

VATS PLICATION OF DIAPHRAGM

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Traditionally, diaphragm plication was performed through thoracotomy, until 1996 when Moroux introduced the widely used thoracoscopic technique of diaphragm plication [1].

Video-assisted thoracoscopic surgery (VATS) was initially used for infants and children. In the literature, first patient series in adults mostly consisted of thoracotomy and VATS cases together. Nowadays, minimally invasive surgical techniques have replaced conventional open surgical methods. Open surgery is preferred in patients who had former thoracal procedure or pneumonia resulting in intense pleural adhesions and can not tolerate single lung ventilation or where a double lumen tube intubation is not possible [Table 1].

Surgical Methods in Diaphragm Evantration	
A. Transthoracally	
I. Thoracotomy	
II. Minimally Invasive Approach	
1. Hybrid (Video-assisted mini-thoracotomy)	
2. Video-assisted thoracoscopy (VATS)	
3. Robot-assisted thoracoscopy (RATS)	
B. Transabdominally	
I. Laparotomy	
II. Minimally Invasive Approach	
1. Video-assisted laparoscopy	
2. Robot-assisted laparoscopy	

Patient position for VATS, like open surgery, is lateral decubitus and 30° reverse Trendelenburg

position. First port is placed in the 6th intercostal space (ICS) on midaxillary line and the place for the second port is determined after exploration of the diaphragm position. Some surgeons use CO₂ insufflation in order to lower the diaphragm. During surgery, plication is performed using only thoracoscopic instruments (Endograsper, Endostitch, etc.). Port number generally varies between 2-4 in the literature, plus some studies point out that the procedure can be done through a single port [2, 3]. Endoscopic tools used for VATS diaphragm plication procedure are more convenient for infants and children in comparison with adults. Moreover, using these instruments it is more difficult to perform a plication with sufficient tension in adults as the diaphragm surface is wider and thicker.

Patient should be in lateral decubitus and 10° reverse Trendelenburg position for diaphragm plication using robot-assisted thoracoscopic surgery (RATS). The first port is introduced where the highest diaphragm elevation level is predicted and CO₂ is insufflated intrathoracically. Camera port is opened through the 4th ICS and after exploration plication is performed following the opening of two more ports for robotic arms. Patient series performed via RATS are limited in the literature, 22 consecutive cases who had undergone transabdominal RATS plication were reported with good early results in a study [4]. Three-dimension visualization during plication

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improving patient comfort and speeding up the healing process which quickens the discharge time of the patient. We would like to point out that minimally invasive surgery is the primary option in patients with symptomatic diaphragm eventration.

REFERENCES

1. Mouroux J, Padovani B, Poirier NC, Benchimol D, et al. Technique for the repair of diaphragmatic eventration. *Ann Thorac Surg.* 1996; 62:905-7.
2. Taberham RJ, Raza A, Alzetani A, Woo EB, et al. VATS plication of the diaphragm. A descriptive observational 10-year Southampton Experience. *Innovations* 2017; 12(6):398-405.
3. Wu H-H, Chen C-H, Chang H, Liu H-C, et al. A preliminary report on the feasibility of single-port thoracoscopic surgery for diaphragm plication in the treatment of diaphragm eventration. *J Cardiothorac Surg.* 2013; 8:224-9.
4. Biswas Roy S, Haworth C, Ipsen T, Kang P, et al. Transabdominal robot-assisted diaphragmatic plication: a 3.5-year experience. *European Journal of Cardio-Thoracic Surgery* 2017; 53(1):247-53.
5. Lai DTM, Paterson HS. Mini-thoracotomy for diaphragmatic plication with thoracoscopic assistance. *Ann Thorac Surg.* 1999; 68(6):2364-5.
6. Rombolá C, Crespo MG, López PT, Martínez AH, et al. Video-assisted minithoracotomy diaphragmatic plication: Respiratory effects in adults. *Thorac Cardiovasc Surg.* 2016; 64(8):647-53.
7. Yalcinkaya I. Diyafram paralizi ve evantrasyonu. Editor: Yalcinkaya İ. Diyafram Hastalıkları. *Toraks Cerrahisi Bülteni* 2013; 4(4):266-71.
8. Yalcinkaya I. Plikasyon. Editors: Toker A, Batirel HF. Çağdaş Videotorakoskopik Cerrahide Teknikler ve Sonuçlar. Nobel Tıp Kitabevi, İstanbul, Ağustos 2014, sh. 157-62.
9. Yalcinkaya I, Evman S, Lacin T, Alpay L, et al. Video-assisted minimally invasive diaphragmatic plication: feasibility of a recognized procedure through an uncharacteristic hybrid approach. *Surgical Endoscopy* 2017; 31(4):1772-7.
10. Evman S, Tezel C, Vayvada M, Kanbur S, et al. Comparison of mid-term clinical outcomes of different surgical approaches in symptomatic diaphragmatic eventration. *Ann Thorac Cardiovasc Surg.* 2016; 22(4):224-9.
11. Patrini D, Panagiotopoulos N, Bedetti B, Lawrence D, Scarci M. Diaphragmatic plication for eventration or paralysis. *Shanghai Chest* 2017; 1:25-9.