



## RESEARCH ARTICLE

## A Revisit of Open Repair for Zenker's Diverticulum Compared to Endoscopic Repair

Ryan Marshall\*, MD, Gobind Gill, MD, Mohamad Babi, MD, Kirk Withrow, MD and Do-Yeon Cho, MD

Department of Otolaryngology Head and Neck Surgery, University of Alabama at Birmingham, USA

\*Corresponding author: Ryan Marshall, MD, Department of Otolaryngology Head and Neck Surgery, University of Alabama at Birmingham, FOT 1155 1720 2<sup>nd</sup> Avenue South Birmingham, AL 35294-3412, USA, Tel: 205-801-7801, Fax: 205-801-7802



### Abstract

**Objectives:** The purpose of our study is to prove open repair (OR) for Zenker's diverticulum can result in similar lengths of stay in the hospital, and similar convalescent periods when compared to endoscopic repair (ER).

**Methods:** Retrospective chart review was performed between 2013-2018 for those patients who had surgical repair of Zenker's diverticulum by two surgeons. After discussing all risks, benefits, and alternatives, patient made a decision whether to have ER vs OR of Zenker's diverticulum.

**Results:** Of those 71 patients, 15 patients underwent ER while 56 had OR of Zenker's diverticulum. Revision cases were more likely to undergo OR ( $p = 0.50$ ). All patients who had OR were significantly younger than ER (OR mean age 67.7, ER = 77.3,  $p < 0.01$ ). OR had longer operative mean times (OR = 103 minutes, ER = 54.33  $p < 0.01$ ). There was no statistical difference in hospital length of stay between the two groups (OR = 2.21 days, vs. ER = 1.47,  $p = 0.35$ ). All 11 complications were encountered during open repairs, with one death due to pneumonia. Revision cases were more likely to undergo OR 72% of the time ( $p 0.5$ ).

**Conclusion:** These findings suggest OR and ER have a similar length of hospital stay although the operative time is longer with a higher complication rate. All patients undergoing either ER or OR were started on clear liquid diets unless a complication was encountered on water soluble esophagram performed on postoperative day one or two. The decision to proceed with either procedure should be a decided on a case by case basis.

### Introduction

Zenker's diverticulum (ZD) is a herniation of esophageal mucosa and submucosa through the space be-

tween the inferior and superior components of the cricopharyngeus muscle. The cricopharyngeus muscle along with the thyropharyngeus muscle form the inferior constrictor muscle. The earliest description of an esophageal diverticulum is credited to Ludlow, a British surgeon, who noticed the findings during an autopsy in 1769 [1]. However, Zenker and von Ziesman further characterized it as a pulsion diverticulum in 1877 [2].

ZD has a reported prevalence of 0.01%-0.11% and typically occurs in elderly patients with a predilection for males [3,4]. Many patients remain asymptomatic; however, when symptoms present, nearly all patients experience dysphagia [5]. Regurgitation is the second most common symptom and is associated with an increased risk for aspiration pneumonia [6]. The pathophysiology remains unclear; however, it is theorized that increased luminal pressures and impaired relaxation of the upper esophageal sphincter play a role [7,8].

There are two main approaches for surgical treatment of ZD. Traditionally, ZD was treated with a trans-cervical or "open" diverticulectomy. Yet, recently, with the increasing popularity of endoscopic techniques, the transoral endoscopic stapler diverticulotomy has gained traction and has become the primary method of treatment recommended by current literature [9].

A meta-analysis published by Albers, et al. included results from 11 retrospective cohort studies published between 1999-2014 compared patient outcomes for endoscopic and open methods for ZD repair. It revealed

**Table 1:** Comparison of primary repair vs. revision repair of Zenker's diverticulum.

	Primary Repair	Revision	P value
Total number of cases	53	18	0.50
Mean Age (years)	69.34	70.89	0.65
Male, n (%)	27 (51%)	7 (39%)	0.41
Zenker's Length (cm)	2.67	3.66	0.03
Zenker's width (cm)	1.95	2.64	0.02
Open Repair, n	43	13	0.50
Endoscopic Repair, n	10	5	0.05
Mean BMI	27.9	25.7	0.98
Length of Stay (days)	1.91	2.5	0.43
Hypertension, n (%)	23 (43%)	5 (28%)	0.051
Diabetes mellitus	5 (9.4%)	4 (22%)	0.22
Hyperlipidemia	4 (7.5%)	0	0.34
Coronary Artery Disease	13 (25%)	7 (39%)	0.37
Complications	7 (13%)	4 (22%)	0.44
Recurrence	0	1 (5.6%)	0.25

the endoscopic approach results in a shorter length of procedure, shorter hospitalization period, earlier diet advancement, lower complication rates, but higher rates of symptom recurrence [10].

However, a study by Shahaway, et al. reported similar days until the initiation of an oral diet with similar rates of post-operative complications. Additionally, they reported only a slightly longer hospitalization stay and argued for the viability of the cervical approach especially for patients who prioritize having a definitive, single treatment session [11].

Due to our institutional perception of ambiguous length of hospital stay, complication rates, and a decreased recurrence rate in the open approach we wanted to explore our experience and patient population regarding Zenker's repair. We anticipated a comparable length of stay, complication rate, procedure time, and recurrence rate between the endoscopic and open approach with similar convalescent periods. We also believe patients undergoing revision surgery are more likely to have complications along with additional medical comorbidities.

## Methods

Inpatient Hospital billing records at a tertiary care medical center in Birmingham, AL were searched for the Current Procedural Terminology (CPT) codes pertaining to Zenker's Diverticulum (43130) to identify patients who have undergone Zenker's repair surgically. Radiographic evidence was also confirmed to reveal a Zenker's diverticulum during the pre-operative clinic visit. The data was available to evaluate patients from April 2013 to April 2018 with the Institutional Review Board approval for our retrospective chart review at the University of Alabama at Birmingham hospital. We were not required to obtain con-

sent for this review study. We were able to identify 71 patients who had undergone either open or endoscopic repair for a Zenker's diverticulum. Detailed information was collected for each patient including age, race, chief complaint, and tobacco or alcohol abuse. We recorded procedure type (endoscopic with stapler or laser vs. open repair), operative time, hospitalization length of stay, complications, recurrence time, prior procedures performed at outside hospitals, and any repeat operations following our initial procedure. Recurrence information was obtained reviewing post-operative clinic visits. Routine post-op visits were performed within two weeks of discharge. Every patient obtained a post-op dohoff tube until cleared safe for swallow by a water soluble esophagram and/or speech evaluation. Revision surgery listed in Table 1 are patients for which previous repair was attempted at an outside hospital.

## Results

Our groups consisted of 15 patients who underwent endoscopic Zenker's repair (ER) along with 56 patients underwent open repair (OR). Of these two groups 18 patients were previously operated on by an outside Otolaryngologist for Zenker's repair for which we have listed in our chart below as revision repairs Table 2.

Reviewing the demographics of the two groups we found an average age of 71 (range 35-96), with the mean for the endoscopic group being 77.33 years old and the open procedure group being 67.7 (p value 0.006). Surprisingly there was a predominance of females with 37 to 34 males. Our patients were mainly white (n = 65).

When comparing the patient's chief complaint upon presentation to our clinic, patients overwhelmingly reported dysphagia (n = 57), with regurgitation

**Table 2:** Comparison of endoscopic vs. open repair of Zenker's diverticulum.

	Endoscopic Repair	Open Repair	P value
Total number of cases	15	56	0.0005
Mean Age	77.3	67.7	0.006
Male, n (%)	7 (47%)	27 (48%)	1
Zenker's Length (cm)	3.94	2.44	0.057
Zenker's width (cm)	1.95	1.95	0.99
OR time (minutes)	54.3	103	0
Mean BMI	27.63	27.76	0.93
Length of Stay (days)	1.47	2.21	0.35
Hypertension N	8 (53%)	28 (50)	1
Diabetes	3 (20%)	6 (10.7%)	0.38
Coronary Artery Disease	8 (53%)	12 (21%)	0.019
Hyperlipidemia	0	4 (7.1%)	0.56
Complications	0	11 (19.6%)	0.099
Recurrence	0	1 (1.8%)	1

next (n = 10), aspiration (n = 2), cough (n = 1), and indigestion/reflux (n = 1). The majority of patients complained of multiple symptoms but the ones listed were the most severe. Symptoms on average were present for 33.3 months (42.3 months ER vs. 30.3 months OR, p=0.34). Most patients denied current tobacco (n = 45) use with 16 patients being former smokers and 10 being current users. Only 21 patients confirmed the use of alcohol.

Patients who had undergone prior operations at an outside facility were more likely to have longer Zenker's 3.66 cm vs. 2.67 cm (p value 0.03) and wider Zenker's 2.64 cm vs. 1.95 cm, (p=0.02). Patients undergoing revisions had an average BMI of 25.7 compared to primary repair at 27.9 (p = 0.85). Revision repair patients were more likely to have hypertension (38% p = 0.051). The other medical comorbidities captured included diabetes mellitus type 2, coronary artery disease, and hyperlipidemia.

Patients were more likely to undergo an open procedure (n = 56), when compared to the endoscopic approach using either the laser or stapler (n = 15). The overall procedure time average was 92.75 minutes with the open approach averaging 103.04 minutes and the endoscopic approach averaging 54.33 minutes. Looking into revision vs. primary repair, we found more patients were undergoing open procedure 13/18 or 72%.

A total of 5 patients were converted to an open approach secondary to exposure difficulty. We encountered 11 complications in our series of patients all within the open approach. Six patients experienced either an esophageal perforation or leak seen on post-operative water soluble esophagram. The other complications consisted of one post-op infection, aspiration, left vocal cord weakness, death, and an episode of hyponatremia. Of these complications, 7 were from primary repairs. The death was a result

of ARDS secondary to pneumonia. We encountered one recurrence in our patient population for which the case was a revision from an outside hospital.

Our length of stay was not statistically significant with our endoscopic group staying an average of 1.47 days and the open approach 2.21 days (p = 0.35).

## Discussion

In the past, open surgical repair of Zenker's diverticulum was widely accepted as the treatment of choice. However, more recently, the endoscopic approach has gained popularity due to the minimally invasive nature of the procedure. Albers, et al. meta-analysis of multiple retrospective cohort studies also demonstrated shorter length of procedure, shorter hospitalization period, earlier diet advancement, and lower complication rates with the endoscopic approach [10]. This finding likely contributes to more surgeons preferring to proceed with this method of repair. On the other hand, rate of recurrence and need for revision surgery still seems to be a problem with the endoscopic approach [10,12]. At our institute, a tertiary care teaching hospital, patients are more likely to undergo an open procedure when compared to the endoscopic approach using either the laser or stapler. Shorter operating times and hospital stays have been an argument in favor of the endoscopic approach by many studies, including our own [9,10,13].

This would imply that our aim should be to resolve a patient's symptoms with only one procedure and avoid recurrence and secondary procedures. This could possibly be done by carrying out open surgical repair, that has been shown to have lower recurrence rates, as a first line treatment instead of attempting endoscopic repair followed by open salvage repair [10,12]. Performing only one procedure would de-

crease costs due to one less procedure and hospital admission despite the initial surgery consuming more operating time. Even if it's at the expense of slightly more complications, which our complication rates are similar to previous meta-analysis [10]. Though interestingly enough, our recurrence rates were extremely low overall at 1.4% for both endoscopic and open repairs. This could possibly be due to our institute being very familiar with these complex repairs and the large volume of cases performed. On the other hand, our recurrence rates could be underestimated secondary to patients returning to their primary Otolaryngologists if they had a complication or their symptoms reappeared. However we believe this is unlikely as our patient populations are usually referred from outside Otolaryngologists.

In regards to the hospital stay, our hospital length of stay time was not significantly different between the endoscopic and open groups. Without any statistical significance this gives evidence for each approach maintaining similar length of stay in the hospital. We also advance the patients' diets equally for both groups if they pass a water soluble esophagram after the procedure. After which, they are allowed a clear diet for 5 days, fulls for 5 days, followed by a regular diet. Our open procedures take a slightly longer time, but our hospital length of stay is very similar.

Looking at primary vs. revision repairs, we found a significant association between greater size of the diverticulum with the patient having undergone a previous repair. Coupled with Pop, et al. finding that their patients' diverticulum size decreased on average 70% after endoscopic repair, it might be postulated that this increased diverticular size found in patients with revision repair is a consequence of an initial partial endoscopic repair [14]. The initial repair may temporarily alleviate the patient's severity of symptoms thereby allowing the diverticulum to increase in size during an asymptomatic period. Interestingly, we also found an almost-significant association between hypertension and previous repair as well. This could be explained by our center commonly seeing patients with complicated medical comorbidities referred by outside physicians.

The type of repair chosen is decided on a case-by-case basis and is highly customized to each patient. Prior to choosing a plan, all of our patients are thoroughly explained the details of each approach including risks and benefits. They have a choice between the open procedure that has a slightly longer operating room time, the creation of an external scar, and higher frequency of complications but lower recurrence rates; or the endoscopic procedure with a slightly shorter procedure time, no external scar, and lower frequency of complications but higher recurrence rates. Tertiary care centers are more likely to attract patients with multiple comorbidities that may have

already undergone procedures at other facilities. This could be one reason our surgeons take a more definitive measures by proceeding with the open approach. While our operating room times could be shorter, we are a teaching hospital which could extend the time secondary to training. It is also important to mention that our surgeons are constantly running two rooms during these cases, which has been shown to be safe when key portions of the procedures are performed when the surgeon is in the room by current literature [15-19].

## Conclusion

These findings suggest open repair and endoscopic repair have a similar length of hospital stay although the operative time is longer with a higher complication rate. All patients undergoing either endoscopic or open repair were started on clear liquid diets unless a complication was encountered on water soluble esophagram performed on postoperative day one or two. The decision to proceed with either procedure should be decided on a case by case basis.

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