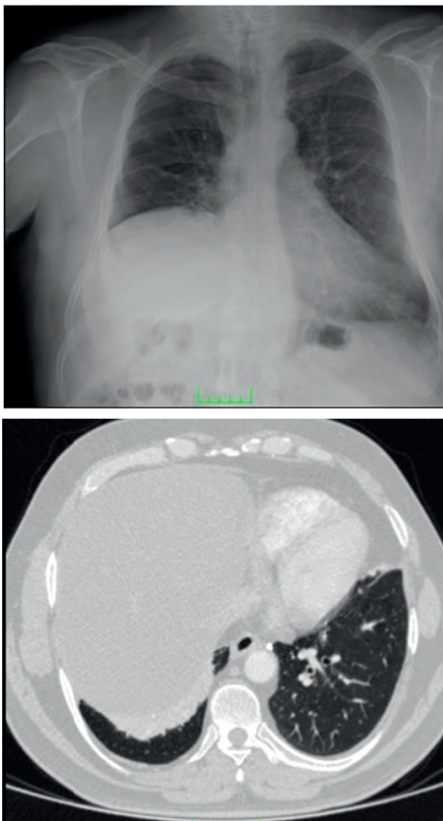


## DIAPHRAGMATIC EVENTRATION



Koray DURAL<sup>1</sup>

Diaphragmatic eventration, described earlier by Beclard in 1829 [1], is a clinic case which generally appears in asymptomatic patients randomly. It is a situation in which all parts of diaphragm or some certain parts of it are permanently higher than normal (figure 1).



**Figure 1.** Diaphragm elevation on the right (Kirikkale Medical Faculty Thorac Surgery archive)

### ETIOLOGY

The actual diaphragmatic eventration is caused by a congenital progressive disorder in the muscle part of the diaphragm, and no pathology is observed in the sternum, ribs and dorsolumbar spine parts of the diaphragm. Diaphragm eventration is rare (incidence<0.05%) and it is more common in men. The left hemi-diaphragm is more constantly affected. The embryological theory is that abnormal or delayed migration of myoblasts of superior cervical somites leads to structural deficiency of the diaphragm muscle [2-6]. In contrast to the actual diaphragm eventration, diaphragm paralysis is an acquired condition that usually results from phrenic nerve damage depending on a tumor or a trauma.

### PATHOLOGY AND CLINICAL FINDINGS

Diaphragm eventration can be bilateral, unilateral, total or localized. In the microscopic presentation of the part that is exposed to eventration, diffusive fibro-elastic changes and some muscle fibers are present. Patients with diaphragm paralysis have a normal amount of muscle fiber, albeit atrophic [7].

While diaphragm eventration presents apparent clinical findings in children and infants, most adult patients are asymptomatic and it is

<sup>1</sup> Prof., Kirikkale University, School Of Medicine, Department Of Surgical Medical Sciences, Department Of Thoracic Surgery

Freeman et al. [21] performed unilateral thoracoscopic plication in 22 patients. They made their selection with the help of the scale they developed, and found a significant improvement in the respiratory function values and quality of life of the patients in the 6-months period after the operation. In 3 patients who did not accept the operation due to different reasons in the same scale group, the values did not improve in the follow-up despite the appropriate medical treatment.

Yalçınkaya et al. [13] observed improvement at the rate of 75% in PFT values and clinical improvement at the rate of 97% in 37 patients, to whom they applied plication with a single port and a 3-4 cm incision by using the method they named as the hybrid method, and they stated that this method can be safely used.

Taberham et al. [16] performed thoracoscopic plication in 35 patients and reported that the results were successful except for 5 patients. The feature of this series is that they performed 2 surgeries simultaneously and one of them had a bilateral pneumonia at a different time.

### Open Trans-abdominal Plication

Open unilateral or bilateral diaphragm eventration or open transabdominal plication for paralysis can be applied. There are very few results data on open transabdominal plication results in adults. The advantages of a clear transabdominal approach are that it does not require access to both sides of the diaphragm and selective ventilation. In addition, a laparotomy is usually a less morbid approach than open thoracotomy. The disadvantages are that it is an open operative approach and it is difficult to access all areas of the diaphragm [3].

### Laparoscopic Plication

Laparoscopic diaphragm plication is advantageous in terms of seeing subdiaphragmatic viscera despite the disadvantage of necessity of performing pneumoperituan. Although there are not many applications, there are articles which indicate that plication is performed through laparoscopy, and report that the results are successful [18].

## CONCLUSION

Direct comparison of various diaphragm plication techniques has not been made. Today, it is difficult to determine the operative approach in terms of results since there are no studies comparing open thoracotomy and diaphragm plication performed by thoracoscopic method that can guide us. However, plication should be attempted with minimally invasive techniques as morbidity is probably lower than a clear approach.

Symptomatic diaphragm eventration is a rare condition and it is sometimes impossible to distinguish it clinically from paralysis. Patients who are asymptomatic do not require treatment and they benefit from operative intervention significantly. Although thoracoscopic plication method is the most preferred method, the selection of operative intervention depends on the surgeon's expertise.

## REFERENCES

1. Cruveilhier J. Atlas d'anatomiepathologique, Vol 1, Book 17, Plate V. Paris, Baillié, 1829, p 2
2. Deslauriers J. Eventration of the diaphragm. *Chest Surg Clin N Am* .1998;8(2):315–30.
3. Shawn SG , Rafael SA . Diaphragmatic Eventration. *Thorac Surg Clin*. 2009 ;19: 511–519.
4. Gutt C.N., Grabensee R. (2015) Diaphragm Plication and Repair. In: Dienemann H., Hoffmann H., Detterbeck F. (eds) *Chest Surgery*. 2014 .Springer Surgery Atlas Series. Springer, Berlin, Heidelberg
5. Serdar Özkan. Diyafram Evantrasyonu ve Cerrahi Tedavisi. *Journal of Clinical and Analytical Medicine*.2104;88-98
6. JA Cordeiro , AK Almeida , SA Oliveira , BM Fernandes , ACM Rego , I Araújo-Filho . Diaphragmatic eventration: Review of current knowledge, diagnostic, and management options. *International Journal of Medical Research & Health Sciences*. 2016; 5: 3:62-65
7. Obara H, Hoshina H, Iwai S, Ito H, Hisano K. Eventration of the diaphragm in infants and children. *Acta Paediatr Scand* .1987;76:654-8.
8. Takahiro Uchida , Yugo Tanaka , Nahoko Shimizu , Sanae Kuroda , Takefumi Doi , Daisuke Hokka , Yutaka Okita , Yoshimasa Maniwa. Diaphragmatic plication for iatrogenic respiratory insufficiency after cardiothoracic surgery. *J Thorac Dis*. 2019;11(9):3704-3711
9. Balcı EA, Ozyurtkan MO . Clinical and surgical specifications of adult unilateral diaphragmatic eventration according to their aetiology in 28 patients. Importance of using diaphragmatic patch and minimal thoracotomy incision. *European Journal of Cardio-thoracic Surgery*. 2010; 37: 606—612

10. Bawazir OA, Banaja AM.. Thoracoscopic repair of diaphragmatic eventration in children:a comparison of two repair techniques. *J Pediatr Surg.* 2019 Dec 28. pii: S0022-3468(19)30882-6. doi: 0.1016/j.jpedsurg.2019.11.019. [Epub ahead of print]
11. Freeman RK, Wozniak TC, Fitzgerald EB. Functional and Physiologic Results of Video-Assisted Thoracoscopic Diaphragm Plication in Adult Patients With Unilateral Diaphragm Paralysis . *Ann Thorac Surg.* 2006;81:1853–7
12. Evman S, Tezel C, Vayvada M, Kanbur S,Urek S,Bay-sungur V, Yalçinkaya I. Comparison of Mid-Term Clinical Outcomes of Different Surgical Approaches in Symptomatic Diaphragmatic Eventration . *Ann Thorac Cardiovasc Surg.* 2016; 22: 224–229
13. Yalcinkaya I, Evman S, Lacin T, Alpay L, Kupeli M, Oc-akcioglu I. Video-assisted minimally invasive diaphragmatic plication: feasibility of a recognized procedure through an uncharacteristic hybrid approach. *Surg Endosc.* 2017; 31(4):1772-1777
14. Gierada DS, Slone RM, Fleishman MJ. Imaging evaluation of the diaphragm. *Chest Surg Clin N Am.* 1998;8(2):237–80.
15. Ikeda M, Sonobe M, Bando T , Date H. Reconstruction of recurrent diaphragmatic eventration with an elongated polytetra fl uoroethylene sheet. *Interactive Cardio-Vascular and Thoracic Surgery.* 2013; 17: 433–435
16. Taberham RJ, Raza A, Alzetani A, Woo EB, Chamberlain MH, Kouloxouzidis G, Amer KM. VATS Plication of the Diaphragm: A Descriptive Observational 10-Year Southampton Experience. *Innovations (Phila).* 2017 ;12(6):398-405
17. Morrison JMW. Eventration of the diaphragm due to unilateral phrenic nerve paralysis. *Arch Radiol Electrotherap* 1923;28:72–5.
18. Premchandani D , Chitnis A , Katara A , Bhandarkar D. Laparoscopic stapled resection/plication of left hemidiaphragmatic eventration in an adult . *Asian Journal of Endoscopic Surgery.* 2019; Early View :https://doi.org/10.1111/ases.12734
19. Patel Ravisagar , Singh Abhinav, R.M. Mathur, Sisodia Anula . Eventration of diaphragm presenting as recurrent respiratory tract infections – A case report. *Egyptian Journal of Chest Diseases and Tuberculosis.* 2015; 64: 291–293.
20. Graham DR, Kaplan D, Evans CC, et al. Diaphragmatic plication for unilateral diaphragmatic paralysis: a 10-year experience. *Ann Thorac Surg* 1990; 49(2):248–51.
21. Freeman RK, Wozniak TC, Fitzgerald EB. Functional and physiologic results of video-assisted thoracoscopic diaphragm plication in adult patients with unilateral diaphragm paralysis. *Ann Thorac Surg .* 2006;81(5):1853–7.