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Efficacy and safety of Cohen Flex-Tip blocker and left double lumen tube in lung isolation for thoracic surgery: a randomized comparative study

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Abstract

Background: The Cohen blocker is one of the lung isolation devices. Unfortunately, most anesthesiologists believe that its efficacy in inducing lung collapse is less than that of the double-lumen tube (DLT). This study has been performed to compare the adequacy of lung collapse and the adverse effects between the Cohen blocker and the left DLT for thoracic operations.

Method: Forty patients with an age range of 25–50 years and American Society of Anesthesiologist (ASA) physical status I-II of either sex were subjected to an elective thoracic operation with lung isolation achieved by either a left DLT or a Cohen blocker. The patients were distributed randomly into two equal groups ($n = 20$): group (I) left DLT and group (II) Cohen-blocker. The following parameters were measured: the number of intubation attempts, time for correct positioning, and lung collapse assessment grades either spontaneous (grade 1), assisted with suction (grade II), or with manual disconnection maneuver (grade III). Sore throat and hoarseness were compared between the two groups.

Results: The first intubation attempt success rate was 90% and 95% ($p = 0.871$), while the second attempt success rate was 10% and 5% ($p = 0.617$) in the left DLT and Cohen blocker groups, respectively (non-significant p value). The time for correct positioning was significantly shorter in the left DLT group than in the Cohen blocker group ($p < 0.001$). Lung collapse showed similar results between the two groups ($p = 0.803$) regardless of the grade of lung collapse: either spontaneous (grade I), assisted with suction (grade II), or with manual disconnection maneuver (grade III). The left DLT group showed a significantly higher frequency of hoarseness ($p = 0.017$) and sore throat ($p = 0.028$) than the Cohen blocker group.

Conclusion: We concluded that Cohen blocker can be used as a good alternative to the left DLT for its efficiency in inducing lung collapse with minimal incidence of postoperative hoarseness and sore throat.

Keywords: Left double-lumen tube, Cohen blocker, Thoracic surgery

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Background

Lung isolation is a technique that allows one-sided ventilation of each lung separately, which can be achieved either with a right or left double-lumen tube (DLT) or with a variety of bronchial blockers such as the Cohen deflecting tip-blocker.

There is a difference in anatomy between the two main bronchi. The right main bronchus is shorter than the left main bronchus (2.5 cm versus 5 cm long) and has a more vertical orientation from the sagittal plane (25° versus 45°) than the left main bronchus (Hampton et al. 2000), so accidental endobronchial intubation are more likely in the right bronchus (Otoch et al. 2013).

The right bronchus begins to ramify earlier than the left main bronchus (Minnich and Mathisen 2007). To overcome this complexity, the right DLT was designed with a side slot that permits ventilation to the right upper lobe. A polyvinylchloride left DLT tube is currently considered the safest and most extensively used device for obtaining lung separation in most thoracic procedures (left or right) in adult patients.

Various methods have been described to achieve single lung ventilation as an alternative to DLT placement. The Cohen® Flexi-Tip blocker (Cohen 2005) is selected as a favorable lung separation device in certain situations, such as difficult intubation, emergency lung separation, or pediatric cases (Hammer et al. 1999). The Cohen blocker has an external plastic sleeve that facilitates the placement and repositioning of the blocker tip to the desired bronchus (Mungroop et al. 2010).

The objective of this work was to compare the efficacy and safety of Cohen Flex-Tip blocker and left double-lumen tube in lung isolation for thoracic surgery.

The primary outcome of this study was to compare the efficacy of the Cohen blocker with that of the left DLT for producing lung collapse during single lung ventilation in thoracic operations. The secondary outcome was to compare the two lung isolation devices regarding the incidence and severity of postoperative hoarseness and sore throat.

Patients and methods

This randomized controlled trial was conducted in Al-Zahra Hospital from January 1, 2018 to August 15, 2018. After approval from the Research Ethics Committee (REC) of the Faculty of Medicine for Girls, Al-Azhar University under registration number N^0 REC-AFHG 2018/1 and after an informed consent was obtained from the participants.

Forty adult patients with American Society of Anesthesiologist (ASA) grade I–II disease, and an age range between 25 and 50 years, of either sex were scheduled for an elective thoracic operation under general anesthesia with a one-sided ventilation technique performed with either a left DLT (Mallinckrodt™ endobronchial tube, Covidien, Minneapolis, MN, USA) group I or a Cohen blocker (Cook® Critical Care, Bloomington, IN) group II. Patients with a body mass index > 40 kg/m^2, an ASA grade of III or greater, suspicion of difficult intubation, e.g., an El Ganzouri airway score > 4(El-Ganzouri Abdel 2011), pregnancy, or a history of bleeding disorder were excluded from the study.

After arrival to the operating room, the patients were allocated equally using a computer-generated randomization table into two groups (20 patients each), group (I), left DLT and group (II), Cohen blocker (Fig. 1).

Anesthetic technique

Thirty minutes before induction of anesthesia, all patients were pre-medicated with midazolam 0.02 mg/kg intravenously after the insertion of a 22 G peripheral cannula. Basic monitoring devices (SPO_2, ECG, noninvasive BP, and end-tidal CO_2) were connected and monitored continuously. General anesthesia was initiated with intravenous fentanyl (1–2 μg/kg) and thiopental sodium (3–6 mg/kg) until loss of eyelash reflex, followed by administration of an intubating dose of rocuronium (0.6 mg/kg). Both the fiber optic and lung isolation devices were lubricated with 2% lidocaine gel and tested prior to insertion. Then, intubation was performed by trained expert anesthetist using direct laryngoscopy. The adjustment of required anesthetic was conducted according to the hemodynamic changes of the patients using inspired sevoflurane and incremental doses of fentanyl and rocuronium.

Insertion of the left double-lumen tube

A standard left DLT (37 Fr for women and 39 Fr for men) with its style was inserted into the mouth with the bronchial lumen in front of the tracheal lumen as a guide. Once the blue cuff was placed beyond the glottis, the DLT was rotated 90° counter clockwise. The style was removed by an assistant while the tube was advanced toward the trachea until definite resistance was observed. Air was used to inflate the blue cuff (bronchus) and the white cuff (tracheal) according to the manufacturer's recommendation to prevent leakage.

Fiber optic was inserted through the tracheal lumen to confirm that the blue bronchial cuff was immediately below the carina in the left bronchus and to determine the takeoff of the right upper lobe bronchus. A collapse of the selected lung was achieved by either clamping the bronchial lumen to collapse the left lung or clamping the endotracheal lumen to collapse the right lung.

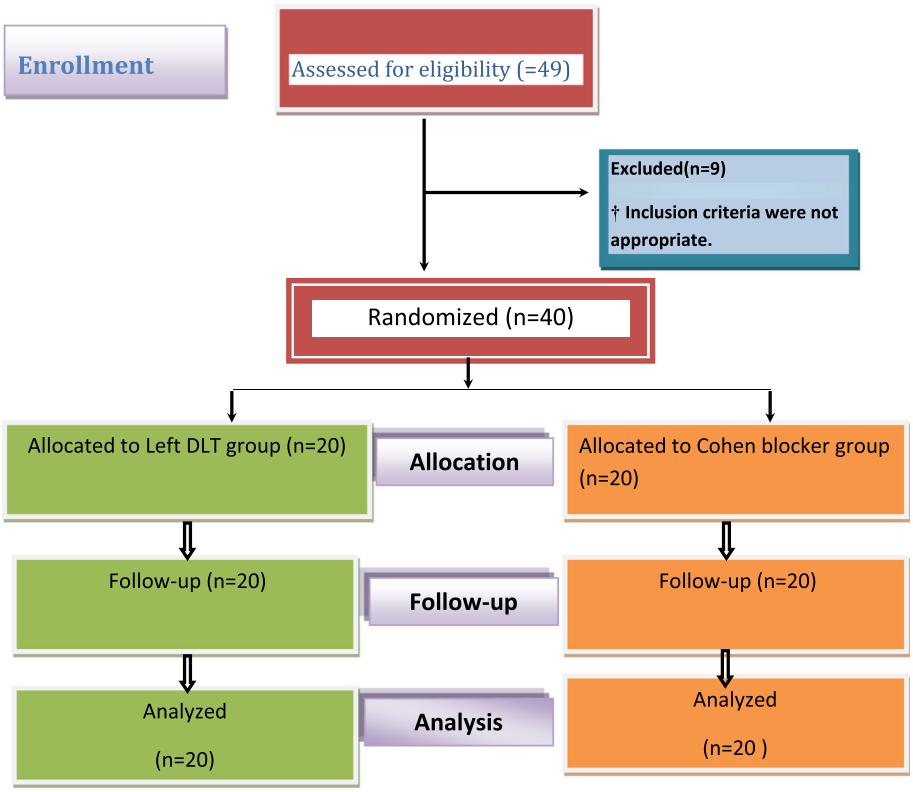

Fig. 1 Flow chart of the randomized study

Insertion of the Cohen® Flex-Tip blocker

After tracheal intubation was performed using a standard cuffed polyvinyl chloride single-lumen tube, a specialized multiport adaptor was connected to the single tracheal tube, the side port connected to the anesthetic circuit to allow ventilation. The upper port allows for placement of the fiber optic laryngoscope, and the port on the other side allows for placement of the bronchial blocker (BB). The Cohen® Flex-Tip blocker with a wheel-controlled deflecting mechanism allows the guidance of the distal end of the blocker into the right or left bronchus Fig. 2.

The fiber optic was inserted at the superior port of the adaptor. Once the carina was visualized, the blocker was inserted such that the face of its deflecting tip control wheel was on the side of the desired bronchus to be blocked (right or left). Then, the relevant cuff was inflated with 8–10 ml of air until the desired bronchus was occluded Fig. 3.

It is important to reconfirm the placement of the left DLT or the Cohen blocker by fiber optic once the patients were turned into the lateral decubitus position to achieve satisfactory placement of the device.

The following data were recorded by an anesthesiologist who was blinded to the study groups:

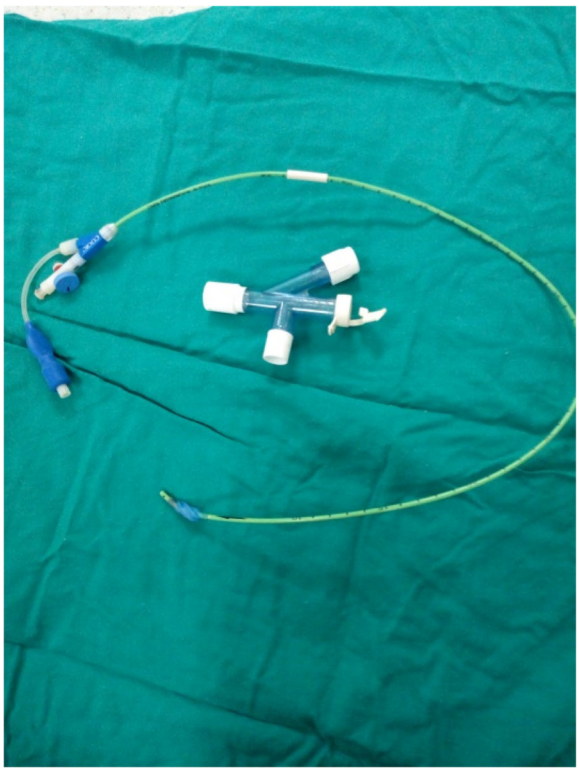

Fig. 2 The Cohen® Flex-Tip blocker

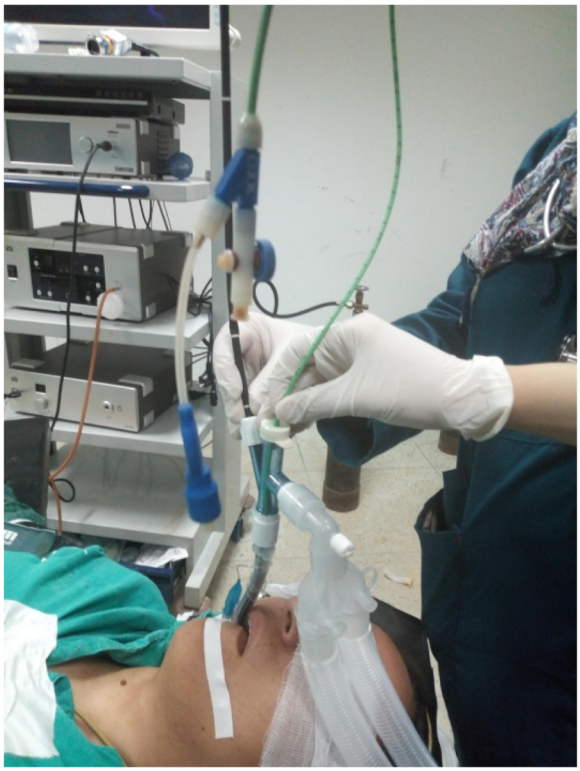

Fig. 3 Insertion of the Cohen® Flex-Tip blocker after the insertion of fiber optic cable through the single lumen tube

1- Number of intubation attempts: only two intubation attempts were allowed, and successful intubation was confirmed by the appearance of a capnograph waveform and detection of equal bilateral breath sounds. If the second attempt failed, the patient was excluded from our study.
2- Time for the correct positioning: Using a stopwatch, the time from the moment of fiber optic insertion until seeing the border of the blue bronchial cuff just below carina and occluded the left main bronchus was recorded.
3- Lung collapse assessment grades: By observing the shrinkage in lung tissues after opening the pleura. Lung collapse was categorized as follows:
   A- Spontaneous (grade 1): Adequate lung collapse occurred by clamping the appropriate lumen of the left DLT or occlusion of the desired bronchus of the Cohen blocker.
   B- Assisted with suction (grade II): Adequate lung collapse occurred by the insertion of a suction catheter into the non-ventilated lumen of the left DLT or the center channel of the Cohen blocker.
   C- Manual disconnection maneuver (grade III): Adequate lung collapse occurred by disconnecting the single lumen tube or the double lumen tube from the breathing circuit for 2 min to facilitate lung collapse (Li et al. 2017).
4- The incidence of complications: The occurrence of hoarseness and sore throat over 2 h in the post-anesthetic care unite was measured using a four-grade scale (Mencke et al. 2003) with a cold as a point of reference for sore throat.

Postoperative score for hoarseness:

A- No hoarseness = 0
B- Observed by the patient (mild) = 1
C- Noticed by the investigator (moderate) = 2
D- The patients cannot speak (severe) = 3

Postoperative score for sore throat:

A- No sore throat = 0
B- Pain as with the beginning of a cold (mild) = 1
C- Pain as with a cold (moderate) = 2
D- Pain is sharper than with a cold (severe) = 3

Sample size justification

Our sample size was based on previous studies considered a mean (standard deviation) collapse time of 18(7.2) min after initiation of OLV in the DL group. They reported that a total number of 36 patients were necessary to detect a 40% difference between groups (Bussières et al. 2016) with an alpha of 0.05 and a power of 0.80. To account for the probable dropout, a total of 40 patients were enrolled in this study.

Statistical analysis

Data were analyzed with SPSS version 16.0 for Windows (SPSS Inc., Chicago, Illinois). The qualitative data were expressed as numbers and percentages and compared between the two groups using the Chi-square test. The quantitative data with normal distribution were expressed as means ± SD and compared between the two groups using the independent sample *t* test. The confidence interval was set to 95%, and the allowed margin of error was set to 5%. Therefore, p value ≤ 0.05 was considered significant.

Results

The two study groups were similar in terms of the demographic and the operative data Table 1.

The two lung isolation devices groups showed a similar number of intubation attempts based on statistical analysis (non-significant p value) Table 2.

The first attempt success rate was 90% and 95% ($p = 0.871$), while the second attempt success rate was 10% and

Table 1 Demographic and operative data

	Left DLT group	Cohen blocker group	*p* value
Number of patients	20	20	
Age (years)[b]	41.7 ± 9.3	42.4 ± 8.5	0.805[b]
Weight (kg)[b]	77.6 ± 14.5	84.6 ± 21.6	0.236[b]
Height (cm)[b]	164.5 ± 4.3	167.2 ± 7.7	0.179[b]
BMI (kg/m^2)	26.68 ± 6.75	27.26 ± 5.64	
Gender:			
Male	7 (35.0%)	12 (60.0%)	0.113[a]
Female	13 (65.0%)	8 (40.0%)	
Mallampati score[a]			
Class I	16 (80.0%)	12 (60.0%)	0.168[a]
Class II	4 (20.0%)	8 (40.0%)	
ASA score[a]			
I	15 (75.0%)	10 (50.0%)	0.102[a]
II	5 (25.0%)	10 (50.0%)	
Type of operation[a]			
Lobectomy	7 (35.0%)	8 (40.0%)	0.959[a]
Lung biopsy	7 (35.0%)	5 (25.0%)	
Segmentectomy	6 (30.0%)	7 (35.0%)	
Duration of surgery (min)[b]	215.4 ± 104.4	192.9 ± 66.2	0.421[b]

[a]Chi-square test
[b]Independent sample *t* test

5% ($p = 0.617$) in the left DLT and Cohen blocker groups, respectively.

The time for correct positioning was much shorter in the left DLT group (75.68 ± 10.61 s) than in Cohen blocker group (210.91 ± 63.64 s) with a significant *p* value < 0.001 Table 3.

Regarding lung collapse evaluation grades, a comparison between the left DLT group and the Cohen blocker group showed no significant difference ($p = 0.803$), regardless of the grade of lung collapse; spontaneous (grade I) 70% versus 60%; assisted with suction (grade II) 15% versus 20%; and manual disconnection maneuver (grade III) 15% versus 20% Table 4.

Evaluation of the patients for the first 2 h postoperatively revealed that the left DLT group showed a significantly higher incidence of complications than the Cohen blocker group. Hoarseness presented in 35% of the patients in the left DLT group and 5% of the patients in the Cohen blocker group ($p = 0.017$). Sore throat presented in 40% of the patients in the left DLT and 10% of the patients in the Cohen blocker group ($p = 0.028$) Table 5.

Discussion

Lung separation devices are recommended for producing single lung ventilation in various operations such as thoracic surgeries. Among the many lung isolation devices, the DLT is the most frequently used lung separation device because most anesthesiologists are familiar with its use.

The two lung isolation devices groups showed a similar number of intubation attempts which indicates that the placement of the left DLT and Cohen blocker was easy and successful. The time for correct positioning was much shorter in the left DLT group than in Cohen blocker group, mainly because the insertion of single lumen tube and Cohen blocker requires two separate techniques. The efficacy of the Cohen blocker for lung collapse was similar to that of the left DLT and cause less hoarseness and sore throat.

Table 2 Number and percentage of intubation attempts

Number of intubation attempts	Left DLT		Cohen blocker		Chi-square test	
	No.	%	No.	%	×2	*p* value
First	18	90	19	95	0.026	0.871
Second	2	10	1	5	0.250	0.617

Table 3 Time for correct positioning

Groups	Time for the correct position (s)	Independent *t* test	
	Mean ± SD	*T*	*p* value
Left DLT	75.68 ± 10.61	9.374	< 0.001
Cohen blocker	210.91 ± 63.64		

Table 4 Comparison of lung collapse assessment grades

Lung collapse grade	Left DLT		Cohen blocker		Chi-square test
	No.	%	No.	%	*p* value
Grade I (spontaneous)	14	70	12	60	0.803
Grade II (assisted with suction)	3	15	4	20	
Grade III (manual disconnection)	3	15	4	20	

The primary outcome of this study was to compare the efficiency of left DLT and the Cohen blocker in producing lung collapse during thoracic operations. The parameters studies to determine the efficacy of the devices were the number of intubation attempts, the time for correct positioning, and the lung collapse assessment grades.

In our study, the number of intubation attempts to determine which device should be considered the best for lung isolation. Intubation with a standard laryngoscope with a DLT can be more difficult than with a single-lumen tracheal tube due to its wider external diameter, less compliant characteristics, and straighter shape (Brodsky 2009; Russell et al. 2013).

Our study showed that when the number of insertion attempts was limited to two attempts, the first attempt success rate was 90% and 95% ($p = 0.871$), while the second attempt success rate was 10% and 5% ($p = 0.617$) in the left DLT and the Cohen blocker groups, respectively; these results showed no statistically significant differences.

This finding is in agreement with that of Conacherid, who recorded only two patients in the DLT group and one patient in the bronchial blocker group as a failed intubation during the first attempt of intubation (Conacher 2012). Also, supporting the finding of our study, Slinger et al. (2008) concluded that it is easy to insert both devices in the first attempt of intubation.

Regarding the time of correct positioning, our study showed that it was much shorter in the left DLT group than in the Cohen blocker group (75.68 ± 10.61 s versus 210.91 ± 63.64 s) with a significant *p* value ($p < 0.001$). In agreement with our result, a study by Melanie et al. (2009), showed that the Cohen blocker required longer time for repositioning than the DLT. Also, supporting the results of our study, Kawamoto et al. (2008) concluded that the time for the correct positioning of the Cohen blocker was longer than that for the DLT.

We observed that the left DLT and Cohen blocker groups displayed similar lung collapse grades based on statistical analysis, with a non-significant *p* value($p = 0.803$) regardless of the grade of lung collapse; spontaneous (grade I) 70% versus 60%; assisted with suction (grade II) 15% versus20%; and manual disconnection maneuver (grade III) 15% versus 20% .

The results of our study can be explained by the suction channel of the Cohen blocker has a different distal opening, which may be why an initial active suction improves lung collapse in these patients compared with the other types of the bronchial blocker (El-Tahan 2015).

Popescu reported the same results at 10 and 20 min after chest opening and concluded that application of early or late suction does not improve the degree of lung collapse (Popescu 2014). In contrast to our study, a study by Amar et al. (2014) showed that the DLT produced more lung collapse than the bronchial blocker, and this result can be explained by the smaller lumen of bronchial blocker which allows for suction of air, since secretions such as blood and pus obstruct the lumen and hinder the application of suction to the collapsed lung.

Evaluation of the patients in the first 2 h postoperatively revealed that the left DLT group showed a significantly higher incidence of complications than the Cohen blocker group. Hoarseness presented in 35% of the patients in the left DLT group and 5% of the patients in the Cohen blocker group ($p = 0.017$). Sore throat presented in 40% of the patients in the left DLT group and 10% of the patients in the Cohen blocker group ($p = 0.028$).

Postoperative sore throat seems to be worst for the patients in the early postoperative period, and therefore it is important to measure it in the post-anesthetic care unit (Hung et al. 2010). Kitahara et al. (2005) revealed that hoarseness is a key postoperative predictor of larynx dysfunction that leads to distress in patients.

Table 5 Incidence of hoarseness and sore throat

Four-grade scale	Hoarseness		*p* value	A sore throat		*p* value
	Left DLT	Cohen blocker		Left DLT	Cohen blocker	
No	0	0	0.017[a]	0	0	0.028[a]
Mild	5	1		6	1	
Moderate	2	0		2	1	
Severe	0	0		0	0	
Incidence (%)	35%	5%	0.017	40%	10%	0.028

[a]Chi-square test

Knoll et al. (2006) examined 60 patients for the prevalence of airway complications following lung isolation, and in agreement with the results of our study, they found that the percentage of patients with hoarseness was lower in the bronchial blocker group than in the DLT group ($p = 0.046$).

Liu et al. (2017) reported lower incidence of post-operative side effects in the bronchial blocker group, which may be due to the thin shaft of the blocker, which has a minimal compression effect on the vocal cord.

In agreement with our conclusions, Kosarek et al. (2013) recommended the use of the Cohen blocker in a variety of thoracic surgery types as the Cohen blocker leads to complications less frequently than the DLT.

Limitations of this study

One of the limitations of the present study was that we did not use a pressure gauge to check the cuff pressure. However, the cuff was insufflated with titrated volume of air to occlude the bronchus under direct visualization of the fiber optic.

Additionally, we did not use a unique strategy for post-operative pain management. However, different type and amount of analgesics had been described according to the severity of pain.

Another limitation was that there was a difficulty in the adequately of blinding the experiment in this study because of the discrepancy between the Cohen blocker and the left DLT technique. However, the surgeon was absent from the operating room during the left DLT or the Cohen blocker placement and was blinded to the airway device by means of a blue sheet covering the lung isolation device. Also, all the measured parameters were recorded by an anesthesia resident who was blind to this study design.

Conclusion

Although Cohen blocker required a longer time for correct placement than the left DLT, once in place the efficacy of the Cohen blocker for lung collapse was similar to that of the left DLT and was associated with a lower incidence of hoarseness and sore throat.

The use of manual disconnection maneuver or the application of early suction for Cohen blocker had a comparable degree of lung collapse with left DLT in thoracotomy procedures.

Therefore, we concluded that the Cohen blocker may be used as a good alternative to the left DLT for single lung ventilation in thoracic operations. However, further studies with more cases may be needed to confirm its efficacy.

Abbreviations

ASA: American Society of Anesthesiologist; BB: Bronchial blocker; DLT: Double-lumen tube; FBO: Fiber optic; PACU: Post-anesthetic care unite

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Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding on reasonable request.

Author's contributions

The author read and approved the final manuscript.

Ethics approval and consent to participate

Approval from the Research Ethics Committee (REC) of the Faculty of Medicine for Girls, Al-Azhar University under registration number N0 REC-AFHG 2018/1. Informed consent was obtained from all participants.

Consent for publication

Informed consent was taken from the patient to publish Fig. 3.

Competing interests

The author declares that she has no competing interests.

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