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Neck circumference as a measure for Pediatric obesity in predicting respiratory adverse events during anesthesia

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Abstract

Background

Childhood obesity is associated with a range of adverse metabolic, cardiovascular, respiratory and psychological problems. Recent studies showed a higher prevalence of increased BMI and complications in obese children undergoing surgeries compared with their lean peers.

Aim of the study

Central obesity (indicated by neck circumference) is associated with airway-related acute perioperative complications. Measuring neck circumference could be a useful screening tool for perioperative respiratory complications.

Patient and method

A prospective study carried out on 68 patients aged 6 to 12 years undergoing noncardiac surgeries that require general anesthesia and endotracheal intubation. Clinical and anthropometric data were collected by anesthetists from all patients. Patients were classified according to their BMI percentile (underweight, healthy, overweight and obese). Respiratory events that are included were: Mallampati score, difficult mask ventilation grade, direct laryngoscopy, no. of attempts and desaturation.

Results

By using the paired t-test and correlation, there was significant difference between neck circumference and Mallampati score where the p-value was 0.044 and there were no significant differences between neck circumference and the other parameters.

Conclusion

Neck circumference in not a useful clinical screening tool for the occurrence of perioperative adverse respiratory events in pediatric age group. It may give us an idea about Mallampati score in uncooperative patients.

Keywords

Neck circumference, pediatric obesity and perioperative respiratory complications.

Introduction

Obesity is a medical condition in which excess body fat has accumulated to the extent that it may have an adverse effect on health, leading to reduced life expectancy and/or increased health problems. Obesity increases the likelihood of various diseases, particularly heart disease, type 2 diabetes, obstructive sleep apnea, certain types of cancer, and osteoarthritis.[1] Obesity is most commonly caused by a combination of excessive food energy intake, lack of physical activity, and genetic susceptibility, although a few cases are caused primarily by genes, endocrine disorders, medications or psychiatric illness. Evidence to support the view that some obese people eat little yet gain weight due to a slow metabolism is limited; on average obese people have a greater energy expenditure than their thin counterparts due to the energy required to maintain an increased body mass.[2]

Obesity is a leading preventable cause of death worldwide, with increasing prevalence in adults and children, and authorities view it as one of the most serious public health problems of the 21st century. Obesity is stigmatized in much of the modern world (particularly in the Western world), though it was widely perceived as a symbol of wealth and fertility at other times in history, and still is in some parts of the world.[3]

Pediatrics obesity is a condition where excess body fat negatively affects a child's health or wellbeing. As methods to determine body fat directly are difficult, the diagnosis of obesity is often based on Body Mass Index. Due to the rising prevalence of obesity in children and its many adverse health effects it is being recognized as a serious public health concern.[4] The term overweight rather than obese is often used in children as it is less stigmatizing.[5]

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Neck Circumference and Obesity:

Despite the ease of use and popularity of BMI, however, it is not a good descriptor of regional or overall adiposity. Regional deposition of fat, particularly in the upper body segment (central obesity), is associated with chronic diseases such as hypertension, diabetes, and obstructive sleep apnea.[6] Waist circumference and neck circumference are the two most commonly used indices of central adiposity. There is a strong association between abdominal obesity and acute and chronic diseases. Comparatively, fewer investigators have examined the association between neck circumference and diseases.[7] Traditionally, a large neck circumference has been associated with obstructive sleep apnea and difficult intubation in adult surgical patients. Studies describing the association of neck circumference with perioperative adverse events in children are lacking. [8,9]

Patient and methods:

A prospective study was carried out in Central teaching hospital of pediatrics/Baghdad, during the period from 1st of September 2012 to 31st of January 2013. 68 patients were included whom will be submitted to elective operations in that hospital.

Inclusion criteria:

- Age group: 6-12 years old.
- Elective surgery that requires general anesthesia and endotracheal intubation.
- Patients of ASA grade I and II medical condition.

Exclusion criteria:

- Children with goiter or other neck masses, neck deformity, or tracheostomy, or who were wearing a cervical collar, were excluded from the study.

- Children with craniofacial anomalies, cognitive impairment, or severe cardiorespiratory disease were excluded.

A cutoff age of 6 years was chosen because of the increased difficulty with compliance while measuring anthropometric parameters in younger children.

The study was approved by the local comity of the scientific console of anesthesia and intensive care in Baghdad teaching hospital, the department of pediatrics surgery, and the unit of anesthesia in Central teaching hospital of pediatrics.

All clinical and anthropometric measurements are collected by qualified anesthetists, residents and anesthetic assistants. History was taken from families about chronic diseases such as Asthma, Hypertension and Diabetes. It was assured by drug history or clinical reports.

Anthropometric measurements were done as a routine in this hospital for weight only, by a simple weight scale, we asked the residents to measure the height of patients by using metric scale drown on the wall of the transitional zone of the operation rooms. For the Body Mass Index, we used the medical calculator (Archimedes™) powered by Skyscape Inc., which is an application for health workers on personal computers and smart phones.

Neck circumference was measured by using flexible metric tape with the children in standing position, head held erect, at the level of the thyroid cartilage. Data regarding adverse events were prospectively collected during the pre-incision period and on arrival in the post anesthesia care space. Normal BMI was defined as age- and gender-specific values, underweight was defined as <5 percentile, normal BMI 5-85 percentile, overweight 85-95 percentile and obese >95 percentile. The anesthetist recorded the Mallampati score, as per routine in all patients. Significant desaturation was defined as oxygen saturation <90% (for _10 seconds) during the study.

All patients were preoxygenated with 100% oxygen for 3 minutes, Anesthesia was induced with ketamine 1.5-2 mg/kg and intubation was facilitated with suxamethonium 1-2 mg/kg, maintenance of anesthesia was by halothane 1-1.5% in 100% oxygen.

Difficult mask ventilation was graded according to Han et al. [23] This 4-point scale, ranging from 1 to 4, is used to describe the ease and progressive difficulty of mask ventilation. Grade 3 is defined as mask ventilation that is inadequate to maintain oxygenation, unstable mask ventilation, or mask ventilation requiring 2 providers. Grade 4 mask ventilation indicates lack of perceptible chest wall movement during mask ventilation attempts despite airway adjuvants and additional personnel. Difficult direct laryngoscopy was defined as >2 attempts at laryngoscopy.

Statistical analysis

Data analyses were performed using SPSS 20.0 for Windows (SPSS Inc., Chicago, IL) and MedCalc 7.4.1.1 (written by Frank Schoonjans, Mariakerke, Belgium). Means and standard deviations of age and anthropometric variables were compared along gender lines. The Pearson correlation coefficient was used to explore the association between neck circumference and other continuous variables such as age, BMI percentile, Mallampati score, difficult mask ventilation, difficult laryngoscopy and desaturation. All data were presented in tables, figures or paragraphs and in all statistical analysis and procedures level of significance was set at p-value (sig.) ≤ 0.05 to be considered as significant difference

Results

As we can see in table 1 and figure 3 and 4 the distribution of cases according to the gender and BMI percentile with their percent of the total no. of cases.

Table 1 Percent distribution of gender to BMI percentile.

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	Gender	No. of cases	Percent
Healthy	Male	22	32.35%
	Female	10	14.70%
	Total	32	47.05%
Overweight	Male	10	14.70%
	Female	8	11.76%
	Total	18	26.47%
Obese	Male	10	14.70%
	Female	8	11.76%
	Total	18	26.47%

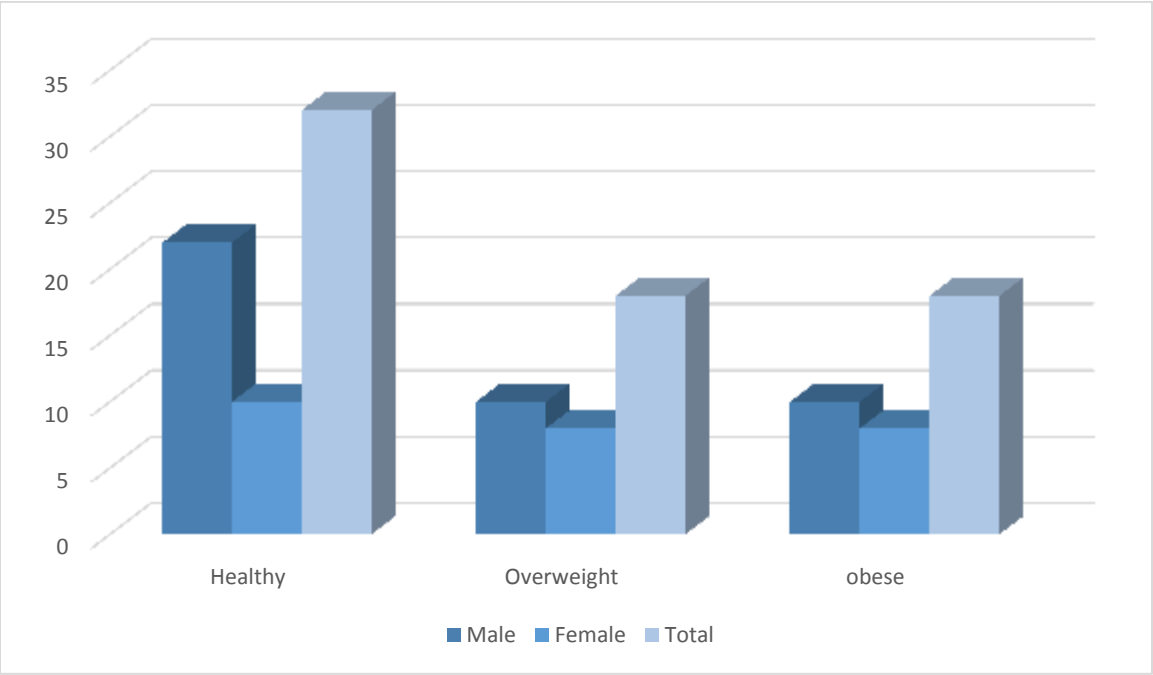

Fig. 3 Distribution of gender to BMI percentile.

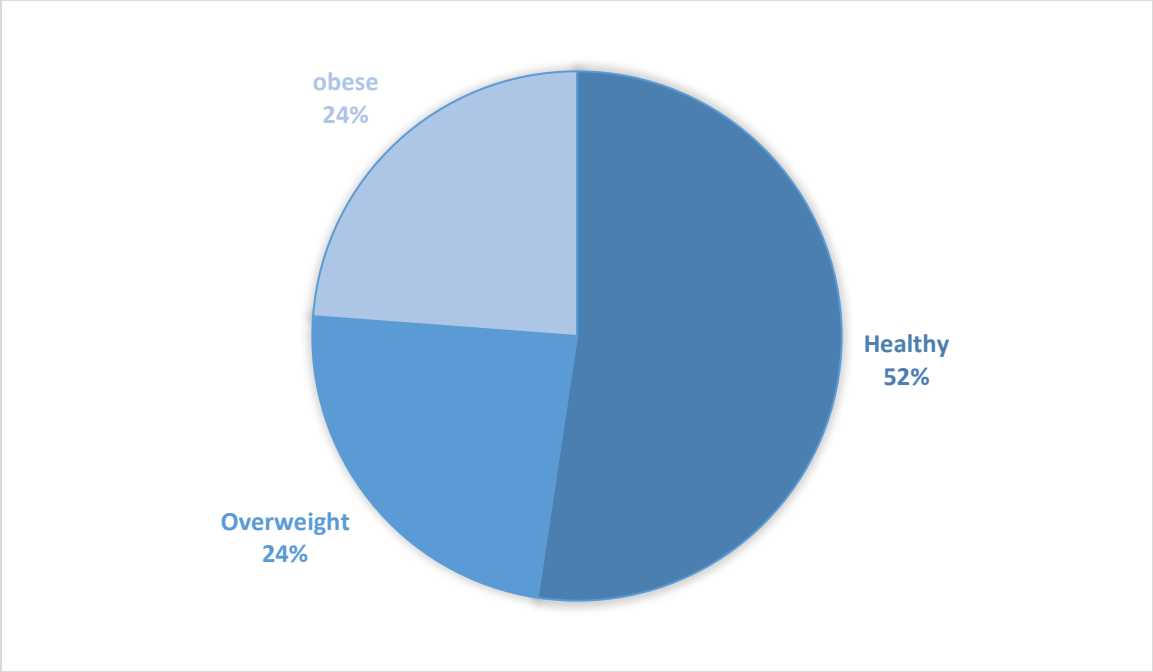

Fig. 4: BMI centile percent.

By using SPSS ver. 20/IBM using the paired t-test and correlation it's found that there was significant difference between neck circumference and Mallampati score where the p-value was 0.044 and there were no significant differences between neck circumference and the other parameters as shown in the table 2 and figure 5 below:

Table 2: correlation between neck circumference and Mallampati score

	No.	Mean	Standard deviation	p-value	correlation
Neck circumference	68	27.941 cm	2.439	0.044	0.245
Mallampati score		1.35	0.540		

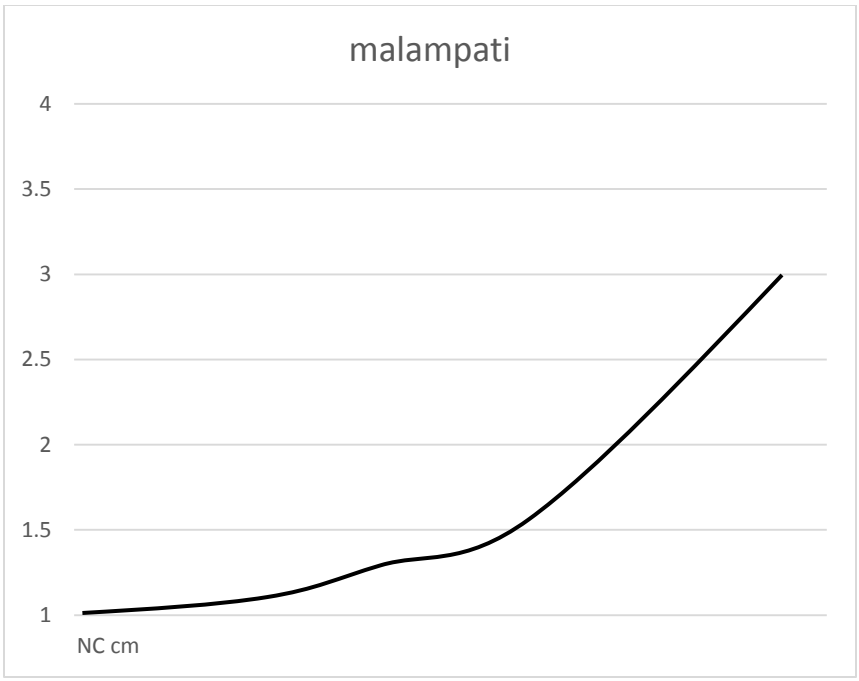

Fig. 5: Correlation between neck circumference and Mallampati score

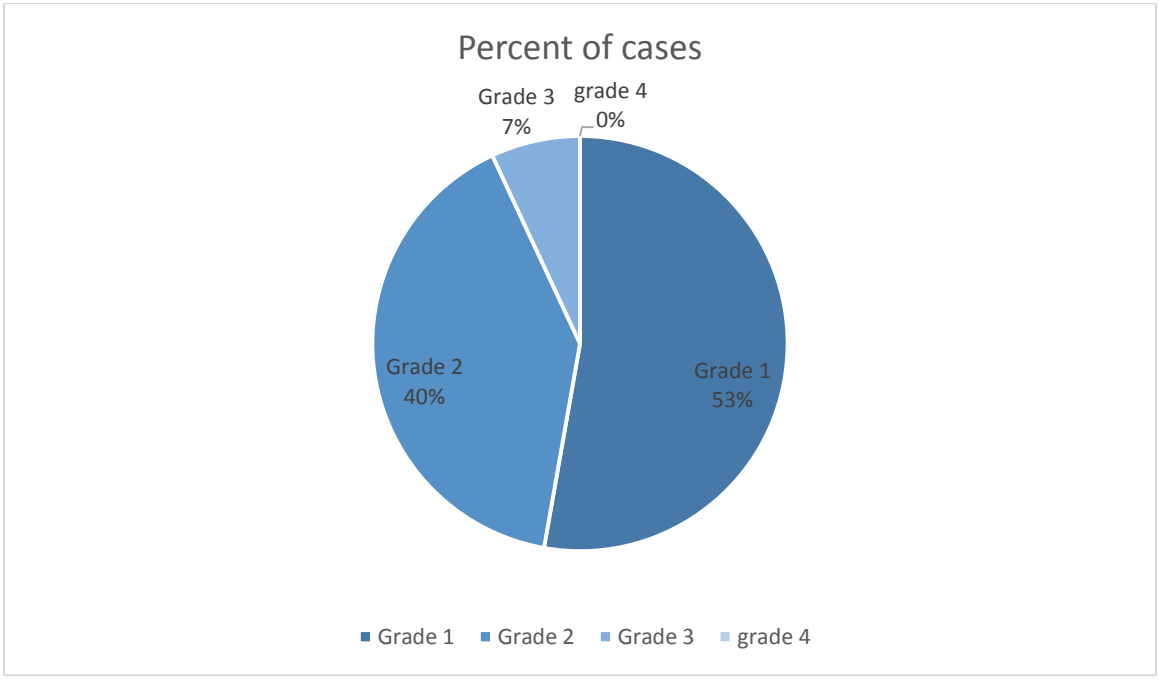

Fig.6: Percent of cases for Mallampati score

This figure demonstrates the percentage of each Mallampati score in our patients in this study.

Table 3: correlation between Neck circumference and direct laryngoscopy score, No. of attempt, difficult mask ventilation and desaturation.

	Mean	No.	SD	p-value
Neck Circumference	27.941	68	2.4396	
Direct Laryngoscopy Score	1.26	68	0.563	0.601
Number of Attempts of Intubation	1.32	68	0.531	8.831
Difficult Mask Ventilation	1.18	68	0.384	0.142
Desaturation	94.21	68	3.784	0.480

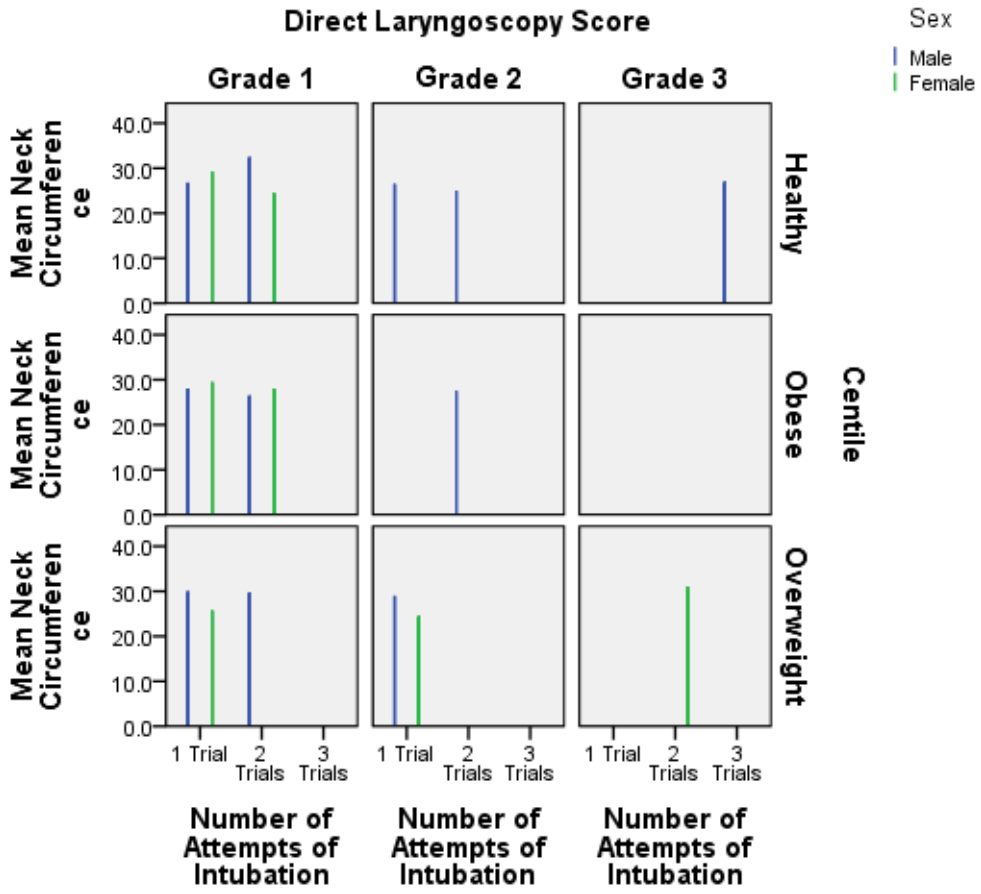

Fig. 8: Correlation between mean NC and Direct laryngoscopy grade, No. of attempt and BMI percentile.

Discussion:

Pediatric obesity is interpreted with BMI percentile however, it is not a good descriptor of regional or overall adiposity. Neck circumference is a commonly used index of central obesity and traditionally a large neck circumference has been associated with difficult intubation in adult patients.

In our study, we tried to find a correlation between neck circumference and difficult airway in pediatric age group, but as shown previously in the results there was no correlation between neck circumference and any of direct laryngoscopy score and attempts, mask ventilation, and desaturation (p-value were 0.601, 0.831, 0.142 and 0,480 respectively). The only correlation that was found statistically significant was between neck circumference and Mallampati score (p-value 0.044).

Nafiu et al did not find a significant association between neck circumference and difficult laryngoscopy, and did observe a significant association between large neck circumference and awkward mask ventilation, as well as the need for multiple laryngoscopies. [10]

Aggarwal et al concluded that neck circumference was found to be a predictor of difficult mask ventilation. Statistically significant correlation was found between difficult laryngoscopy and intubation. Age and best oropharangeal view were found to be predictors of difficult laryngoscopy and intubation. [11]

Conclusion:

Neck circumference -as a measure for obesity- is not a good predictor for difficult laryngoscopy in pediatric age group, and also for other respiratory adverse events that could happen during anesthesia such as difficult mask ventilation and airway management.

In spite of that, neck circumference can give us a good idea about Mallampati score in case of uncooperative patients.

further researches were needed to assess the correlation.

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