Anatomical Landmark for Internal Jugular Vein Catheterization for Detection of Jugular Venous O_2 Saturation ($SjvO_2$) in Thai People

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Abstract

Thirty-two (32) cadavers were dissected to find the anatomical landmark for puncturing the internal jugular vein. The point for the right internal jugular vein was 2 cm above and 2.17 cm lateral to the right clavicular head, and that for the left internal jugular vein was 2 cm above and 2.08 cm lateral to the left clavicular head. The right internal jugular vein was found to dominate eighty-eight per cent (88%) of the cadavers. The anatomical point 2 cm above and 2 cm lateral to the head of the clavicle was appropriate for puncturing the internal jugular vein. After puncturing the internal jugular vein, a catheter was inserted ascending to the jugular bulb where jugular venous O_2 saturation (Sjv O_2) related to the cerebral metabolism was detected.

Key word : Internal Jugular Vein Catheterization, Jugular Venous O_2 Saturate, Anatomical Landmark, Thai People

Several traumatic brain centers are concerned with abnormal cerebral metabolism following severe head injury[1-9]. One way to detect abnormal cerebral metabolism is detecting venous oxygen saturation drained from the brain by the internal jugular vein. The jugular bulb is the most proximal part of the internal jugular vein that collects intracranial venous blood without extracranial venous blood contamination. Unfortunately, the jugular bulb is located at the jugular foramen making a direct puncture impossible. One way to insert a catheter is from the internal jugular vein at the proximal neck and ascending it to the jugular bulb. In this study, first a percutaneous technique mentioned in previous literature was used. This is a technique in which a catheter is placed into a puncture lateral to the internal carotid artery at the cricoid or inferior border of the thyroid cartilage level[3,7,10]. When this technique failed, an open technique in which a catheter is placed in the internal jugular vein with its tip ascending to the jugular bulb was used.

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After the anatomical position of the internal jugular vein was studied and previous literature describing a percutaneous internal jugular vein canulation was reviewed, (Fig. 1)[11,12] a puncture about 2 cm above and 2 cm lateral to the clavicle head was made on the vein of a fresh cadaver. After that, dissection along the tract of the puncture was performed and the internal jugular vein was found underlying it. This study was aimed to find the average position of the midpoint of the internal jugular vein to make a puncture and place a catheter in Thai patients which would benefit physicians treating patients with abnormal cerebral metabolism.

MATERIAL AND METHOD

The fixed cadavers consisting of 18 males and 14 females were dissected at the proximal neck. The age at death ranged from 25 to 104 years (mean 71). The head was positioned supine with the neck extension of 30°. The skin and subcutaneous tissue were dissected to identify the sternal and clavicular head of the sternocleidomastoid muscle. The dissection was continued to identify the carotid sheath which was then dissected to identify the internal jugular vein. The first measurement was taken at 2 cm superior to the head of the clavicle and identified as a reference point. The second measurement was done laterally from the reference point to the internal jugular vein midpoint. The measurement was taken on both the right and left side of the proximal neck and the sizes of both the right and the left internal jugular veins at this level were measured. The average distances from the reference point to the midpoint, medial border, and lateral border of the internal jugular vein were calculated. The average size and percentage of the dominating internal jugular vein were also calculated.

RESULTS

The first distance was measured at 2 cm in all cadavers to make a reference point. The second distance was measured from the first point to the midpoint of the internal jugular vein ranging from 1.5 to 2.8 cm (mean 2.17 cm) on the right, and 1.5 to 2.5 cm (mean 2.08) on the left. The sizes of the internal jugular veins varied from 0.8 cm to 1.9 cm

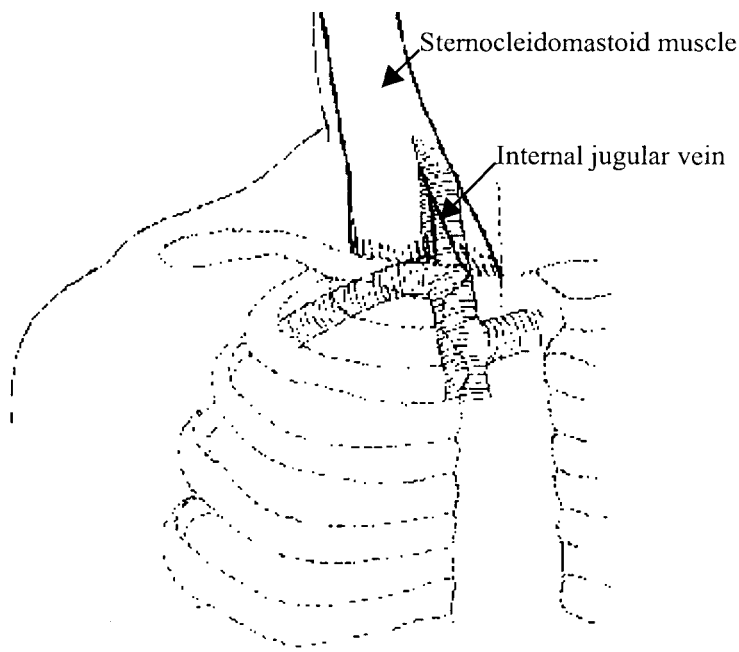

Fig. 1. Anatomy of internal jugular vein.

Table 1. Anatomical position of the internal jugular vein.

No.	Right				Left			
	Superior	Size	Lateral	Range	Superior	Size	Lateral	Range
1	2	1.4	2.8	2.1 - 3.5	2	2.8	2.5	1.1 - 3.9
2	2	1.2	2.2	1.6 - 2.8	2	1.5	2.5	1.75 - 3.25
3	2	1.8	1.8	0.9 - 2.7	2	0.9	2.3	1.85 - 2.75
4	2	1.9	2.2	1.25 - 3.15	2	1.2	2.5	1.9 - 3.1
5	2	1.5	2.5	1.75 - 3.25	2	1.1	2.5	1.95 - 3.05
6	2	1.5	2	1.25 - 2.75	2	1.4	1.8	1.1 - 2.5
7	2	1.5	2	1.25 - 2.75	2	1	2	1.5 - 2.5
8	2	1.5	3	2.25 - 3.75	2	1.2	2	1.4 - 2.6
9	2	1	1.8	1.3 - 2.3	2	1.2	1.8	1.2 - 2.4
10	2	1.8	2.3	1.4 - 3.2	2	0.8	2.5	2.1 - 2.9
11	2	1.5	2.3	1.55 - 3.05	2	0.9	2.5	2.05 - 2.95
12	2	1.8	3	2.1 - 3.9	2	1.1	2.1	1.55 - 2.65
13	2	1.2	2	1.4 - 2.6	2	0.9	1.8	1.35 - 2.25
14	2	1.8	2.5	1.6 - 3.4	2	1.2	2	1.4 - 2.6
15	2	1.5	2	1.25 - 2.75	2	1.2	1.8	1.2 - 2.4
16	2	1.6	2	1.2 - 2.8	2	0.9	1.9	1.45 - 2.35
17	2	1.3	2.5	1.85 - 3.15	2	1.2	2.3	1.7 - 2.9
18	2	1.5	2.4	1.65 - 3.15	2	0.8	2	1.6 - 2.4
19	2	1.5	2	1.25 - 2.75	2	1.9	2.1	1.15 - 3.05
20	2	1.4	2	1.3 - 2.7	2	1.3	2.2	1.55 - 2.85
21	2	1.5	1.8	1.05 - 2.55	2	0.9	1.8	1.35 - 2.25
22	2	0.8	1.5	1.1 - 1.9	2	0.8	2	1.6 - 2.4
23	2	1.2	1.9	1.3 - 2.5	2	0.6	1.8	1.5 - 2.1
24	2	1.2	2.1	1.5 - 2.7	2	1.1	2.1	1.55 - 2.65
25	2	1.3	2.3	1.65 - 2.95	2	1.1	2	1.45 - 2.55
26	2	1.6	2.3	1.5 - 3.1	2	1	2.2	1.7 - 2.7
27	2	1.4	2	1.3 - 2.7	2	0.5	2	1.75 - 2.25
28	2	1.4	2	1.3 - 2.7	2	1.2	2	1.4 - 2.6
29	2	1.5	1.8	1.05 - 2.55	2	0.6	1.5	1.2 - 1.8
30	2	1.2	2	1.4 - 2.6	2	0.9	2	1.55 - 2.45
31	2	1.3	2.4	1.75 - 3.05	2	1.1	1.5	0.95 - 2.05
32	2	1.4	2	1.3 - 2.7	2	0.6	2.5	2.2 - 2.8
Average	2	1.44	2.17	1.45 - 2.89	2	1.09	2.08	1.53 - 2.62

Superior :- Superior to the head of the clavicle Lateral :- Lateral to the head of the clavicle

Size :- Size of the internal jugular vein

Range :- Range of the position between the medial border and lateral border of the internal jugular vein from the reference point

(mean 1.44) on the right, and 0.5 cm to 2.4 (mean 1.09) on the left. The distance from the right reference point to the medial border of the right internal jugular vein varied from 0.9 cm to 2.25 cm (mean 1.45 cm). The distance from the right reference point to the lateral border of the right internal jugular vein varied from 1.9 cm to 3.75 cm (mean 2.89 cm). The distance from the left reference point to the medial border of the left internal jugular vein varied from 0.9 cm to 2.2 cm (mean 1.53 cm). The distance from the left reference point to the lateral border of the left internal jugular vein varied from 1.8 cm to 3.9 cm (mean 2.62 cm). The right internal jugular vein was found to dominate in 25 cadavers while the left internal jugular vein was found to dominate in the remaining 7 cadavers. The data of all the positions are shown in Table 1.

DISCUSSION

The surface anatomical landmark is important in surgical procedure. A venesection of the brachial vein was performed 2 fingers superior and 2 fingers anterior to the medial condyle of the humerus. To puncture the subclavian vein, the point is located inferior to the clavicle at the junction of one-third medial and two-thirds lateral of the clavicle. The anatomical landmark guides the surgeon in locating the underlying organ and making surgical procedure a success.

In this study, it was found that the average distance from the right reference point to the midpoint of the right internal jugular vein was 2.17 cm. The average distances from the right reference point to the medial and the lateral border of the right internal jugular vein were 1.45 cm and 2.89 cm, respectively. The distance from the reference point to the midpoint of the left internal jugular vein was 2.08 cm. The average distance from the left reference point to the medial and the lateral border of the left internal jugular vein was 1.53 cm and 2.62 cm, respectively. The right internal jugular vein of eighty-eight per cent of the cadavers was larger than the left. The average mid-position of the internal jugular vein was located in the average range between the medial and the lateral border of both the right and the left internal jugular veins. In this study, it was found that if the point 2 cm lateral to the reference point was selected on both the right and the left, this position was the range where the internal jugular vein of 90 per cent of all the cadavers was found.

In clinical application, the point for making an internal jugular vein catheterization should be about 2 cm above and approximately 2 cm lateral to the head of the clavicle (Fig. 2). This point is located between the sternal head and the clavicular head of the sternocleidomatoid muscle. There are two reasons why it is easier to puncture at this point than others. The first reason is that there are skin, subcuteneous tissue, and carotid sheath overlying the internal jugular vein making it easy to puncture. The other reason is that the distal part of the internal jugular vein is joined with the subclavian vein to form the inferior vena cava in the mediastinum. This is an immobilized portion of the internal jugular vein compared to the upper portion of the internal jugular vein in the neck. Puncturing the dominating right internal jugular vein was more successful than the left.

A complication of this procedure is injury to nearby organs such as the pleural cavity, lung, brachial plexus, trachea, esophagus, and common carotid artery. However, injury to these nearby

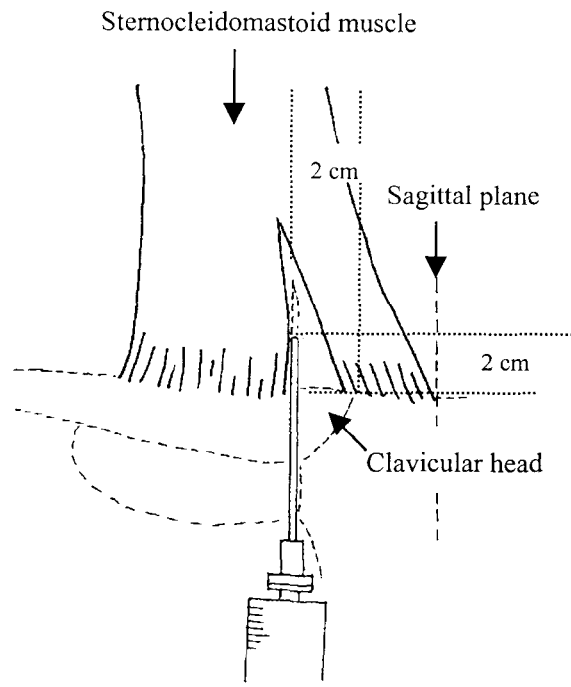

Fig. 2. Needle is aligned in parasaggital plane and directed superoirly to puncture internal jugular vein at 2 cm above and 2 cm lateral to the clavicular head.

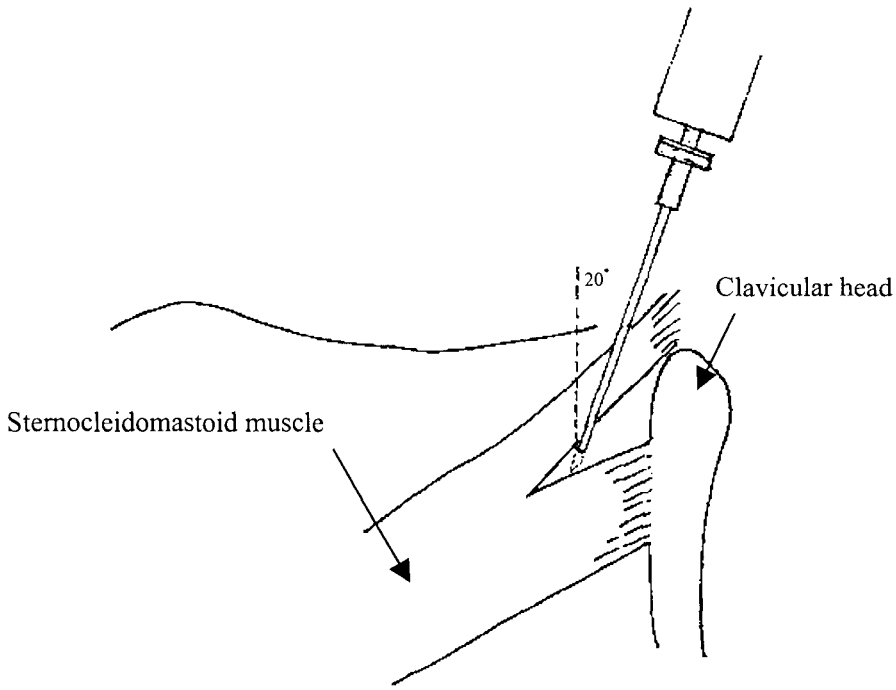

Fig. 3. Needle is aligned 20° vertical and directed superiorly to puncture internal jugular vein.

organs can be avoided by puncturing in the direction 10°-20° vertical (Fig. 3). Long-time catheterization increases the incidence of infection and thrombosis. Previous studies showed a low incidence of infection and complication of internal jugular vein catheterization but the incidence of subclinical internal jugular vein thrombosis was considerable(3,13-15).

At our center, subclavian catheters number 358 were used for the internal jugular catheter. The position of the patients was supine with 30° neck extension. After the skin was prepped and draped, the needle and its sheath with syringe was punctured at the point described (Fig. 2). The direction of the needle was 10°-20° vertical while gently aspirated (Fig. 3). The needle was penetrated deeply up to about 4 cm in large patients. If venous blood did not enter the syringe, it was slowly withdrawn while suction was maintained. When blood was aspirated, the syringe and needle were removed. The catheter with a guidewire was inserted into the needle's sheath until resistance was met. The guidewire was then removed and the catheter was aspirated. The catheter withdrew a few millimeters, if blood did not flow easily. The catheter was sustained into place using a 3-0 nylon suture. Sterile tape strips were applied. The catheter was left in place for 3-5 days after catheterization to treat abnormal oxygen saturation of the brain. The catheter patency was maintained by heparinized saline 1 unit per 1 ml flushes at 2-3 ml/h. The position of the catheter's tip was evaluated by crosstable lateral skull radiograph. Using this technique, neither arterial puncture nor pneumothorax was found.

SUMMARY

Thirty-two (32) Thai cadavers were dissected to find the point for puncturing and placing a catheter into the internal jugular vein. The point was found to be 2 cm above and 2.17 cm lateral to the right clavicular head for the right internal jugular vein, and 2 cm above and 2.08 cm lateral to the left clavicular head for the left internal jugular vein. The right internal jugular vein was found to dominate 88 per cent of all the cadavers. In clinical practice, the point 2 cm above and 2 cm lateral to the head of the clavicle was a highly successful puncture in the internal jugular vein.

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ตำแหน่งในการใส่สายสวนเข้าหลอดเลือดดำ internal jugular เพื่อดูดเลือดบริเวณ jugular bulb สำหรับหาค่าความเข้มข้นของออกซิเจนในเลือดดำที่ออกมาจากสมอง

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เพื่อศึกษาถึงตำแหน่งของการใส่สายสวนในหลอดเลือดดำเพื่อดูดเลือดบริเวณ jugular bulb ของหลอดเลือดดำ internal jugular ได้ชำแหละศพชาวไทย 32 รายพบว่าตำแหน่งที่เหมาะสมอยู่ที่ 2 เซนติเมตรเหนือต่อหัวของกระดูกไหปลาร้าและ 2.17 เซนติเมตรออกไปทางด้านข้างสำหรับหลอดเลือดดำ internal jugular ทางด้านขวา ส่วนตำแหน่งสำหรับหลอดเลือดดำ internal jugular ทางด้านซ้ายพบว่าอยู่ที่ 2 เซนติเมตรเหนือต่อหัวของกระดูกไหปลาร้าและ 2.08 เซนติเมตรออกไปทางด้านข้างหลอดเลือดดำ internal jugular ด้านขวามีขนาดใหญ่กว่าด้านซ้ายคิดเป็นร้อยละ 88 ของทั้งหมด ตำแหน่งนี้มีประโยชน์ในการใส่สายสวนในหลอดเลือดดำ internal jugular ย้อนขึ้นไปหา jugular bulb เพื่อดูดเลือดดำที่ออกมาจากสมองมาหาค่าความเข้มข้นของออกซิเจน ค่าที่ได้นี้มีความสัมพันธ์กับเมตาบอลิสมของสมอง

คำสำคัญ : การใส่สายสวนเข้าหลอดเลือดดำจูกูลาร์เส้นใน, ความเข้มข้นของออกซิเจนในหลอดเลือดดำ, ตำแหน่งทางกายวิภาค, คนไทย

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