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Original Article

Effects of laryngeal mask placement on position of internal jugular puncture

Lei Pang[1], Haichun Ma[1], Xi Jiang[2], Liang Ge[1]

[1]Department of Anesthesiology, The First Hospital of Jilin University, Changchun, Jilin, China; [2]International Health Promotion Center, The First Hospital of Jilin University, Changchun, Jilin, China

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Abstract: Objective: The purpose of this study was to explore the best angle for tilting the head to the left to locate a puncture point during right internal jugular puncture for patients with a laryngeal mask and to provide a theoretical basis for improving the success rate in clinical practice and reduce complications associated with internal jugular puncture. Methods: Vascular overlapping rates at three points when the right side of the patient's neck was at different angles (high: midline of the protuberance on the sternocleidomastoid and clavicle; medium: intersection point of the sternocleidomastoid chest bone and clavicle segment; low: sternocleidomastoid chest bone near the clavicle area) were measured in 366 adult patients to analyze the vascular overlapping rates of the same puncture point when the head was tilted to the left at different angles as well as the vascular overlapping rates of different puncture points when the head was tilted to the left at the same angle. Results: After placement of the laryngeal mask, overlapping degrees were clearly increased at the high and medium levels when the neck was tilted to the left at 30° ($P<0.05$) and at the high level when the neck was tilted to the left at 60° ($P<0.05$). However, no obvious increases of overlapping degree were observed at the low level when the neck was tilted to the left at 30° ($P>0.05$) or at the medium and low levels when the neck was tilted to the left at 60° ($P>0.05$). Conclusion: The best puncture locations of the right internal jugular vein are obtained at the low level with the head tilted to the left at 30° and at the medium and low levels with the head tilted to the left at 60° after placement of a laryngeal mask.

Keywords: Elderly patients, laryngeal mask, internal jugular vein puncture, ultrasound guidance

Introduction

With the wide application of laryngeal masks in clinical practice, differences compared with endotracheal intubation have gradually become an area of concern for anesthesiologists [1, 2]. Currently, both domestic and foreign studies have shown changes of the vascular position in the right neck after placement of laryngeal masks, increases in the overlapping degree of the common carotid artery and internal jugular vein, and increasing difficulty in right internal jugular puncture and high-median level puncture of the right neck [2-4]. Low level refers to the sternocleidomastoid and chest bone near the clavicle area, where the overlapping degree exhibits a smaller increase, which is suitable for internal jugular vein puncture, with a smaller risk of missed puncture of the carotid artery [3]. A traditional internal jugular puncture uses surface markers for positioning based on the practitioner's experience. However, for elderly patients who use laryngeal masks, these surface markers are no longer accurate puncture reference points due to the changes in position of the sternocleidomastoid or inaccessibility of a carotid artery pulse in the case of an inflated laryngeal mask balloon. The blind puncture method can cause severe complications such as carotid artery injury, hematoma and pneumothorax [5, 6].

This study explored the best angle of head tilting to the left to obtain the optimal puncture point during right internal jugular puncture for patients with a laryngeal mask to provide a theoretical basis for improving the success rate of clinical procedures and reducing the complications of internal jugular puncture.

Materials and methods

A total of 366 patients (no gender limitation) who underwent elective surgery under general

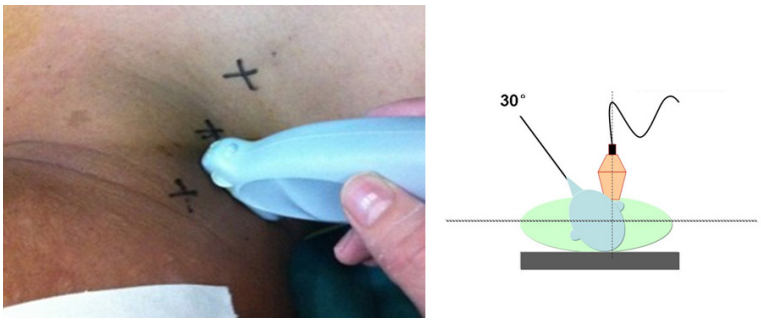

Figure 1. The short edge of an ultrasonic probe was used to measure the inner diameter of vessels and the overlapping distance at three points (high, medium and low levels) when the patient tilted their head to the left at 30°.

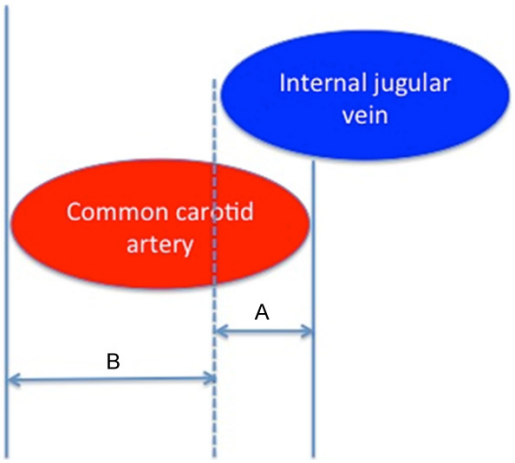

Figure 2. Overlapping degree = overlapping distance (A)/inner diameter of the common carotid artery (B) ×100%.

anesthesia were enrolled. These patients were older than 60 y, with a body mass index (BMI) of 20-28 kg/m^2 and ASA grade I-II. Patients with limited neck movement, a history of neck surgery, trauma, and other cervical abnormalities were excluded. This study was approved by the ethics committee of our hospital. Patients signed an informed consent form preoperatively.

A venous pathway was established, and then the patient was monitored for ECG, pulse oxygen saturation, and noninvasive blood pressure in a horizontal position without pillows. The same anesthetist used an iLOOk™ 25 type ultrasound instrument (Sonosite company, USA) to measure and record the inner diameter of vessels and the overlapping distance at three points (high, medium and low levels) when the patient tilted their head to the left at 30° and 60° [7], as shown in **Figure 1**. After routine general anesthetic induction, an appropriate LMA-*Unique*™ (LMA, UK) laryngeal mask corresponding to the patient's body weight was placed. Elderly female patients used a #3 laryngeal mask with an air injection of 15-20 ml, whereas elderly male patients used a #4 laryngeal mask with an air injection of 20-25 ml. The air balloon pressure was maintained below 60 cmH_2O [7]. The breathing machine was examined to ensure that no abnormalities of the airway pressure and waveform occurred. No air leakage occurred due to auscultation. The pulse oxygen saturation did not change within 5 min. The inner vessel diameter and overlapping distance at three points (high, medium and low levels) were determined when the patient tilted their head to the left at 30° and 60° by the aforementioned method. The overlapping degree was calculated by the following formula: overlapping degree = overlapping distance/inner diameter of the common carotid artery ×100%, as shown in **Figure 2**.

SPSS 10.0 was used to analyze data. Measurement data were presented as the means ± standard deviation (SD). The overlapping degree and inner diameter of neck vessels before and after placement of the laryngeal mask were compared using a paired *t*-test. Single-factor analysis of variance was used to compare the relationships of internal carotid arteries and veins at different head positions. A value of $P<0.05$ indicated statistically significant differences.

Results

Ultrasound results showed that before placement of a laryngeal mask, the overlapping degrees of the common carotid artery and internal jugular vein were lower at the high, medium and low levels when the neck was tilted to the left at 30° and 60°, whereas after placement of a laryngeal mask, these overlapping degrees were increased ($P<0.05$), as shown in **Table 1**. After placement of a laryngeal mask, the overlapping degrees of the com-

Table 1. Comparison between the inner diameter of the common carotid artery and internal jugular vein and the overlapping degree before and after laryngeal mask placement (n=366, $\bar{x}\pm s$)

Time	Angle	High level			Medium level			Low level		
		Common carotid artery (mm)	Internal jugular vein (mm)	Repeated overlapping rate (%)	Common carotid artery (mm)	Internal jugular vein (mm)	Repeated overlapping rate (%)	Common carotid artery (mm)	Internal jugular vein (mm)	Repeated overlapping rate (%)
Before	30°	6.9±0.9	11.3±1.5	13±9	6.3±1.0	11.0±1.0	22±8	6.8±0.6	11.0±1.5	11±7
	60°	6.6±0.5	11.0±1.4	10±8	6.3±1.9	10.6±1.9	19±7	6.9±0.7	10.8±2.0	12±5
After	30°	6.7±0.9	10.2±1.0	34±15**	6.2±0.7	11.2±1.5	49±21**	6.7±0.9	12.0±0.5	18±13*
	60°	6.6±0.8	10.3±1.1	29±16**	6.3±0.9	11.0±0.9	23±10*	6.6±1.1	11.2±1.6	19±8*

Compared with the condition before laryngeal mask placement, *P<0.05, **P<0.01.

mon carotid artery and internal jugular vein were clearly increased at the high and medium levels when the neck was tilted to the left at 30° and at the high level when the neck was tilting to the left at 60° (P<0.01). The overlapping degree was lower at the low level when the neck was tilted to the left at 30° and at the medium and low levels when the neck was tilted to the left at 60°, as shown in **Table 1**.

Discussion

Internal jugular puncture is used for transfusion, intravenous nutrition, intravenous drug administration, central venous pressure measurement, right cardiac catheterization or catheter pacemaker placement and emergency blood dialysis. A traditional internal jugular puncture is often performed according to the relationship of the internal jugular vein and sternocleidomastoid, namely, at three points (high: midline of the protuberance on the sternocleidomastoid and clavicle; medium: intersection point of the sternocleidomastoid chest bone and clavicle segment; low: sternocleidomastoid chest bone near the clavicle area) when the patient's neck is at different angles, and these three points are commonly used positions for central vein catheterization [8]. A laryngeal mask is convenient because it results in a minor effect on the throat, a minimal cardiovascular reaction and stable hemodynamics, and it provides safe, rapid and effective airway management that patients can tolerate. Therefore, it can achieve satisfactory ventilation and anesthesia effects, resulting in its increasingly wide application in clinical practice.

In the present study [2, 3, 5, 6], the neck was maintained at 30° or 60°, which reflect the puncture positions of traditional internal jugular vein puncture. Ultrasonic imaging technology was used to compare the vascular position changes of the common carotid artery and internal jugular vein before and after the placement of a laryngeal mask. The results showed that compared to the condition before placement of the laryngeal mask, the overlapping degrees of the common carotid artery and internal jugular vein were increased at the high, medium and low levels when the neck was tilted to the left at 30° and 60°, suggesting that cervical vascular shifting occurs after placement of a laryngeal mask. This result may have occurred because the inflation volume of a laryngeal mask affects the degree of congestion of neck vessels. A larger inflation volume results in greater air pressure, and a greater degree of congestion results in easier relative displacement of the cervical blood. Ultrasound results suggested that compared to the condition before placement of the laryngeal mask, the overlapping degrees of the common carotid artery and internal jugular vein were clearly increased at the high and medium levels with the neck tilted to the left at 30° and at the high level when the neck was tilted to the left at 60°. The overlapping degree was lower at the low level when the neck was tilted to the left at 30° and 60°, which were the best puncture positions for the internal jugular vein. During placement of the laryngeal mask, the inferior end of the mask is located in the upper opening of the esophagus, whereas the superior end closely attaches to the bottom of the ventral epiglottis. The vent hood sac requires a certain amount of air to ensure good ventilation. In the present study, after placement of the laryngeal mask, Doppler ultrasound detection revealed changes in the shape of neck blood vessels in some patients, in which the cross-section of blood vessels changed from a circular to an elliptical shape, and the inner diameter of the vessels

was altered. This result may have been caused by the compression of the vent hood sac on the cervical vessel after the injection of air [9].

In conclusion, after placement of a laryngeal mask, the overlapping degree of the common carotid artery and internal jugular vein increased. The overlapping degree was increased at the low level, namely, the level of the sternocleidomastoid chest bone near the clavicle area. The area was suitable for internal jugular vein puncture, and the mispuncture rate of common carotid arteries was small. If punctures are performed at the medium level, namely, the intersection between the sternocleidomastoid sternum and collarbone segment, the tilting angle of head to the left should be increased, which will reduce the overlapping degree of arteries and veins. The high level, namely, the midline between the protuberance on the sternocleidomastoid and clavicle, is not suggested for right internal jugular puncture in patients with a laryngeal mask. Thus, the best puncture locations of the right internal jugular vein are the low level with the head tilting to the left at 30° and the medium and low levels with the head tilting to the left at 60° in elderly patients after the placement of a laryngeal mask.

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Disclosure of conflict of interest

None.

Address correspondence to: Dr. Ge Liang, Department of Anesthesiology, The First Hospital of Jilin University, No. 71 Xinmin Street, Changchun, Jilin, China. Tel: +86 15804300399; E-mail: geliang_jdyy@sina.com

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