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Research Article

Post Esophagectomy Diaphragmatic Hernia (PEDH): An Experience of a Dedicated Cancer Center of Pakistan

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ABSTRACT

Objective: To study the outcomes of post esophagectomy diaphragmatic hernia managed at our institute.

Methodology: We conducted a retrospective case series among patients who underwent surgical resection for esophageal cancer in the last 10 years from Jan 2010 to Dec 2019. Patient's charts were reviewed and postoperative surveillance CT scans were reviewed for the development of post-operative diaphragmatic hernias. Demographic and variables related to diaphragmatic hernia and its management were recorded and analysed.

Results: Out of 590 patients, 10 patients developed post esophagectomy diaphragmatic hernia. All patients received neo adjuvant chemo-radiotherapy. 8 patients underwent three stage esophagectomy, one had Ivor Lewis esophagectomy and one had transhiatal esophagectomy. CT scan was used as a modality of choice for the diagnosis. Two patients developed hernia during their hospital stay and 8 patients presented late. 7 patients were diagnosed due to complications of the hernia. One patient presented with acute abdomen and ischaemic gut. 2 presented with severe epigastric pain. 4 presented with shortness of breath. 3 patients were diagnosed on surveillance CT scans. All patients underwent surgery for closure of the hernia defect. Laparoscopic surgical management was performed in 5 patients. Five patients had primary tension free closure while five patients had mesh repair. Two patients had recurrence. Both were re-operated and mesh repair was done. There was no 30 days mortality.

Conclusion: Diaphragmatic hernia is a serious complication. Early surgical intervention is needed for the treatment. With minimally invasive techniques, incidence has increased. For standardization of management and quality of care, randomized control trials are needed.

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Introduction

Esophageal cancer is considered an essential cause of cancer related mortality and there has been six folds rise in the incidence rate of esophageal cancer worldwide [1]. Multi-modality treatment provides better outcomes and surgery plays an essential part in the management of disease [2]. Surgical resection is only possible among 25% of the

patients with diagnoses of esophageal cancer [3]. Esophagectomies are associated with significant morbidity and mortality because of extensive abdominal, thoracic and neck dissection [4]. Diaphragmatic hernia is a known and reported complication after esophagectomy with incidence of 0.4% to 15% [5, 6]. The complication is due to the combined effect of negative thoracic pressure, positive abdominal pressure and enlargement of esophageal hiatus. Minimally invasive techniques are more prone

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towards the development of this complication [7]. Early recurrence and poor survival are the barriers in estimating the over-all incidence of diaphragmatic hernia.

Management includes reduction of contents and repair of the hernia defect by approximating the crura. Mesh repair is still debatable. Some argue about its importance and some argue that it would erode into stomach and its blood supply. Although, two randomized control trials advocate that mesh repair is associated with reduced short-term recurrence rates [8, 9]. Surgery for diaphragmatic hernia can be performed either laparoscopically or open. Laparoscopic surgery has several advantages like less blood loss, shorter hospital stays and minimal morbidity in terms of surgical incision. However open surgery can also be performed [10, 11]. At our hospitals we regularly perform Esophagectomies for esophageal cancer. We perform laparoscopic as well as open surgeries and do three stage, Ivor Lewis as well as transhiatal surgeries. The objective of this research is to identify the risk factors associated with formation of a diaphragmatic hernia and also to see the short term and long-term management outcomes.

Methodology

It is a retrospective study with convenient sampling. All patients who underwent resections for esophageal cancer as either elective or emergency procedures at Shaikat Khanum Memorial Cancer Hospital and Research Center (SKMCH&RC), Pakistan from 1st Jan 2010 to 31st Dec 2019 were selected. Patients with a preoperative diagnosis of hiatal hernia were excluded from the study. The ethical approval was sought from Institutional Review Board (IRB) of SKMCH&RC. Data was collected through human information system (HIS), electronic database of SKMCH&RC. Variables recorded were age, gender, pre surgery histopathology, clinical staging, treatment received, type of surgery, mode of surgery, pathological stage, time between esophagectomy and diaphragmatic hernia, diaphragmatic hernia content, symptoms, repair technique, follow-up and recurrence. Three surgical techniques were utilized in our center for the management of esophageal cancer. McKeown's three stage esophagectomy, Hybrid Ivor Lewis esophagectomy and Orringer transhiatal esophagectomy. Our center adopted minimally invasive techniques for esophagectomies in 2011. Almost all of the procedures are performed laparoscopically in our center.

Calculations were performed with Statistical Package for the Social Sciences (SPSS 20) for Windows version 20 statistical software. Data was described using median with minimum and maximum value for skewed distributed quantitative variables. For categorical variables, number of observations and percentages were reported. The study is complied with the SKMCH&RC guidelines on research involving human subjects.

Results

A total of 590 Esophagectomies were performed at SKMCH&RC by interdisciplinary team including two surgical oncologists and a thoracic surgeon during October 2010 to October 2020. 10 patients developed diaphragmatic hernia after esophagectomy with incidence rate of 0.016%. Mean age of the patients was 44.90 +/- 6.75 years. 7 patients

were females and 3 were males. None of the patient had any comorbidities. Mean BMI of the patient was 24.2 +/- 6.2kg/m². Median duration between the symptoms till the diagnoses of esophageal cancer was 4 months (2-12). 9 patients had squamous cell carcinoma and 1 had adenocarcinoma. Middle esophageal cancer was found in 7 patients while 3 patients had lower esophageal carcinoma. All of the patients had locally advanced disease (T3 in 8 patients and T4 in 2 patients) with nodal involvement in 9 patients. All of the patients received neo adjuvant chemotherapy (2 cycles of carboplatin and paclitaxel) and radiotherapy (25 fractions 50 Gy). 80% of the patients underwent McKeown's three stage esophagectomy, 10% patient underwent Hybrid Ivor Lewis esophagectomy and 10% underwent transhiatal esophagectomy. All of the procedures were performed laparoscopically. Mean blood loss during the curative surgery for esophageal cancer was 88 +/- 45.41 ml and mean duration of surgery was 335 +/- 101.2 minutes. 4 patients had breach in the pleura during dissection (3 patients had left pleural breach and 1 had right pleural breach).

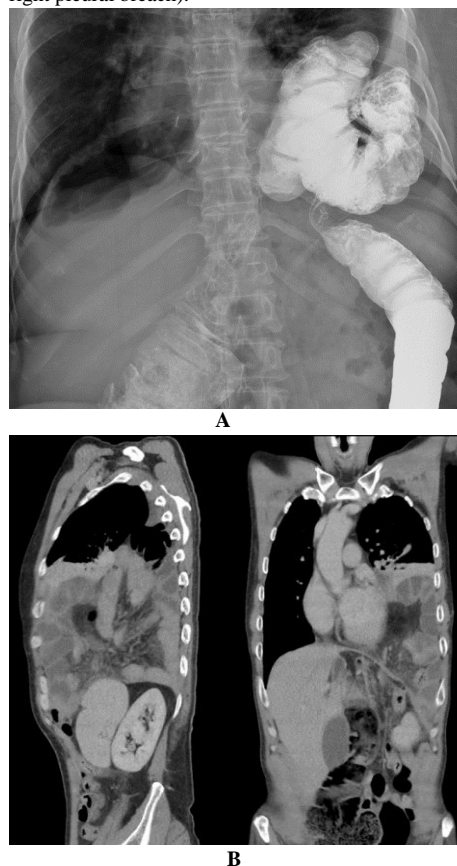


Figure 1: Left sided diaphragmatic hernia post esophagectomy **A)** Barium enema **B)** CECT showing herniation of large bowel into the thorax.

10 patients developed diaphragmatic hernia in our institution. Most common symptoms encountered were chest pain (n=3) and shortness of breath (n=4). Median duration between primary surgery and symptoms was 11 months (7 days to 27 months). 3 patients had computed tomography (CT) scan for follow up of cancer and diaphragmatic hernia was detected on the CT scan. CT scan was the only modality used to detect hernia. 9 patients had left sided hernia while 1 patient had right sided hernia. Figure 1 showing left sided diaphragmatic hernia after

esophagectomy after barium contrast and CT scan. Laparoscopic repair was performed in 8 patients, open technique was utilized in 1 patient and 1 patient had laparoscopic to open conversion. 50% of the times, emergency surgery was performed. Mesh hernioplasty was performed in 6 patients. Majority of times, colon and omentum comprised the hernial content (n=8), while 2 patients had small bowel along with omentum and colon. Figure 2 showing colonic herniation into right side of chest. Mean blood loss was 46.5 +/- 4 ml and mean duration of surgery was 137.5 +/- 43.64 minutes. There were no complications during surgery for hernia repair. 2 patients developed recurrence. Both the patients' complaints were of abdominal pain. One patient underwent laparoscopic repair and one patient underwent open repair. In both the patients mesh was placed. There was no 30 days mortality. 9 patients are alive till the date, however 1 patient died after 4 months due to pneumonia and lung abscess. None of the patients developed disease recurrence or metastases.

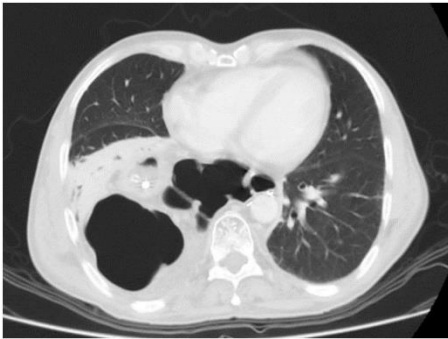


Figure 2: CT scan showing right sided diaphragmatic hernia with herniation of colon into the thorax.

Discussion

A total of 82 post esophagectomy diaphragmatic hernia cases have been reported [10-12]. The incidence is higher with minimally invasive technique 2.7% to 4.5% [13-15]. In our series almost all of the esophagectomies were performed laparoscopically. Kent and colleagues reported incidence of PEDH after open technique 0.8% and after minimally invasive technique 2.8% [10]. Our incidence rate was only 0.016%. This could be attributed to the fact that all the surgeries were performed only by 2 surgeons improving their surgical efficiency with time. This case series hints towards early PEDH as two of our patients developed PEDH during hospital stay. An explanation for early complication is reduced amount of adhesion. Positive intra-abdominal pressure and sucking negative intra thoracic pressure can be an explanation of late complication. However, minimally invasive esophagectomies are a risk factors for this complication as during surgery the hiatus is dissected more to ensure the tension free passage for conduit.

Patients with PEDH can be asymptomatic and can have various symptoms including chest pain, heaviness in the chest, vomiting, constipation, lower gastrointestinal tract bleeding, fever, leukocytosis and liver congestion [16, 17]. Seven patients in our study had symptoms including chest heaviness, shortness of breath and abdominal pain, however three patients were asymptomatic and were picked up on surveillance CT scan. Although barium enema can be performed for the diagnosis, but CT scan is the standard of choice. CT scan is used in our hospital for the screening of any recurrence and metastases; hence this

complication can be screened with CT scan on regular follow up. The chances of bowel strangulation and incarceration are always present; thus, the surgical repair of diaphragmatic hernia is always warranted. Although, there is no evidence available at present suggesting that the surgical management is crucial it is still controversial [11, 15, 16]. All our patients were managed with surgery.

Majority of hernia occurred in the left side of diaphragm in our study which is consistent with findings of previous published studies [10, 15]. Possible explanation is the staple line along the lesser curvature of stomach and smooth serosal surface over greater curvature of stomach causing more adhesion formation over right crus. Left lobe of liver might play a role of mechanical barrier. However, there is strong association between pleural breach and hernia formation. In 4 of our patients, there was pleural breach. One patient had right sided pleural breach during primary surgery and he developed right sided diaphragmatic hernia, hinting towards strong association.

Surgery for diaphragmatic hernia can be performed either laparoscopically or open. Laparoscopic surgery has several advantages like less blood loss, shorter hospital stays and minimal morbidity in terms of surgical incision. However, open method is safe if bowel is ischaemic. As in one of our patients, patient presented to us with bowel ischaemia, so decision was made to perform laparotomy and hence on surgical findings small bowel resection and anastomosis was performed along with the hernia repair. Mesh repair is still debatable. Some argue about its importance and some argue that it would erode into stomach and its blood supply. The principal of surgery is to perform tension free repair which can be done with approximation of crura.

We performed mesh hernioplasty in half of the patient and primary repair in another half. However, two randomized control trials advocate that mesh repair is associated with reduced short term recurrence rates [8, 9]. Median day of discharge for our patients was 6 days (5-7 days). None of the patients developed any complication during 30 days of surgery. Kent and Vallböhmer reported complication rate of 27% and 28.6% respectively. Our mortality rate (0%) is better if compared with the 4.5% mortality rate of Kent *et al.* and 14.3% of Vallböhmer *et al.* [10, 12, 13, 15].

It's a retrospective case series which hints towards the limitation of this study. This study provides the ground for further randomized control trials and meta analyses. It is the first study from this part of the world where esophageal carcinoma is highly prevalent, hence information from this article will add the information and will help the professionals in understanding this complication and its management.

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Availability of Data and Materials

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Author Contributions

Dr. Osama Shakeel and Dr. Asif Noor helped in writing the manuscript. Dr. Toqeer helped in the collection of images and data. All authors have approved the final manuscript.

Ethics Approval and Consent to Participate

Institutional review board approval to publish was obtained.

Consent for Publication

Patients' consents were obtained.

Competing Interests

None.

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