RESEARCH PROTOCOL

Single lung ventilation refers to the situation in which one lung is ventilated and the other lung is deflated, mechanically separating the two lobes of the lung. Single lung ventilation is performed to facilitate surgical access in intrathoracic procedures involving the lung, esophagus, anterior mediastinal structures, and aorta, as well as in selected orthopedic spine procedures (1). There are three types of lung isolation methods; 1. Double-lumen endobronchial tube, 2. Broach blocker, 3. Single-lumen endobronchial tube (2). The most commonly used method for single-lung ventilation is intubation with a double-lumen endobronchial tube (3), (4). Double-lumen tubes allow isolation of both lungs, selective ventilation, and intermittent suctioning. A double-lumen tube has separate tracheal and bronchial lumens; it is essentially two tubes connected side by side. The shorter tube has a high-volume, low-pressure tracheal head and forms the tracheal lumen positioned just above the carina. In both left and right double-lumen tubes, the smaller, low-volume, high-pressure bronchial cuff is ideally positioned just below the tracheal carina and before the division of the lobar bronchus. The cuffs pilot balloons and the connection areas at the top of each of the two tubes are all color-coded (white for the tracheal tube and blue for the endobronchial tube). When the double-lumen tubes are properly positioned, both the tracheal and bronchial cuffs are inflated, clamping the lumen of the opposite lung to provide selective single-lung ventilation. Left double-lumen tubes are most often selected because of the longer left main bronchus, easier positioning, and greater margin of error compared to right double-lumen tubes. The length of the left bronchus is 4-6 cm in men and 3-5 cm in women, while the length of the right main bronchus is 1-2 cm. It is more difficult to maintain the position of right double-lumen tubes than left double-lumen tubes, therefore complications due to incorrect positioning may be more common. For these reasons, the use of right double-lumen tubes is limited to special situations. These are; left pneumonectomy, distorted anatomy of the left main bronchus entrance due to external and intraluminal compression, and the surgical site containing the left main bronchus. Placement of left double-lumen tubes is generally easier than right double-lumen tubes. Under direct laryngoscopy, the endobronchial tip is inserted between the vocal cords, the stylet is removed, and the double-lumen tube is rotated 90 degrees to the left while advancing. Airway damage (hoarseness, sore throat, tracheal rupture) and hypoxemia may occur due to incorrect positioning of the double-lumen tube (5). Traditionally, the position of the left double-lumen tube is confirmed by auscultation. Initial auscultation is performed with both tracheal and bronchial cuffs inflated; if the double-lumen tube is properly inserted, ventilation through both lumens should result in equal bilateral breath sounds. The tracheal lumen is then clamped and ventilation should result in breath sounds on the left side but not the right. The bronchial lumen is then clamped and ventilation should result in breath sounds on the right side but not the left. Fiberoptic bronchoscopy is the gold standard for confirming the position of double-lumen tubes (6). If the left double-lumen tube is ideally positioned, the initial bronchoscopic view through the tracheal lumen will show a blue bronchial balloon visible just beyond the carina on the left side without herniation into the trachea. The tube is then confirmed by advancing the bronchoscope into the bronchial lumen to ensure that the bronchial tube has not been advanced too far. The video double lumen tube, which has been used in recent years, is a technique where the tube location can be continuously seen on the screen during the application and surgery, but it has not become very widespread yet (7), (8). The primary purpose of this study is to investigate the superiority, advantages and disadvantages of these techniques used for the correct and short-term positioning of the double lumen tube in single lung ventilation. The secondary purpose is to determine the method that will ensure that the tube location can be verified in the shortest time and that intraoperative location changes can be detected in a short time, and that complications that may occur due to incorrect placement of the double lumen tube can be prevented, thus reducing complications. Other purposes are to perform the intubation procedure with the double lumen tube in the shortest time and verify its location in the shortest time, to save time, to prevent complications by detecting tube location changes in the intraoperative period in the shortest time, and thus to provide the shortest and safest operation time. Shortening the duration and preventing complications will also reduce costs. Although it has been stated in the literature that video double

lumen tubes are cost effective, their superiority over other techniques has not been demonstrated because their use has not yet become widespread. Another aim of the study is to compare the cost effects of these three methods.

Using the studies in the literature, the total number of patients for three groups was found to be 93 by using G-power to calculate the sample size and taking the effect size as 0.33 at a 95% confidence level and 80% power.

In Kayseri City Hospital, ASA I-III patients aged 18-84 who are planned to undergo surgery with single lung ventilation between December 2024 and May 2025 will be included in the study after obtaining their informed consent. In our hospital, video double lumen tube verification techniques, and auscultation and fiberoptic bronchoscopy are routinely used for conventional double lumen tubes. Patients are blinded in terms of the method to be applied, and since the anesthesiologist who will perform the intubation procedure is the person who performs the method, blinding cannot be performed. Anesthesiologists who perform the intubation procedure will not have any information about the study. They will use the method they prefer. Patient randomization will be done in this way. In the study, volunteers were blinded because they did not know which intubation method would be used, while blinding could not be done for the anesthesiologist who would perform the intubation. Due to the advantages mentioned above, a left tube will be used in all patients. Tube sizes will be determined according to the height and gender of the patients. Group I will be divided into three groups randomly as patients whose tube location will be confirmed by auscultation, Group II patients whose tube location will be confirmed by using fiberoptic bronchoscopy, and Group III patients whose tube location will be confirmed by using a video-guided double-lumen intubation tube. After the patients are taken to the operating room, routine monitoring will be applied and vascular access will be established with an 18G intravenous catheter. After preoxygenation with 100% O2 for 2 minutes, anesthesia induction will be applied with 2-3 mg/kg propofol, 1-2 mcg/kg fentanyl, and 0.6mg/kg rocuronium. They will be ventilated with 100% oxygen until neuromuscular blockade occurs for at least 2 minutes. The intubation duration will be started after the vocal cords are visualized with the laryngoscope and will be taken as the time until end tidal CO2 is seen on the monitor. Intubation verification time was planned for Group I as the time when bilateral respiratory sounds are heard while both cuffs are inflated, then the tracheal lumen is clamped and no respiratory sounds are heard on the right, respiratory sounds are heard on the left and then the bronchial lumen is clamped and no respiratory sounds are heard in the left lung, and respiratory sounds are confirmed to be heard in the right lung. For Group II, it was planned to be taken as the time when the fiberoptic bronchoscope is first entered into the tracheal lumen and the carina and bronchial blue-colored cuff is seen to be inflated without herniation in the left bronchus and then entered through the left bronchial lumen and it is seen that the tube is not advanced too much. III. In the group, it was planned to be taken as the time when the bronchial lumen of the video double lumen tube entered the left bronchus and the blue cuff was inflated. After the patients were given the lateral decubitus position with the lung to be operated on top, the tube location for each group was confirmed again and the time was recorded. Anesthesia maintenance will be provided using 1 MAC sevoflurane. The number of intubation attempts in the 3 groups, the duration of intubation, the duration of tube location verification, the quality of lung collapse, the need for fiberoptic bronchoscopy, the duration of fiberoptic bronchoscopy, the number of tube dislocations, and the duration of dislocation correction will be monitored. After extubation, the patients will be taken to the recovery room. In the recovery room, the patients will be questioned about the presence of sore throat and hoarseness. The methods used in the patients will be compared in terms of cost according to the type of tube and the use of fiberoptic. The data to be collected for the study will be recorded using the SPSS 22 program and analyzed in the same program. Frequency, percentage, mean value, standard deviation, maximum and minimum (min-max) values will be used for descriptive statistics, Pearson Chi-square test will be applied for statistical analysis of categorical data and Fisher’s Exact Test will be applied for values below five in four-sided tables.

The conformity of quantitative data to normal distribution will be tested with the Kolmogorov-Simirnov and Shapiro Wilk tests. For statistical analysis of quantitative data in independent groups, Unpaired t test and One-Way Anova test (post hoc Tukey test) will be used for data conforming to normal distribution, Mann-Whitney U, Kruskall-Wallis test and Pearson Correlation coefficient will be used to show the relationship between variables for data not conforming to normal distribution. Statistical significance of the difference was accepted as p< 0.05.

SOURCES:

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