transthoracic. So, do you consider that really noninferior?



Dr Madhuri Rao (*Minneapolis, Minn*). Thank you for the question and the comments. So, I think in terms of the conversions—so 2 of them were for bleeding. The other 1 was a very difficult lymph node dissection, which even after conversion to sternotomy, we were not able to get that granulomatous node off of the pulmonary artery and the phrenic, and so we actually did biopsies and sent it off. And once we knew it was granulomatous we did not actually complete the full nodal dissection. So, it's, of course, surgeon's decision at the point but it's debatable whether a lateral thoracoscopic thymectomy would have offered any better on that. With regard to the bleeding, again, a comparison itself in our group is not—given the population, is not accurate. However, we are pretty early in our learning curve, and there have been studies that show that the learning curve is probably at about 30 to 40 for these subxiphoid thymectomies. And the transthoracic thymectomy conversion rate has been quoted at 8% to 13%. So, taking those into consideration, yes, there is room for improvement. I think it's something that we can work on.

Dr Sonett. And my second question addressed to your adding significance to chest tube duration difference between the 2 subgroups, but I think you answered, basically, that was your practice parameter. We remove our chest tubes in 12 to 24 hours along with discharge, and our length of stay is <1 day for our last 40 patients altogether. So attributing chest tube duration to type of minimally invasive approach is fraught with issues.

Three, a significant number of patients in your group had respiratory complications. In the Randomized Trial of Thymectomy in Myasthenia Gravis (MGTX) trial, which you quoted, there were no exacerbations of myasthenia gravis (MG) in the entire prospective study, if the patient was well taken care of preoperatively. So, 2 questions to this. What is your preoperative stabilization of the patients? Do you ever take patients that are completely are not in remission before doing thymectomy for MG? And, could all those ports across all those diaphragmatic excursions, 5 transgressions, maybe hurt the diaphragm to some extent, at least temporarily?

Dr Rao. Thank you. So, the first question, we do we have 2 dedicated neurologists that work up the patients with MG pretty thoroughly. They need plasmapheresis and medication management. So, we do have a rigorous protocol. Of the 3 respiratory issues, only 1 of them was a patient with MG, actually. And he's also the 1 who had 1 of the bleeding issues. So, it could have been—and I think he was the 1 who also had plasmapheresis and was difficult to manage preoperatively. The other 2 were actually—1 was an obese patient who was hypoventilating after surgery, and 1 was an over-sedation patient who needed bilevel positive airway pressure for a little while. So, there was actually 1 patient with MG who had the respiratory complication. As to the question of the diaphragm, we actually skive above the diaphragm for the lateral ports. The 2 subxiphoid ports that are lateral, we again [inaudible] above the insertion of the diaphragm. So, we do not think that this is the cause for it, but we could look into it further.

Dr Sonett. So, my last question. I really appreciate the subxiphoid approach, and I'm sort of intrigued by the bilateral visualization and am starting to use it some at Columbia. But in Europe and in Asia, where they pioneered this, a true subxiphoid approach is 1 port all subdiaphragmatic/subxyphoid. Do you see yourself going in that direction?

Dr Rao. We would be willing to investigate it as we move along, but I think 1 of the greatest advantages of our port placement is that we can camera hop. we're getting really good views of the phrenic from both of those very lateral ports. So, we don't have any plans to change imminently, but it's something that we could work toward.

Dr Sonett. Yeah, I mean, you should just think of the beautiful views of the phrenic bilaterally.

Unidentified Speaker 2. Dr Sonett, your favorite approach is transthoracic now?

Dr Sonett. Well, I use a combination of 1 5-mm ports in the left chest and a subxiphoid now. Because I've become more familiar with using that subxiphoid to see the right phrenic, and then remove the specimen from the subxiphoid incision. I'm intrigued about transitioning all the way to the subxiphoid but have not made that full transition, in particular at this point I appreciate the left-sided ports enable safe and complete dissection in the neck, and the tissue lateral to the left phrenic nerve.

Unidentified Speaker 2. Okay.

Dr René Peterson (*Copenhagen, Denmark*). Thank you very much. René Peterson, Copenhagen. I enjoyed your presentation.

Dr Rao. Thank you.

Dr Peterson. I use the subxiphoid approach as well, especially for large tumors. I find it very beneficial. You

can bring out quite large tumors from the subxiphoid incision. However, there are some concerns using the subxiphoid incisions, especially in the [inaudible] patients, like you've done in this series, and this is the risk of herniation. The upper midline is known to have a high risk of herniation in abdominal surgery. So, I would just like to hear what were—did you see any herniation in this series, and what are your concerns and thoughts to avoid it? Thank you very much.

Dr Rao. Thank you for your question. We did actually look at that. I didn't put too much into this presentation, but we have it on our manuscript. Our medium follow-up was 17 months, and we did not see any herniations. We try as much to follow our patients. We have had a white referral base, but we try as much to call our patients. And when we do get the scans, we're looking at that, and we haven't seen any.