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Research Article

Comparison of Actual and Ideal Body Weight for Size Selection of I-Gel™ Laryngeal Mask Airway in Obese Patients

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ABSTRACT

Background: The manufacturers of i-gel™ Laryngeal Mask Airway (LMA) recommend size selection by actual body weight (ABW). However, this actual weight-related size selection may not be satisfactory in some patients because of the wide range of weights for each device size and individual anatomical variation.

Objective: The purpose of our study was to compare the application of actual and ideal body weight (IBW), either to select the appropriate size of the i-gel™ LMA in obese patients.

Methods: This study was a randomized clinical trial. Twenty-two patients with age 17 to 60 year, body mass index (BMI) 30-35 kg/m^2, and the difference between LMA sizes based on ABW and IBW were allocated to ABW and IBW group. After insertion of the device, several variables including insertion parameters, sealing function, gastric channel function, and post-operative complications were recorded. The statistics data were analyzed with SPSS version 24 software, which p value<0.05 is considered significant.

Results: The first attempt insertion success rate was lower in the ABW group than IBW group showing a significant difference. The IBW group show a significant higher first attempt insertion rate (p=0.025), shorter insertion time (p=0.02) and easier placement (p=0.017). Gastric channel function and postoperative complications were similar in both groups.

Conclusions: Using IBW shows better performance for size selection of the i-gel™ LMA in obese patients than ABW.

Keywords: LMA; i-gelTM; ABW; IBW; Obese patient

INTRODUCTION

Laryngeal mask airway (LMA) is one of the most widely used supraglottic airway devices. The second generation of these devices has direct access to the digestive tract that is separated from the respiratory tract so as to reduce the risk of aspiration, and is able to prevent leakage in or pharyngeal pressure higher than the first generation. LMA i-gel has innovative features in the cuff section that do not need to be developed so that the insertion process is relatively easier and reduces the risk of network compression around [1-5].

Selection of adequate size is very important to ensure the performance and safety of the supraglottic airway device. In accordance with the manufacturer's guidelines, in clinical practice the determination of the size of a supraglottic airway device based on Actual Body Weight (ABW) is the most commonly used method because it is easy to do. However, choosing a size based on Actual Body Weight may not be suitable for some patients because of the wide range of weight for each device and the variation in size and individual anatomy. To overcome this problem, various alternative strategies for size determination have been suggested as alternatives to replace the size determination method based on the ABW. Even though with these various alternatives, there is still no research evidence that is strong enough to predict optimal device size so that guidelines for determining the size of most supraglottic airway devices are still carried out based on ABW [6-13].

Obesity can affect pharyngeal structure and geometry. Previous articles have shown that increase of peripharyngeal fat disposition in obese patients result in a decrease of upper airway size As a result, the use of supraglottic airway devices with

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standard ABW guidelines for obese patients may cause difficulties when inserted into the canal of upper breath which is much narrower [14,15].

The concept of Ideal Body Weight (IBW) was first introduced to estimate better drug clearance in obese patients. Within the scope of anesthesia, IBW is often used as a guideline for determining drug dosage and tidal volume in obese patients. Therefore, IBW may provide results in determining the size of supraglottic airway devices that are more suitable for obese patients [16-18]. The research conducted by Kim et al. in 2015, it was concluded that determining the size of LMA Classic based on IBW requires shorter insertion times, easier insertion and fewer complication rates compared to determining LMA size based on ABW in obese patients [19].

In 2017, similar studies using LMA ProSeal were carried out by Solanski et al. In this study, it was shown that the determination of LMA ProSeal size in obese and obese patients based on IBW was better in terms of ease insertion, ventilation and sealing compared to ABW-based size determination [20]. Based on the above, this study will compare BBI and BBA as guides in determining the size of LMA I-gel of obese patients [21-26].

MATERIALS AND METHODS

Location and research period

This research was conducted at Wahidin Sudirohusodo Hospital, Makassar, from May to September 2018.

Design and research variable

This study used a randomized single blind clinical trial design. The research variables consisted of independent variables (ABW and IBW), dependent variables (insertion success rate, insertion duration, ease of insertion, oropharyngeal leak pressure, peak airway pressure, complications), and intermediate variables (LMA size) [27-32].

Population and sample

The population of this study was patients who would undergo laparoscopic cholecystectomy under general anesthesia at RSUP Dr. Wahidin Sudirohusodo Makassar, Hasanuddin University Hospital, and his network. The study sample was all affordable populations that met the inclusion criteria and agreed to participate in the study taken by the consecutive sampling method. The entire sample used was 22 research samples [23,33-40].

Data collection method

Patients who met the study criteria underwent an applicable elective surgery preparation procedure. In the operating room, patients were positioned head up 20-250 with the position of the head sniffing position followed by the installation of oxygen saturation monitors, non-invasive blood pressure, electrocardiogram, temperature, and precordial stethoscope [41-43]. Preoxygenated with 100% oxygen for 5 minutes. Premedication with intravenous fentanyl 2 μ g/kg BBA. Induction with intravenous propofol 2.5 mg/kg BBA. Muscle paralysis with intravenous atracurium 0.5 mg/kg BBA. After jaw relaxation is achieved, LMA i-gel™ insertions are carried out with measurements based on ABW in the ABW, or IBW group in the IBW group. LMA placement was confirmed by observation of chest development and auscultation of breath sounds in both lung and gastric fields, LMA fixation. Number of insertion trials, duration of insertion, assessment of ease of insertion, oropharyngeal leakage, gastric insufflation, leak in the gastric tract. Anesthetic treatment uses a sevoflurane inhalation agent of 2.5 vol% in 60% oxygen with fresh gas flow (FGF) 3 liters/minute (LPM). Oropharyngeal leak pressure was checked by setting an adjustable pressure limit (APL) valve of 30 cm H_2O. Measuring peak airway pressure was carried out by recording the peak peak pressure when mechanical ventilation was performed with a tidal volume setting of 8 ml/kg BBI and a breathing rate of 12x/minute [44-51]. Mechanical ventilation is carried out for 1 minute, followed by manual ventilation. Post-LMA installation complications such as sore throat, airway edema, changes in sound, blood stains on the LMA are recorded [52,53].

Data analysis technique

The data obtained is processed and the results are displayed in the form of narratives, tables or graphs. Statistical analysis used SPSS (Statistical Program and Service Solution) 24. The normality test was tested by Saphiro Wilk [54-59]. The homogeneity test on numerical variables was carried out by t-independent test and on categorical variables tested with Fischer's exact. Frequency or numerical variables were tested by independent t-test, while non-parametric variables were tested by the Mann-Whitney U test. p values<0.05 were considered statistically significant [60-64].

RESULTS

Randomized single blind clinical trial has been conducted to find out the appropriate weight guidelines in choosing the size of LMA i-gel ™ of obese patients. The study was conducted at Wahidin Sudirohusodo Hospital in Makassar from May to September 2018 [65-68].

During the study period, 22 patients who will undergo general anesthesia and meet the inclusion criteria had agreed to participate in this study. The subjects were divided into 2 groups, namely the actual weight group of 11 people and the ideal weight group of 11 people. In the ABW group there were 5 men and 6 women while in the IBW group there were 4 men and 7 women. The two groups were tested by the Fischer's exact test, where p>0.05 was statistically homogeneous (Table 1).

Table 1: Characteristic of sample between ABW and IBW.

Parameters	Group of ABW (n=11)	Group of IBW (n=11)	p-Value
Age (Year)*	43.82 ± 6.615	42,00 ± 8,16	0.572
Gender			
(male/female)**	5 (45.45%)/6 (54.55%)	4 (36.36%)/7 (63.64%)	0.46
BMI (kg/m^2)*	31,5 ± 1,15	30.89 ± 0.53	0.14
Mallampati (I/II)	4(36.36%)/7(63.64%)	5(45.45%)/6(54.55%)	0.46

*Data are presented in mean ± standard deviation (SD) and analyzed by t-independent test.

**Data are presented in numbers (percentages) and analyzed by the Fisher's exact test. The value of $p>0.05$ means the same (homogeneous).

Comparison of the success of LMA insertion in the first trial of the ABW and IBW groups showed that in the ABW group as many as 6 people (54.54%) succeeded in LMA insertion in the first experiment, while in the IBW group 10 people (81.81%) successfully performed LMA insertions on the first try. Comparison of the success of LMA insertion in the first trial between the two groups was tested by the Mann-Whitney U test and was assessed as statistically significant ($p<0.05$) (Table 2). Comparison of the insertion duration of the ABW and IBW groups showed that the mean ±standard deviation (SD) duration of insertion in the ABW group was 21.691 ±6.7943 seconds, while in the IBW group it was 15.455 ± 4.6231 seconds. The duration of insertion was tested by a t-independent test, where $p<0.05$ was stated to be statistically significant (Table 2). The ease of insertion in the ABW group consisted of no resistance, mild resistance, and severe resistance, each of 2 people (18.19%), 5 people (45.45%), and 4 people (36.36%). Whereas the ease of insertion in the IBW group consisted of no resistance and mild resistance, each of them was 8 people (72.73%) and 3 people (27.27%), while for severe resistance and failure of treatment was not found in the IBW group (0%). Comparison of the ease of insertion between the two groups was tested by the Mann Whitney U test and assessed as statistically significant ($p<0.05$) (Table 2) [69-73].

The mean ± SD oropharynx leakage pressure in the ABW group was 28.36 ± 1.629 cm H_2O, whereas in the IBW group it was 28.09 ± 1.921 cm H_2O, with differences that were not statistically significant after being tested by the t-independent test ($p>0.05$). The mean ± SD peak airway pressure in the ABW group was 19.63 ± 1.501 cm H_2O, whereas in the IBW group it was 20.630 ± 1.501 cm H_2O, with differences that were not statistically significant after being tested by the t-independent test ($p>0.05$) (Table 2).

The incidence of complications in the ABW group occurred in 3 people (27.73%), 1 patient complained of sore throat and blood stains on LMA experienced by 1 other patient. While complications in the IBW group only occurred in 1 person (9.1%), 1 person complained of sore throat. Comparison of complication events in the two groups was tested by the Mann-Whitney U test and judged not to be statistically significant ($p>0.05$).

Table 2: The results of the LMA i-gel™ insertion assessment in the ABW and IBW groups.

Parameters	BBA Group (n=11)	BBI Group (n=11)	p-Value
Successful Insertion at First Try*	6 (54.54%)	10 (90.9%)	0.025
Insertion Success#	11 (100%)	11 (100%)	-
The size of the LMA i-gelTM used			
No. 3	0 (0%)	4 (36.36%)	
No. 4	9 (81.82%)	7 (63.64%)	0.015
No. 5	2 (18.18%)	0 (0%)	
Duration of insertion (second)**	21.691 ± 6.7943	15.455 ± 4.6231	0.02
Ease of Insertion Value*			

1 (no resistance)	2 (18.19%)	8 (72.73%)	
2 (light resistance existed)	5 (45.45%)	3 (27.27%)	
3 (medium resistance existed)	4 (36.36%)	0 (0%)	
4 (failed insertion)	0 (0%)	0 (0%)	0.017
Leak pressure of oropharynx (cm H_2O)**	28.36 ± 1.629	28.09 ± 1.921	0.723
Peak airway pressure (cm H_2O)**	19.63 ± 1.501	20.63 ± 1.501	0.134
Amount of gastric inflation*	1 (9.1%)	0 (0%)	0.317
Insertion Success NGT#	11 (100%)	11 (100%)	-
Postoperative complications			
Blood spots on LMA	1 (9.1%)	1 (9.1%)	
Airway edema	0 (0%)	0 (0%)	
Hoarseness	0 (0%)	0 (0%)	
Throat pain	2 (18.2%)	0 (0%)	0.28

*Data presented in the form of numbers or frequencies (percentages) were analyzed by the Mann Whitney U test.
**Data presented in mean ± standard deviation (SD) were analysed by t-independent test.
#Data cannot be analysed. p values<0.05 were considered to be statistically significant.

Discussion

This study shows that the use of ideal body weight as a guideline for selecting LMA i-gel size is better in terms of the success rate of insertion at the first time, insertion duration, ease of insertion and lower incidence of complications compared to actual weight in obese patients.

In 1996, Voyagis et al. have examined the influence of sex on LMA size selection. The study included 300 subjects, 144 of which were given the size of LMA by sex (size 5 for men and size 4 for women) and 156 others given sizes according to actual weight [10]. Based on these studies, it was found that selection of LMA size by sex provided better ventilation conditions. In this study, we have conducted homogeneity tests on subjects based on sex, and obtained homogeneous results in both groups so that the potential bias that can be generated by these variables can be ignored.

In this study, there were significant differences in the success rate of LMA insertion in the first trial which reached 90.91% for the IBW group and 54.54% in the ABW group. The success rate of insertion in the first trial for the ABW group was lower compared to the literature study conducted by Ramachandran et al. here success rates ranged from 85-96%. This may be caused by anatomical factors of the upper airway in the population of patients we studied. All LMA insertion procedures were successfully carried out on all subjects in this study, in other words there were no LMA insertion failures [14,15].

In this study, the LMA insertion procedure can be performed more quickly and more easily in the IBW group (mean 15.455 ± 4.6231 seconds) compared to the ABW group (average 21.691 ± 6.7943 seconds). At present, the use of LMA in emergency situations has been recommended by assistants who are not experienced in airway management 75. Based on these reasons, the ease and speed of insertion of this device is considered to be an important component in carrying out airway management with a supraglottic airway device. The use of ideal body weight as a guideline for selecting the size of i-gel LMA in obese patients can be applied in various clinical situations.

Significant differences were also found in the comparison of the ease of insertion of LMA, where there were 72.73% of samples that had a value of 1, that is, there was no resistance in the IBW group. While in the ABW group there were only 18.19% which had a value of 1. This was due to the smaller LMA size in the IBW group which was easier to insert in the narrowed oropharyng space due to fat accumulation found in obese patients. The size of a large LMA certainly has resistance to these conditions. This is also in accordance with previous research by Kim et al. who also sparked the first value of the ease of insertion.

In this study, an endoscopic visualization of larynx was carried out so that the results of this study support can be used as a guide in determining the size of the LMA i-gel to facilitate intubation. This is consistent with previous studies by Brimacombe et al. who also used laryngeal assessment *via* fiberoptic endoscopy inserted through LMA [6]. In this study, laryngeal visualization was statistically not different between the two groups. This is in accordance with previous studies by Kim et al. that there was no significant difference between the two groups [19].

LMA is currently designed to prevent gastric regurgitation and aspiration. It can be seen at this time that LMA has a gastric tract that can be used for insertion of Gastric Tube. In this study, there were no significant differences in the success of nasogastric tube insertion at LMA. In contrast to previous studies by Solankski et al., nasograstric tube insertion through LMA proseal was more successful in the IBW group (91.93%) than in the ABW group (75.80%).

The use of smaller size LMA has the potential to produce a higher peak airway pressure when giving control ventilation with the same tidal volume. This is due to the smaller volume of tubes and cuff bowls on smaller LMA devices. Increased pressure on the airway can increase the risk of barotrauma and leak in the oropharynx. However, in our study there was no significant difference in peak airway pressure between the two groups. This is in line with research previously carried out in Kim et al. and Solanski et al. [19,20].

The Laryngeal mask airway is designed to be placed on the hypopharynx area, and the proximal part of the cuff must be positioned under the hemp of the mandible and tonsils. Asai et al. demonstrating that the use of larger LMA sizes increases the risk of cuff in the oral cavity, potentially causing sore throat and nerve injury [13]. Based on these reasons, previous studies suggested the use of LMA with a smaller size if a portion of cuff was seen in the oral cavity. Based on functional aspects, the use of LMA with a smaller size has the potential to cause air leakage in the oropharyngeal cavity due to inadequate seal ability. LMA i-gel does not have a cuff that can be developed, which can add to the function of the oropharyngeal seal of a supraglotic device. However, obese patients tend to have a narrower upper airway so that the use of LM with smaller sizes can be placed more precisely and provide satisfying seal ability. In our study, there was no statistically significant difference in oropharyngeal leak pressure between the two groups. Similar results were also stated in studies using LMA Classic19 and LMA Proseal20 in the population of overweight and obese patients. Post-operative pharyngolaryngeal complications were a problem to consider in the use of the supraglotic airway device [72,73].

Based on our study, the selection of measurements based on actual body weight was associated with a higher incidence of complications compared to the size selection based on ideal body weight. The use of larger LMA sizes in obese patients with narrower upper airways can cause injury to soft tissue during insertion procedures and this is related to more difficult insertion procedures in the ABW group. Therefore, it is necessary to adjust the LMA size to be used in obese patients.

CONCLUSION

In this study, it can be concluded that the use of ideal body weight as a guideline for selecting the size of the LMA i-gel^{TM} in obese patients results in the success rate of insertion in the same first trial, supported by an easier and faster insertion process. The researcher suggested that operators in conducting LMA insertions should be one person only to avoid factor differences in LMA insertion.

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