Diaphragmatic Hernia After Esophagectomy in 440 Patients With Long-Term Follow-Up

Dhakshina Moorthy Ganeshan, MD, Arlene M. Correa, PhD, Priya Bhosale, MD, Ara A. Vaporciyan, MD, David Rice, MD, Reza J. Mehran, MD, Garrett L. Walsh, MD, Revathy Iyer, MD, Jack A. Roth, MD, Steven G. Swisher, MD, and Wayne L. Hofstetter, MD

Department of Radiology and Thoracic and Cardiovascular Surgery, University of Texas, MD Anderson Cancer Center, Houston, Texas

Background. Postesophagectomy diaphragmatic hernia (PDH) is a recognized but severely under-reported and potentially hazardous event. Information regarding the natural course of this condition and guidelines regarding indications for reoperative intervention are lacking. In this study we aim to describe the frequency, predictors of incidence, and indications for repair.

Methods. Cross-sectional imaging (computed tomography scan) from patients who underwent esophagectomy between January 2001 and December 2007 at a single center were reviewed by two radiologists blinded to previous reports and clinical outcomes. Patients with PDH were compared with a similar cohort who did not have hernia. Patient characteristics, outcomes, and hernia descriptors including longitudinal progression were recorded. Multivariable logistic regression analyses identified predictors of PDH and need for repair.

Results. Of a total of 440 patients who underwent esophagectomy, 67 (15%) were radiologically diagnosed with PDH. Of these, only 7 of 67 cases (10%) were prospectively reported by the radiologist. Median time interval from esophagectomy to hernia was 2 years. Type of esophagectomy was an independent predictor for hernia developing \((p = 0.027)\). Patients with high body mass index were less prone to have PDH \((p = 0.043)\). Thus far, 9 patients (2%) have required surgical intervention, all for hernia-related symptoms or progression. Despite mesh repair, 4 of 9 have recurred and 2 were re-repaired. There was 1 PDH-associated death, 8 years after transthiatal resection.

Conclusions. Variables contributing to PDH are both technical and patient dependent. Whereas the majority of patients with PDH have not required repair, a small portion who became symptomatic or had large, progressive hernia required remedial surgery. Post-esophagectomy patients require long-term surveillance for PDH.

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Address correspondence to Dr Hofstetter, University of Texas, MD Anderson Cancer Center, Unit 1489, 1400 Hermann Pressler Dr, Houston, TX 77030; e-mail: whofstetter@mdanderson.org.

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performed in our institution. To allow for modern techniques and adequate follow-up, the study cohort was limited to the period between January 2001 and December 2007. Only patients whose disease required subtotal or total esophagectomy were included. Furthermore, patients must have had clinical follow-up that incorporated radiologic imaging (CT) for at least 1 year after surgery to be included in the study. From this search, we identified 440 eligible patients. Subsequently, the CT imaging of all these patients were reviewed by two radiologists blinded to previous patient information and clinical outcomes. A third radiologist mediated any discordance or discrepancy in radiologic findings. The readers were asked to record the presence or absence of diaphragmatic hernia, and if present, to describe the location and contents of the hernia. For the purpose of this study PDH was defined as an anatomic defect, usually in the esophageal hiatus, that allows contents other than the surgically transposed interposition graft to herniate above the diaphragm (Figs 1, 2), but excluded omental fat that was transposed into the chest as part of the planned operation. In addition, the size of the PDH was graded on a scale from 1 to 3, which was accomplished by subjective visual assessment, with grade 1, 2, and 3 referring to small, moderate, and large hernias, respectively (Fig 3).

The following clinical information was collected for each patient: age, sex, and body mass index (BMI) of the patient; the histopathology and location of the esophageal tumor; type of surgery performed; presence or absence of a PDH; time between esophagectomy and diagnosis of hernia; symptoms (if any) in patients who had hernia; and presence of any interval hernia progression. We also recorded the date of any remedial surgical interventions performed to correct a PDH.

Type of Surgery
Four different techniques of resection were utilized over the study period: Ivor-Lewis (through right thoracotomy); transhiatal esophagectomy; McKeown; and minimally invasive esophagectomy. According to the technique of resection, the crura were managed differently. The diaphragm opening was minimally enlarged during the Ivor-Lewis technique, and the conduit was not apposed to the crus after transposition. Transhiatal resections required a larger opening in the crus to allow for transmediastinal manipulation of the esophagus, but the conduit was typically tacked to the crus at the conclusion of the interposition. Similarly, a McKeown technique allowed for a crural to conduit apposition at several points, but did not necessarily require the larger opening compared with that in a transhiatal esophagectomy. Finally, minimally invasive esophagectomy resections did not have the interposition graft tacked to the crus as these were most often performed using the transthoracic approach.

This study was compliant with the Health Insurance Portability and Accountability Act and was approved by our Institutional Review Board. The need for informed consent was waived.

Statistical Analysis
Patients with PDH were compared with other patients within the study cohort who did not manifest hernia. Patient characteristics, outcomes, and hernia descriptors including longitudinal progression were recorded. Univariable logistic regression analysis was performed. Variables with \( p < 0.25 \) on univariable analysis were further analyzed in a multivariable logistic regression model. Specific endpoints were incidence of PDH and repair. Statistical significance was defined as \( p < 0.05 \). The statistical software used was SPSS version 19 (SPSS, Chicago, IL).
Results

A total of 554 patients underwent esophagectomy at our institution during the identified period between January 2001 and December 2007. Patients who died within the first year of follow-up (n = 95) or who did not have cross-sectional imaging available for review (n = 19) were excluded. Therefore, for the purposes of our study we analyzed 440 patients who had undergone esophagectomy during our study period and had clinical follow-up that included cross-sectional imaging for at least 1 year after surgery. The vast majority of patients had adenocarcinoma as the indication for resection, although some had other histopathology such as Barrett’s with high-grade dysplasia or gastrointestinal stromal tumor (demographics are shown in Table 1). The median follow-up for the entire group was 52 months. The median time between the esophagectomy and diagnosis of diaphragmatic hernias was 2 years (range, 47 days to 9.35 years). Of the 440 patients, 15% (67 of 440) had PDH within the follow-up period. None of the patients in this series had a large preexisting hiatal hernia before esophagectomy. As is consistent with the epidemiology of esophageal adenocarcinoma, our patient population consisted mostly of male patients, but a disproportionate majority of the male as compared with female patient cohorts (17% versus 5%) were diagnosed with PDH. When analyzed by type of surgery, the incidence of diaphragmatic hernia was 12% (32 of 267) after Ivor-Lewis, 24% (25 of 103) after transhiatal esophagectomy, 17% (7 of 40) after three-field (McKeown) esophagectomy, and 10% (3 of 30) after minimally invasive esophagectomy (p = 0.027; Table 1).

A postesophagectomy hernia was seen in the left hemithorax in 44 patients (65.7%), right hemithorax in 3 patients (4%), midline in 19 patients (28.4%), and bilateral in 1 patient (1.5%). The contents and grading of the hernia size are described in Tables 2 and 3.

Primary Endpoint, Occurrence of PDH

To explore variables that may be correlated to the endpoint of any PDH we performed a univariable and multivariable analysis (Table 4). Type of esophagectomy was an independent predictor for developing a hernia primarily because transhiatal esophagectomy (hazard ratio 2.35, confidence interval: 1.31 to 4.30) was associated with significantly higher incidence of PDH compared with the other types of esophagectomy. Patients with BMI that was above normal (BMI > 25 kg/m²) were found to be less prone to have PDH develop compared with patients whose BMI was 25 kg/m² or less (hazard ratio 0.56, confidence interval: 0.31 to 0.98). Patient sex was similarly a predictor, with females showing a far lower incidence of PDH, but the overall female sample size is small, making interpretation of this result potentially problematic.

Because the significance of a PDH containing only abdominal fat is unknown, we explored a subgroup of patients with any visceral PDH. When we excluded the hernias that contained only abdominal fat, we found 44 of 440 patients (10%) with PDH. These visceral hernias were seen in 6.7% (18 of 267) after Ivor-Lewis, 20% (21 of 105) after transhiatal esophagectomy, 7.9% (3 of 38) after three-field esophagectomy, and 6.6% (2 of 30) after minimally

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Table 1. Demographics of Postesophagectomy Diaphragmatic Hernia Patients

<table>
<thead>
<tr>
<th>Demographics</th>
<th>Total Sample</th>
<th>PDH</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population</td>
<td>440</td>
<td>67 (15%)</td>
<td></td>
</tr>
<tr>
<td>Median age (range)*</td>
<td>61 (23–83)</td>
<td>56 (23–79)</td>
<td>0.03</td>
</tr>
<tr>
<td>Sex: male/female</td>
<td>377/63</td>
<td>64/3</td>
<td>0.02</td>
</tr>
<tr>
<td>Body mass index</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≤25 kg/m² (reference)</td>
<td>137</td>
<td>27 (20%)</td>
<td></td>
</tr>
<tr>
<td>&gt;25 kg/m²</td>
<td>303</td>
<td>40 (13%)</td>
<td>0.08</td>
</tr>
<tr>
<td>Histology</td>
<td></td>
<td></td>
<td>0.971</td>
</tr>
<tr>
<td>Adenocarcinoma (reference)</td>
<td>383</td>
<td>58</td>
<td></td>
</tr>
<tr>
<td>Squamous cell carcinoma</td>
<td>31</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Other neoplasm</td>
<td>26</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Type of esophagectomy</td>
<td></td>
<td></td>
<td>0.027</td>
</tr>
<tr>
<td>Ivor-Lewis (reference)</td>
<td>267</td>
<td>32 (12%)</td>
<td></td>
</tr>
<tr>
<td>Transhiatal</td>
<td>103</td>
<td>25 (24%)</td>
<td>0.004</td>
</tr>
<tr>
<td>McKeown (three-field)</td>
<td>40</td>
<td>7 (17%)</td>
<td>0.33</td>
</tr>
<tr>
<td>Minimally invasive</td>
<td>30</td>
<td>3 (10%)</td>
<td>0.75</td>
</tr>
</tbody>
</table>

* Age at time of initial surgery.

PDH = postesophagectomy diaphragmatic hernia.
invasive esophagectomy. Univariable and multivariable analysis on PDH with visceral organs alone shows similar results to the combined cohort containing abdominal fat hernias (Table 5). Although none of the fat-only hernias in our study have developed complications or required repair, those patients who are alive remain under observation for progression.

Secondary Endpoint, Incidence of Repair

In our series of 67 patients with diaphragmatic hernia, 8 patients were ultimately symptomatic (12%). Of these 8 symptomatic patients, 5 had obstructive bowel symptoms requiring urgent repair. Another 3 patients had abdominal pain without evidence of bowel obstruction, but only 2 underwent semielective repair because the third patient had tumor recurrence and died of non-hernia-related symptoms. All the remaining PDH patients were asymptomatic but 2 required prophylactic, elective repair. Another 3 patients subsequently became symptomatic and their hernias increased in size and were operated on. The remaining 3 patients remained asymptomatic and stable in size and were conservatively managed by watchful waiting. All of the hernias that required repair were graded as large before surgery.

The approach to hernia repair was by open laparotomy in 8 patients, and 1 patient underwent a laparoscopic procedure. We observed a recurrence of PDH in 4 patients (44%) after repair, perhaps highlighting the difficulty in obtaining a definitive repair after this event occurs. For these 4 patients, the time between initial repair of PDH and observation of hernia recurrence was 3, 4, 12, and 15 months, respectively. Two of these 4 patients underwent a second surgical repair. In our series there was 1 PDH-associated death, 8 years after transhiatal resection. When we analyzed factors that were potentially associated with the incidence of surgical

Eleven of the hernias were categorized as large (grade 3 hernias). Three of these patients presented with acute symptoms during initial presentation requiring immediate surgery. The remaining 8 patients were initially asymptomatic. Of these 8, 2 underwent surgery as a prophylactic measure as the hernias were very large and were considered to be at high risk for developing complications; another 3 patients subsequently became symptomatic and their hernias increased in size and were operated on. The remaining 3 patients remained asymptomatic and stable in size and were conservatively managed by watchful waiting. All of the hernias that required repair were graded as large before surgery.

<table>
<thead>
<tr>
<th>Hernia Contents</th>
<th>Progression</th>
<th>Number Repaired</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fat only</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Pancreas (pancreas only, 4; fat and pancreas, 7)</td>
<td>7</td>
<td>0</td>
</tr>
<tr>
<td>Colon</td>
<td>11</td>
<td>4</td>
</tr>
<tr>
<td>Small bowel plus colon</td>
<td>2*</td>
<td>1</td>
</tr>
</tbody>
</table>

* One hernia significantly increased in size, necessitating surgery because of symptoms; the other patient had abdominal pain without obstruction but could not undergo repair owing to tumor recurrence and the patient died soon after.
repair of the PDH (sex, age, histology, type of resection, side of hernia, size of hernia, BMI, time to onset of hernia, symptoms from hernia), the presence of symptoms was the only variable associated with incidence of repair in our patient cohort.

Comment

Our data indicate that PDH is a far more common event than has been previously reported. Until this study it was considered a rare complication, with the reported incidence ranging from 0.4% to 13% [2–7]. Diaphragmatic hernia after esophagectomy was first reported in 1987 by Terz and colleagues [1]. Price and associates [7] reported an incidence of only 0.7% in a large review of 2,182 patients who underwent esophagectomies; and Van Sandick and colleagues [3] quoted a 4% incidence in their series of 219 patients. We are reporting a much higher incidence of 15%, which could be due to our having included both symptomatic patients (n = 8) and asymptomatic patients (n = 59) in our study. Our methods included a blinded review of retrospective sectional imaging (computed tomography) from all patients who underwent resection over the study period, allowing us to capture the asymptomatic patients and follow the events over time. This has not been previously described in a large patient cohort. We are also reporting a number of hernias that contained only abdominal fat (23 of 67), the significance of which is still unclear.

According to our results, the technique of resection affects the incidence of PDH. Transhiatal esophagectomy was associated with the highest incidence of PDH compared with the other types of esophagectomy. The reasons for this are likely multifactorial. However, one known predisposing factor for PDH is the enlargement of the hiatus during esophagectomy [3]. It is reasonable to postulate that more hiatal enlargement is acquired during the transhiatal procedure to allow for the surgeon’s hand in the mediastinum, thus resulting in an alteration of anatomy and higher potential for PDH. Knowledge of this probability could guide the surgeon in making necessary adjustments to prevent this event. Recent studies have also indicated that minimally invasive techniques were associated with a higher incidence of PDH compared with open techniques [4, 5]. It was suggested that the paucity of adhesions after minimally invasive esophagectomies could increase the risk of diaphragmatic hernia developing compared with the open approaches [4–7]. We did not observe an increase in the rate of PDH in our minimally invasive esophagectomy group. Perhaps larger multiinstitutional collaborative studies could validate these findings. Our suspicion is that the extent of hiatal enlargement once again plays a major role in the incidence of PDH.

Of interest was that our data indicated that patients with above normal BMI (>25 kg/m²) may be less prone to have PDH. Although the exact reasons for this are not clear, it is possible that increased intraabdominal contents in these patients may either obscure the hiatus, helping to prevent herniation, or that there is less mobility of abdominal contents, which could prevent PDH.

Postesophagectomy diaphragmatic hernia occurred most frequently into the left thorax, which is similar to results reported by other researchers. It is likely that the liver on the right side of the abdomen, and the adhesions from the conduit to the liver after gastric pull-up may be a predisposing factor for this left-sided predominance [3–6]. The gastric conduit is generally positioned in the right side of the chest, which may also confer somewhat of a space-occupying effect and prevent herniation into the right hemithorax.

Postesophagectomy diaphragmatic hernia can occur in the early postoperative period or may present many years later, with cases reported as late as 7 years after esophagectomy [3, 8]. The clinical manifestations of diaphragmatic hernia are protean, which makes it very difficult to diagnose it purely on clinical grounds. Imaging plays an important role in diagnosing PDH. However, our study shows that this condition is severely underreported by radiologists (only 7 of 67 PDH identified in our series were prospectively reported by the radiologists in the first CT study that they were present). There may be multiple reasons for this. First, radiologists are predominantly looking for recurrent tumor in these patients who are undergoing annual staging surveillance scans and may not be paying particular attention to PDH. Second, even if identified, they may have questioned the significance of small hernias in this setting, particularly when they are asymptomatic. However, our study shows that some patients who initially had asymptomatic hernias progressively increased the size of their hernias, and had hernia-related symptoms necessitating surgery. Hence, it is essential that all PDHs, whether symptomatic or not, should be reported by radiologists, and these may require long term-longitudinal follow-up or intervention.

The decision to repair a PDH is of interest. Needless to say, patients presenting with complications such as obstruction or strangulation need immediate surgical repair. In our experience, a patient with symptoms attributable to PDH (ie, abdominal pain, shortness of breath, obstipation, or early satiety) who is of reasonable performance and prognosis should be repaired. Large, progressively enlarging hernias were repaired with the thought of preventing major morbidity from the PDH itself. It was also the large hernias that tended to be symptomatic more often than the grade 1 or 2 PDH patients. Hernias presenting in the near perioperative period should be considered for repair. The asymptomatic patients with small to medium, stable hernias present more of a therapeutic dilemma. Given the potential for morbidity associated with corrective surgery, careful thought needs to be given when deciding which patients require surgical intervention [9]. Adding support to this argument is that there is relatively high rate of recurrence of hernia (30% quoted by Vallbohmer and coworkers [6] and 44% in our study) after surgical repair. However, this finding has to be balanced against the significant mortality rate (20% to 80%) associated with patients who present with a complicated diaphragmatic hernia [10, 11].

It can be technically challenging to perform corrective surgery in patients presenting with diaphragmatic hernia.
after esophagectomy. Primary repair by reapproximating the diaphragmatic crura and reapproximating the conduit to the diaphragm may be performed if there is enough laxity to perform a tension-free repair. Conversely, the defect may require repair using mesh prostheses. However, rather than placing the mesh in the acquired hiatus defect, we suggest a relaxing incision in the left diaphragm, so that native tissue can be approximated to the conduit instead of suturing mesh directly to a hollow organ. Once the diaphragm is moved over to approximate the conduit and close the hiatus defect, mesh can be placed in the diaphragm to repair the defect created by the relaxing incision more laterally in the diaphragm. It is important to emphasize that the vascular supply to the conduit should not be compromised in any way during the surgical repair.

As suggested by other investigators, postesophagectomy diaphragmatic hernia is a potentially preventable event. That surgical alteration of the anatomy leads to the event would suggest that measures could be undertaken to avoid PDH. Minimizing the hiatal enlargement or repairing the “too large” hiatus are potential avenues of prevention.

Both transhiatal and McKeown procedures lend themselves to fixation of the conduit to the diaphragmatic hiatus, potentially limiting access to the chest cavity [4–6]. We routinely suture the gastric conduit to the diaphragmatic crus muscles to try to prophylactically prevent this complication in the three-field esophagectomy and transhiatal esophagectomy, but not for Ivor-Lewis esophagectomy. We also believe that adequately mobilizing the gastrocolic ligament serves to keep the colon away from the hiatus.

There are limitations to our study. It represents the retrospective experience of a single institution with several different surgeons and surgical techniques. All of the cases were for oncologic indications. Technical processes and clustering effects could have biased our results. Also, despite efforts to standardize a method, our hernia grading system was ultimately performed on a subjective visual assessment, making comparisons a bit challenging. The number of hernias and potential for hernia is likely also underestimated by our patient population. Part of our inclusion criteria necessitated long-term follow-up with imaging to observe longitudinal outcomes. That would eliminate a group of patients who did not survive the first year after surgery because of either complication or disease progression. Nonetheless, this is an important study in that it is the largest study where there is imaging confirmation (CT scan) of the presence or absence of PDH and natural progression of this event.

In conclusion, the overall incidence of PDH is much higher than has been previously appreciated. Variables contributing to PDH are both technical and patient dependent. The clinical manifestations of diaphragmatic hernia are nonspecific and difficult to differentiate from those of other common functional conduit disorders seen after esophagectomy. It is important to have a high index of suspicion for this condition as a delayed or missed diagnosis may present with serious complications. Sectional imaging is likely the best method of screening and surveillance. Whereas the majority of patients with PDH may remain asymptomatic, a small but significant portion may become symptomatic or progressively increase in size, requiring remedial surgery. Postesophagectomy patients require long-term surveillance for PDH.

References
DR ALLAN PICKENS (Atlanta, GA): Can you comment briefly on your approach to the repair, transthoracic versus transabdominal repair. Also, did you use mesh on any of the repairs?

DR HOFSTETTER: Thanks for the question. Most of the ones that were repaired were approached transabdominally and open. There was one laparoscopic abdominal repair. There are a couple of different ways that I would suggest and other ways that have been published. If there is enough laxity in the diaphragm to bring it back together, either at the crus or above or both, I think that’s a viable alternative. I have repaired three of these and have not had a recurrence to date, knock on wood, but that’s because I’m using a relaxing incision in the diaphragm.

I feel that if you are going to use mesh and if you put mesh next to a hollow organ, you are setting yourself up for either a recurrence or a problem later on with the mesh, and I don’t like having Gore-Tex or anything like it next to that stomach or whatever it is that we have used to reconstruct the forset. So I make a relaxing incision in the left diaphragm. I move the left diaphragm and the crus over to the interponate, so that I have natural tissue opposed to natural tissue. And then in the defect created in the diaphragm is repaired with a piece of mesh, and I think that is a tension-free repair. I’m also interested in hearing what has been successful for the group here today.

DR MARK ONAITIS (Durham, NC): What have you done by the aorta? Down inferiorly we have seen three that go right along the aorta, and when you go back to fix it, there’s nothing to sew to down there.

DR HOFSTETTER: So here’s an interesting thing is what do you do about the patient who comes in, already with a large hiatal hernia, and the tissues that are surrounding the hiatus are attenuated. The tissues are not looking very good and you can’t really get any stitches to hold. So initially I would try to get a couple of stitches in as if you were doing a Nissen fundoplication and get some stitches in the crus. I have had that situation where I have had to repair things posteriorly, and I’ve done creative things like putting the left lateral segment of the liver over there. But, again, I’m trying to do everything I can to avoid putting mesh up against that conduit and against the blood supply to the conduit.

DR SHANDA HALEY BLACKMON (Houston, TX): A great presentation, Wayne. The Pittsburgh group published a nice paper talking about diaphragmatic hernias, and I think they had 10 patients who had gastric conduit herniation, and it was interesting that you didn’t include any gastric conduits in your hernia series. I think those are some of the more symptomatic ones. I know in our patients we have had someone who has had a gastric conduit herniate, volvulize, and we have lost the conduit. So I think that’s somebody who needs to be included in this group, because they do certainly become symptomatic. And we have had someone that I have seen who was a redo repair of someone who had an esophagectomy. They herniated, they were repaired outside, and then we did the second repair, and that patient had a lot of complications and it was a very difficult repair. So I was just curious why you didn’t include gastric conduit herniation in there and if you think that’s maybe a different series?

DR HOFSTETTER: I think it’s a valid point to bring up. It depends a little bit on the technique of surgery. I think that conduit herniation may be more common in patients where segmental esophageal resection has been performed. For our series, it was difficult to expect my radiologist to comment on what they thought was pathologic with the stomach being already transposed into the chest. I think that is something for the thoracic surgeon to look at and say, I have a patient who has had conduit difficulty, they’re not draining well, and do I have a herniated stomach? I can’t expect my radiologist to give me that information de novo. But I think it sounds like a great project for someone to pursue.

In terms of avoiding that complication I try to do my best to get all that stomach straightened up initially. I get as much of the redundance out so I don’t have to worry about herniation, because, as you all know (and this is a result that I thought was going to come out of our study), during a transthoracic or a McKeown or a minimally invasive approach you have the opportunity to suture the conduit to the diaphragm, but if you’re doing an Ivor-Lewis or minimally invasive variant of an Ivor-Lewis, that’s really tough to do.

There was a period over a couple of years where during an Ivor-Lewis, we were coming over to the left diaphragm (from the right chest) and suturing the left diaphragm to the stomach to prevent herniation, because that’s what I was trying to do is to keep that hiatus closed to prevent herniation. But I think overall we have to worry about keeping that hiatus tight, not making the opening so large, and making sure that we pull that stomach up so that it can’t become redundant in the chest. So that’s where I have been going.

DR MARK J. KRASNA (Neptune, NJ): A great talk, Wayne. You have now succeeded Dr Heitmiller and your name will go along with postoperative hiatal hernias now. Just to continue Shanda’s point, I remember early on, Josh Sonett and I saw a lot of redundant stomach in the chest, and the reason those were so important is because they often cause a left lower lobe or a right lower lobe pneumonia. So one of the things that we started to do after that, and I think this goes to prevention, is at the end of the operation before closing the chest, we would always reduce everything else that was not supposed to be the interponate—I really like that word—down back into the abdomen and then put the tacking stitches.

If I do an Ivor-Lewis or a left transthoracic, we have a nice, thin conduit, if there’s any omentum coming up with it, even if it’s just along the lesser curve, we push everything else back into the belly, and you’re really only left with the conduit in the chest. I think by doing that, you don’t kind of promote stuff from coming up.

You mentioned the left lobe of the liver. When you are in the right chest doing an Ivor-Lewis and you have a very big hiatus that you are looking down at, you can actually make sure that the liver is kind of snug, next to the stomach, and that also prevents more stomach from coming up but I think it also prevents future abdominal contents from “sliding.”

My question to you is, you kept mentioning cross-sectional imaging. The radiologists nowadays think that the best way to diagnose a hernia in the hiatus is actually coronal imaging. I wonder if you could comment on coronal imaging versus axial imaging.

DR HOFSTETTER: Either one is fine. I was trying to make the point, and not to belabor it too much for the presentation, that I think we can’t rely on chest x-ray films to make the diagnosis. It’s as simple as that.

DR MITCHELL MAGEE (Dallas, TX): I think this is somewhat of a tribute to our better treatment. I remember when I was a general surgery resident, I asked my attending that same question: why don’t we see a lot of hernias, we’ve got this giant hole in the diaphragm hiatus, and he said, son, if this patient lives long enough to have a hernia, they’ll be lucky, and if that’s the worst thing that ever happens to them, they’ll even be more lucky.
As you said, that’s one of many arguments that I have for doing a minimally invasive McKeown approach, because you can suture it to the diaphragm in the end. But you can also do it too tight, and particularly if you create angulation of the conduit as it comes through the diaphragm when you suture it up to the diaphragm, you can also end up with early problems.

DR HOFSTETTER: We had small numbers, we only had 30 minimally invasive esophagectomies in our group, but our hernia incidence is only 10% in that small group. I know the literature that’s out there, and the idea was that we’re creating less adhesions and therefore we’re subject to more hernias because it’s just not as stuck. I still personally think that it has to do with manipulation of the hiatus (not overwidening) and what you said, adhering to the principles of making sure that things are tacked down when possible.

Another hernia, by the way, readdressing Dr Blackmon’s question, that we haven’t talked about and may be interesting, occurs when you have a right-sided conduit that herniates into the left chest across the aorta and the heart? I have had a couple of patients who I swore were initially struggling because it was narrowed in the area of herniation, also creating a slowly emptying pouch for them to reflux/regurgitate from. So there are several types of hernias that I am really not addressing here, and I agree with that.

DR KAMAL A. MANSOUR (Atlanta, GA): You brought a good point that you had two recurrences after your repair of the hernia?

DR HOFSTETTER: Four, unfortunately.

DR MANSOUR: Here is a word of wisdom. We wrote a chapter on traumatic diaphragmatic hernias, chronic, and to approach the hernia from the chest or from the abdomen alone may be wrong. You cannot just dump stuff from the chest down into the abdomen in a chronic situation where adhesions are formed. You can kink these bowels and can get actually reherniation and even death.

Therefore I recommend that if the hernia is too large, that you go in the chest and make a counterincision in the abdomen, and when you reduce the herniated organ, you make sure that what you reduce is not kinking on itself or over an adhesive band. Just a word of advice. Thank you.

DR HOFSTETTER: Good point.

DR DANIEL L. MILLER (Atlanta, GA): Just one last point. I think the key is if you enter the left chest or not. If you do you will have an increase risk of herniation. So when I’m doing an Ivor-Lewis or transhiatal, I always have the anesthesiologist to give a breath up to 40 mm Hg of pressure, and if I see evidence of a pneumothorax or enter into the pleural I will tighten up the hiatus. I usually only divide the right crura only. And I think creating an opening into the left chest, the negative pressure within the chest facilitates upward movement of abdominal viscera.

DR HOFSTETTER: You mean the pleura?

DR MILLER: Yes.

DR HOFSTETTER: Because I routinely open the left pleura, and I wonder about that frequently. Thanks for the comment. That is something we will look at. In the current series, my trans-thoracic cases, which routinely have an opened left pleura, do not have a higher hernia incidence than other techniques. In fact, as mentioned, the highest incidence was in the transhiatal group.