Original Article

Topographic landmarks in the evaluation of surgical time, morbidity and complications of tracheotomy

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ABSTRACT

Objectives: This study aims to measure some topographic points and distances in the neck and investigate the effect of these topographic measurements on operative duration and complication rate.

Patients and Methods: This observational prospective study included 65 patients (38 males, 27 females; mean age 66.1±12.1 years; range 23 to 85 years) who were performed conventional open tracheotomy Haydarpasa Numune Training and Research Hospital between May 2012 and July 2014. Patients' age, gender and weight (body mass index), duration of the procedure, and peri- and postoperative complications were recorded. Mentum (M)-suprasternal notch (SN) and cricoid cartilage (CC)-SN distances were measured with a measuring tape. Neck circumference was measured at the levels of CC and cricothyroid membrane.

Results: Operative duration was significantly longer in obese patients compared to normal weight and overweight patients (p=0.002; p=0.026; p<0.05). Perioperative complication rate was significantly lower in normal weight patients than overweight and obese patients (p=0.004; p<0.01). There was a statistically significant inverse correlation between the CC-SN distance and operative duration (r=-0.431; p=0.001; p<0.01). M-SN distance was significantly shorter in patients with perioperative complications (p=0.003, p<0.01).

Conclusion: According to the study results, operative duration lengthens and perioperative complication rate increases as the weight increases and the neck length shortens.

Keywords: Body mass index; neck circumference; neck length; tracheotomy.

Tracheotomy continues to be a life saving procedure in the management of upper airway compromise since ancient times.[1] It has been associated with many complications some of which can be very serious (e.g. tracheal stenosis, increased bacterial colonization, tracheoinnominate fistula and fatal hemorrhage).[2,3]

The tracheotomy incisions are made at a distance between the cricoid cartilage and the sternal notch. Subcutaneous fat, strap muscles and the thyroid isthmus were separated and retracted before visualizing the trachea.[1] Increased submental and anterior cervical adipose tissue is suggested to act as a physical barrier and complicate the

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procedure.[4,5] A short neck and the excess fat accumulation in the nape of the neck and suprascapular area cause technical difficulty while hyperextending the neck in tracheotomy procedure.[6] Past studies confirmed the early and late complications in obese population since surgery in obese patients is technically more difficult compared to nonobese patients.[7]

It is known that obese patients suffer much from obstructive sleep apnea and respiratory problems. Neck circumference corrected for height has been suggested to be more predictive of obstructive sleep apnea than general obesity.[8] We inspired from this point that technical difficulties and complications may result not only from the excess total body weight and thick subcutaneous tissue at the incision site but may result from neck length and circumference. We assessed some topographic points and distances between these points in the neck in our study. We aimed to find out any correlation between the lengths calculated according to these topographic points, operative duration and the complication rate.

PATIENTS AND METHODS

This prospective observational study was approved by the Institutional Review Board of Haydarpaşa Numune Training and Research Hospital, İstanbul at 2012 and the number of Ethics Committee approval is 2012/9. A written informed consent was obtained from each patient. The study was conducted in accordance with the principles of the Declaration of Helsinki. The patients who underwent a conventional open tracheotomy because of difficulty weaning off a ventilator between May 2012 and July 2014 were included into the study. The patients younger than 18 and the ones with previous history of neck surgery, irradiation and neck lump were excluded from the study. Finally, our study population consisted of 65 consecutive patients (38 males, 27 females; mean age 66.1±12.1 years; range 23 to 85 years).

Age, gender, weight (Body Mass Index, BMI; normal weight: under 25, overweight: 25 to 30, obese: over 30) of the patients, indications for tracheotomy, duration of the procedure, perioperative complications such as hemorrhage and adjacent tissue injury and postoperative complications such as hemorrhage, decannulation, and emphysema were recorded.

All tracheotomies were performed under general anesthesia in the operating room. After the neck was positioned as hyperextended; mentum (M), suprasternal notch (SN) and cricoid cartilage (CC) was marked with a surgical pen. The distances between M-SN and CC-SN were measured with a measuring tape. Neck circumference was measured at the level of cricoid cartilage (CCC) and cricothyroid membrane (CCT).

Surgery performed under general anesthesia by two surgeons from our otolaryngology clinic. The patient's neck is extended maximally over a shoulder roll unless there is a contraindication. Routine injection of the skin with 1% lidocaine with 1:100,000 epinephrine solution is performed. A horizontal or vertical incision is made between the inferior border of the CCC and the SN. We routinely use a 2-3 cm vertical skin incision. The subcutaneous tissue and platysma muscle are divided transversely entering the subplaytsmal plane. After passing through the superficial cervical fascia, the median raphe between the strap muscles is entered with a hemostat and retracted laterally. The thyroid isthmus is retracted superiorly unless the thyroid division is required in rare cases. Pretracheal fascia is incised to expose the tracheal rings. A vertical or U shaped incisions are made with a scalpel between the rings 2, 3 and 4 with the care given not to injure the membranous tracheal posterior wall and vessels. A tracheostomy tube is inserted through the window on the anterior surface of the trachea.

RESULTS

The age, BMI, the minimum and maximum values of the measurements, indications for tracheotomy, duration of the procedure, the number of peri- and postoperative complications were presented in Table 1.

BMI: Mean BMI value was 28.1±5.7 kg/m^2 (range, 17.3-43.2 kg/m^2). 35.4% of patients had normal weight, 35.4% had had more than normal weight and 29.2% were obese.

Table 1. Demographics of the patients (n=65)

	n	%	Mean±SD	Min-Max
Age (year)			66.1±12.1	23-85
Gender				
Male	38	58.4		
Female	27	41.6		
Body Mass Index (kg/m^2)			28.1±5.7	17.30-43.20
Mentum, suprasternal notch			12.8±2.5	7-21
Cricoid cartilage-suprasternal notch			4.7±1.6	1-8
CCT			41.5±4.7	33-56
CCC			40.4±6.1	18.50-58.00
Operative duration (minute)			14.4±11.1	3-45
Hospital stay (day)			25.2±24.2	2-100
Body Mass Index (kg/m^2)				
Normal weight	23	35.4		
Overweight	23	35.4		
Obese	19	29.2		
Perioperative complications	15	23.1		
Postoperative complications	5	7.7		

SD: Standard deviation; Min: Minimum; Max: Maximum; CCT: Neck circumference at the level of cricothyroid membrane; CCC: Neck circumference at the level of cricoid cartilage.

Topographic measurements: The mean M-SN length was 12.8±2.5 cm (range, 7-21 cm). The mean CC-SN length was 4.7±1.6 cm (range, 1-8 cm). Cricothyroid membrane measurements (neck circumference at the level of cricoid cartilage) varied between 33 and 56 cm (41.5±4.7 cm) and CCC measurements (neck circumference at the level of cricothyroid membrane) ranged between 18.5 and 58 cm (40.4±6.7 cm).

Durations: The mean duration of hospital stay was 25.2±24.2 day (range, 2 to 100 days). The mean duration of the surgical procedure was 14.4±11.1 minutes (range, 3-45 minutes). The duration of the surgical procedure was statistically longer in obese patients than normal weight and overweight patients (p=0.002; p=0.026; p<0.05) (Table 2).

There was a statistically significant inverse correlation between the duration of the surgical procedure and the CC-SN length (r= -0.431; p=0.001; p<0.01). But there was no statistically significant correlation between the operative duration and other topographic lengths (p>0.05) (Table 3).

Complications: Perioperative complications were seen in 23.1% of the patients (n=15) and postoperative complications were seen in 7.7% of the patients (n=5). According to BMI comparisons, perioperative complications

Table 2. Evaluation of operative duration according to Body Mass Index

	Operative duration			
	Mean±SD	Median	*p*	Post-hoc
Body Mass Index (kg/m^2)			0.006**	1.2<3
Normal weight (n=23)	9.8±6.1	5.00		
Overweight (n=23)	13.1±10.6	10.00		
Obese (n=19)	21.4±13.1	20.00		

SD: Standard deviation; ** p<0.05; Kruskal Wallis test.

Table 3. Evaluation of operative duration according to topographic measurements

	Operative duration	
	r	*p*
Mentum, suprasternal notch	-0.241	0.055
C-suprasternal notch	-0.431	0.001*
CCT	-0.049	0.703
CCC	-0.051	0.690

CCT: Neck circumference at the level of cricothyroid membrane; CCC: Neck circumference at the level of cricoid cartilage.; r: Spearman correlation coefficient; * p<0.01.

rate was significantly lower in patients with normal weight than overweight and obese patients (p=0.004; p<0.01). The postoperative complications rate was not statistically significant between the groups according to BMI (p=0.613; p>0.05) (Table 4).

M-SN length was statistically smaller in patients with perioperative complications than the patients with no perioperative complications (p=0.003, p<0.01). There was no statistically significant difference in perioperative

Table 4. Evaluation of complications according to Body Mass Index

	Body Mass Index						
	Normal weight		Overweight		Obese		
	n	%	n	%	n	%	*p*
Perioperative complication							0.004*
Absent	22	95.7	18	78.3	10	52.6	
Present	1	4.3	5	21.7	9	47.4	
Postoperative complication							0.613
Absent	20	87.0	22	95.7	18	94.7	
Present	3	13.0	1	4.3	1	5.3	

Pearson ki-kare test; * p<0.01.

Table 5. Evaluation of perioperative complications according to topographic measurements

	Perioperative complications				
	Absent (n=50)		Present (n=15)		
	Mean±SD	Median	Mean±SD	Median	*p*
Mentum, suprasternal notch	13.3±2.4	13.50	11.2±2.0	11.00	0.003*
C-suprasternal notch	4.8±1.6	5.00	4.2±1.2	4.00	0.164
CCT	41.0±4.4	40.50	43.0±5.5	42.00	0.177
CCC	39.7±5.7	40.00	42.7±6.7	42.00	0.146

SD: Standard deviation; * p<0.01; CCT: Neck circumference at the level of cricothyroid membrane; CCC: Neck circumference at the level of cricoid cartilage; Mann-Whitney U test.

Table 6. Evaluation of postoperative complications according to topographic measurements

	Postoperative complication				
	Absent (n=50)		Present (n=15)		
	Mean±SD	Median	Mean±SD	Median	*p*
Mentum, suprasternal notch	12.8±2.5	13.0	13.0±1.9	12.00	0.833
C-suprasternal notch	4.6±1.5	5.00	6.1±2.2	7.00	0.155
CCT	41.4±4.8	41.50	41.6±3.2	42.00	0.730
CCC	40.7±5.5	41.00	36.1±10.3	39.00	0.621

SD: Standard deviation; CCT: Neck circumference at the level of cricothyroid membrane; CCC: Neck circumference at the level of cricoid cartilage.; Mann-Whitney U test.

complications according to the measurements of CC-SN, CCC and CCT (p>0.05) (Table 5).

There was no statistically significant difference in the measurements according to the presence of postoperative complications (p>0.05) (Table 6).

DISCUSSION

It has been shown that perioperative complications of tracheotomy were greater in morbidly obese patients.[9] Defatting tracheotomy was introduced to create short and shallow entrance to the trachea to stabilize the tracheotomy cannula. Gross et al.[5] showed that this technique provides a safe surgery in obese patient population. By reducing the adipose tissue from the anterior neck, they shortened the distance from the skin to the trachea. From this point of view, we tried to find out the factors making the tracheotomy procedure difficult and lengthen the operative duration. Was the reason for this difficulty just soft tissue thickness as in obese patients? Neck circumference was indicated to be more important factor than BMI in the assessment of obstructive sleep apnea.[8] So it might be important in performing tracheotomy procedure. According to us, not only the neck circumference, but also the neck length may play an important role in tracheotomy procedure. We decided to assess some topographic points and distances between these points in the neck and correlate these lengths and neck circumference measurements with operative duration, perioperative and postoperative complications.

Our study showed that perioperative complications were significantly higher in overweight patients compared to normal weight patients. Similarly, the duration of the surgical procedure was statistically longer in obese patients than normal weight and overweight patients. These results supported the previous studies.[4,5] On the contrary, our postoperative complication rates showed no statistical difference among the groups according to weight.

The duration of the operation and the complication rates were not correlated with the neck circumference.

Mentum-SN measurements were statistically lower in patients with perioperative complications. C-SN, CCT and CCC measurements were not statistically different between the groups. No measurements were statistically significant between the groups according to postoperative complications. There was a statistically significant inverse correlation between the operative duration and the CC-SN length meaning that operative duration lengthened by the CC-SN measurement shortened. We found that M-SN length was the determining measurement in terms of perioperative complications but the operative duration depends on the CC-SN length.

The published literature focused on the obesity in assessing the complications of tracheotomy.[2,4,5,10-13] Moreover, recent studies have showed that obese patients are more likely to be dependent on a tracheotomy at the time of discharge.[14,15] We suggested that surgical complications may result not only from the obesity itself but the anatomical structure of the neck setting the surgical area. According to our opinion, short and thick neck may be a problem of nonobese patients.

In conclusion, we suggested that the neck length was the major identifying factor in assessing the surgical complications and speed. This should be taken into account during preoperative evaluations so that the one can take caution against the unexpected and undesirable complications. Because, we found longer operative time and increased rate of perioperative complications as the weight increased and the neck length shortened.

Declaration of conflicting interests

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