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# Commentary: Avoiding the danger zone

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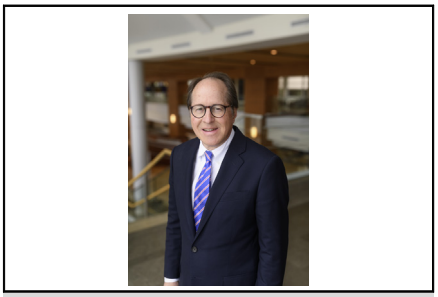

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**CENTRAL MESSAGE**

Careful placement of chest tubes avoiding the apex of the right pleural space will decrease the incidence of postoperative diaphragm paralysis after congenital heart surgery.

Injury to the phrenic nerve causing diaphragm paralysis substantially increases the morbidity and mortality of infants and children undergoing congenital cardiac surgical procedures. The Richard E. Clark Memorial Paper presented at the Society of Thoracic Surgeons meeting in 2020 was quite revealing.[1] In a study of more than 43,000 procedures, diaphragm paralysis occurred in 2.2% of all neonatal procedures. Of those patients, 50% underwent diaphragm plication; the mortality rate doubled and major morbidity tripled.

Any contribution that can lead to a decrease in the number of children having diaphragm paralysis is noteworthy. The current review by Ghani and colleagues[2] clearly shows an association of chest tube position with phrenic nerve injury. Placement of a Blake drain (ie, chest tube) in the right superior pleural space with the chest tube then wedged against the pericardium led to a 4-fold increase in the odds of right diaphragm paralysis. Their simple change in clinical practice to avoid placing the drainage tube in the so-called danger zone of the right superior pleural space (ie, apex right lung) eliminated diaphragm paralysis as a complication for a 12-month period.

The cause of the phrenic nerve injury from this chest tube position is presumably related to pressure on the nerve and the suction of the tube abutting against the phrenic nerve. Simply placing the drainage tube in a location away from the apex of the right superior pleural space led to a dramatic decrease in the incidence of postoperative diaphragm paralysis.

Although it cannot be definitively proven to be causative, these single-surgeon data show a clear association between this particular chest tube placement site and phrenic nerve injury. To my knowledge, this is a novel cause of phrenic nerve injury that has not been previously described. I complement the authors on their transparency and their willingness to change what had been for them a standard postoperative drainage strategy. It is always difficult for surgeons to change practices they had previously associated with good outcomes. Incidentally, their article also confirms the high morbidity rate associated with diaphragm paralysis. In the group with right diaphragm paralysis, the length of stay was 53 days and length of intubation was 20.5 days versus length of stay 17 days and length of intubation 3 days in the group with non-right diaphragm paralysis. These are dramatic differences and confirm the data in the Richard E. Clark Memorial presentation.[1]

There are probably as many strategies for draining the pleural and pericardial spaces following cardiac surgery as there are cardiac surgeons. All surgeons have their own favored techniques. However, this review shows that all of us should avoid placing chest tubes in the danger zone, the apex of the right pleural space.

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Disclosures: Dr Backer is a consultant to W.L. Gore & Associates.

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.

Received for publication June 2, 2020; revisions received June 2, 2020; accepted for publication June 2, 2020; available ahead of print June 26, 2020.

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J Thorac Cardiovasc Surg 2021;161:1625

0022-5223/$36.00



https://doi.org/10.1016/j.jtcvs.2020.06.048

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