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Research Paper

Changes in Intra-Cerebral Oxygenation Under Radical Neck Dissection During General Anesthesia

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ABSTRACT

Although external and internal jugular veins are usually resected under radical neck dissection for oral maxillofacial surgery, changes in the intra-cerebral environment after external and internal jugular veins resection are not well known. The aim of this study was to investigate whether external and internal jugular veins resection effected on the intra-cerebral environment or not. We studied 14 patients with an American Society of Anesthesiologists physical status of I or II who were scheduled to undergo radical neck dissection for oral cancer. There were six men and two women with a mean age of 61.5 years and mean weight of 58.1 kg. We measured the noninvasive blood pressure, pulse rate, oxyhemoglobin (oxy-Hb) level, deoxyhemoglobin (deoxy-Hb) level, total hemoglobin (total-Hb) and cytochrome oxydase (cyt) level. The maximum oxy-Hb level occurred 75 and 120 min after interna jugularis ligature (1.3 ± 4.2 nmol/L (n = 14)), deoxy-Hb level from 75 and 120 min (1.2 ± 2.2 or 2.3 nmol/L (n = 14)), the minimum total-Hb level 150 min (-1.4 ± 3.6 nmol/L (n = 14)), and cytochrome oxydase 60 min a (1.3 ± 4.2 nmol/L (n = 14)). There was no significant difference between the control time point and others in these parameters. An increase in the intra-cerebral oxy-Hb and deoxy-Hb levels was very slight. It is suggested that unilateral radical neck dissection, involving resection of the internal jugular and external jugular vein, do not influence on intra-cerebral oxygen.

KEYWORDS : intracerebral environment, oxyhemoglobin, deoxyhemoglobin, total hemoglobin, unilateral radical neck dissection

INTRODUCTION

The radical neck dissection is performed as a classical procedure in the management of metastasizing squamous cell carcinoma of the head and neck [1]. This procedure was designed to remove the lymph nodes of the neck and loss the spinal accessory nerve, the sternocleidmastoid muscle and external and internal jugular vein [2]. Then the loss of external and internal jugular veins is due to the decrease in cerebral blood circulation. Changes of venous blood flow in the cerebrum may lead to complications and affect often the blood circulation in microvascular anastomoses of free flap [1,3,4].

Although external and internal jugular veins are usually resected under radical neck dissection for oral maxillofacial surgery, changes in the intra-cerebral environment after external and internal jugular veins resection are not well known.

Near-infrared spectroscopy (NIRS) is a noninvasive bedside technique that may be used to monitor the intracerebral environment and is capable of measuring changes in the concentration of intracerebral oxyhemoglobin (oxy-Hb), deoxyhemoglobin (deoxy-Hb), total hemoglobin (total-Hb), and cytochrome oxidase (cyt) [5]. We designed this study to measure those parameters of the intra-cerebral environment during radical neck dissection by NIRS measurement. And the aim of this study was to investigate whether external and internal jugular veins resection effected on the intra-cerebral environment or not.

MATERIALS AND METHODS

This observational study was approved by the Committee on Clinical Investigation for Human Research at Iwate Medical University.

Table 1 Demographic data
Data are presented as mean±S.D

Number of patients	14
Age (yrs)	61.5±10.8
Weight (kg)	58.1±7.3
Sex (M:F)	11:3
Type of surgery	Radical neck resection

We studied 14 patients with an American Society of Anesthesiologists physical status of I or II who were scheduled to undergo radical neck dissection for oral cancer. There were eleven men and three women with a mean age of 61.5 years and mean weight of 58.1 kg (Table 1). All patients underwent intravenous administration of atropine sulfate (0.05 mg/kg) and midazolam (0.5 mg/kg) 30 min before admittance to the operating room. Measurements were made with the patients in the supine position. All patients breathed 100% oxygen with a mask for 5 min before induction, and fentanyl was administered in the operating room. The induction anesthetic was administered intravenously. After loss of verbal contact and the eyelash reflex, ventilation was gently assisted with an F circuit using a fresh gas flow of 6 L/min (100% oxygen). We monitored the noninvasive blood pressure (BP), pulse rate (PR), and blood oxygen saturation (SpO2) with a Life Scope 8® (Nihon Kohden, Tokyo, Japan) and changes in the oxy-Hb, deoxy-Hb, total-Hb, and cyt levels with a near-infrared oxygenation monitor (NIRO 500®; Hamamatsu Photonics, Hamamatsu, Japan). The NIRO sensor was placed on opposite sides of the forehead before starting the operation. The optodes of the NIRO were placed in an opaque optode holder supplied by the manufacturer, and the holder was secured to the forehead with tape. This resulted in an optode separation of 4.8 cm. To ensure light shielding, the NIRO sensors were covered with crepe bandage wrapped loosely around the head. The NIRO measured the changes in parameters from a baseline that was set at zero at the start of measurement. Baseline measurements were made for 1 or 2 min.

All parameters were continuously recorded using a PowerLab 4/25T data acquisition system (ADInstruments, Bella Vista, Australia). Each parameter before operation start (control) was compared with that at

45 min before externa jugularis ligature, 30 min before externa jugularis ligature, 15 min before externa jugularis ligature, externa jugularis ligature, 15 min after externa jugularis ligature, 30 min after externa jugularis ligature, 15 min before interna jugularis ligature, interna jugularis ligature, 15 min after interna jugularis ligature, 30 min after interna jugularis ligature, 45 min after

Table 2 Changes in intra-cerebral oxygen during radical neck dissection

Time	Δ oxy-hemoglobine (nmol/L)	Δ deoxy-hemoglobine (nmol/L)	Δ total-hemoglobine (nmol/L)	Δ cytochrome oxydase (nmol/L)
Operation start	0.0	0.0	0.0	0.0
45 min before externa jugularis ligature,	-0.3±3.9	0.0±2.7	-0.4±4.1	0.3±1.4
30 min before externa jugularis ligature	0.1±3.9	-0.2±3.1	0.1±4.0	0.1±1.4
15 min before externa jugularis ligature	0.1±3.7	-0.1±2.9	0.8±3.4	0.3±1.5
externa jugularis nacht	-0.1±2.9	0.1±2.7	-0.1±3.8	0.7±2.1
15 min after externa jugularis ligature	0.9±3.8	0.3±2.2	-0.1±4.1	0.5±2.1
30 min after externa jugularis ligature	0.9±3.8	0.2±2.0	-1.0±3.5	0.6±2.0

(a) Changes in intra-cerebral oxygen before or after externa jugularis ligature

(b) Changes in intra-cerebral oxygen before or after interna jugularis ligature

Time	Δ oxy-hemoglobine (nmol/L)	Δ deoxy-hemoglobine (nmol/L)	Δ total-hemoglobine (nmol/L)	Δ cytochrome oxydase (nmol/L)
15 min before interna jugularis ligature	0.9±3.9	0.2±2.3	0.9±3.9	0.7±1.9
interna jugularis nacht	0.7±3.9	0.1±2.0	-0.5±3.6	0.5±1.8
15 min after interna jugularis ligature	0.4±3.9	0.4±2.2	-0.5±3.5	0.7±1.8
30 min after interna jugularis ligarure	1.0±4.1	0.6±2.0	-0.7±3.6	0.7±2.1
45 min after interna jugularis ligature	1.1±4.5	1.1±2.2	-0.5±3.9	0.7±2.3
60 min after interna jugularis ligature	1.1±4.5	0.9±2.3	-0.6±4.8	0.8±2.4
75 min after interna jugularis ligature	1.3±4.2	1.2±2.3	-0.4±3.5	0.6±2.4
90 min after interna jugularis ligature	1.2±4.6	1.2±2.3	-1.0±3.3	0.6±2.0
105 min after jugularis ligature	1.2±4.3	1.2±2.3	-1.0±3.1	0.6±2.0
120 min after interna jugularis ligature	1.3±4.2	1.2±2.2	-1.3±3.0	0.6±2.0
135 min after interna jugularis ligature	0.7±4.4	1.2±2.3	-1.1±3.6	0.5±2.0
150 min after interna jugularis ligautre	0.7±4.6	1.0±2.3	-1.4±3.6	0.7±2.1

interna jugularis ligature, 60 min after interna jugularis ligature, 75 min after interna jugularis ligature, 90 min after interna jugularis ligature, 105 min after jugularis ligature, 120 min after interna jugularis ligature, 135 min after interna jugularis ligature, 150 min after interna jugularis ligature

Values are presented as mean ± standard deviation. Intragroup comparisons were made using one-way analysis of variance for repeated measurements followed by Dunnett's test for multiple comparisons. Differences were considered statistically significant at $P < 0.05$.

RESULTS

The changes in invasive BP and PR are shown in Figure 1. The states of hemodynamics are stable during radical neck dissection. The value of oxy-Hb increased slightly after externa juglaris ligature and deoxy-hemoglobin slightly increased after interna juglaris ligature. The maximum oxy-Hb level occurred 75 and 120 min after interna jugularis ligature (1.3 ± 4.2 nmol/L (n = 14)), and there were no significant difference between the control time point and others (Table 1 and Fig. 2). The maximum deoxy-Hb level occurred from 75 and 120 min after internal jugularis ligature (1.2 ± 2.2 or 2.3 nmol/L (n = 14)), and there were no significant difference between the control time point and others (Table 1 and Fig. 2). The value of total-hemoglobin decreased slightly after externa juglaris ligature and the minimum total-Hb level occurred 150 min after interna jugularis ligature (-1.4 ± 3.6 nmol/L (n = 14)), and there were no significant difference between the control time point and others (Table 1and Fig. 3). The value of cytochrome oxydase slightly increased after externa juglaris ligature and the maximum level occurred 60 min after interna juglaris ligature (1.3 ± 4.2 nmol/L (n = 14)), there were no significant difference between the control time point and others (Table 1and Fig. 3).

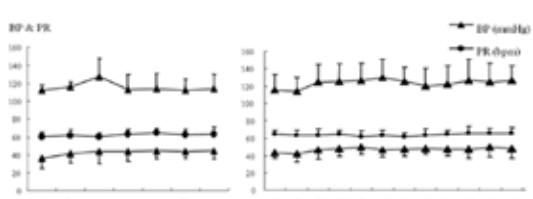

Fig.1 Changes of blood pressure and pulse rate during radical neck dissection

Marks: (a) operation start, (b) 45 min before externa jugularis ligature, (c) 30 min before externa jugularis ligature, (d) 15 min before externa jugularis ligature, (e) externa jugularis ligature, (f) 15 min after externa jugularis ligature, (g) 30 min after externa jugularis ligature, (h) 15 minbefore interna jugularis ligature, (i) interna jugularis ligature, (j) 15 min after interna jugularis ligature, (k) 30 min after interna jugularis ligature, (l) 45 min after interna jugularis ligature, (m) 60 min after interna jugularis ligature, (n) 75 min after interna jugularis ligature, (o) 90 min after interna jugularis ligature, (p) 105 min after jugularis ligature, (q) 120 min after interna jugularis ligature, (r) 135 min after interna jugularis ligature, (s) 150 min after interna jugularis ligature

The states of hemodynamics are stable during radical neck dissection.

DISCUSSION

In the present study, we observed an increase in the intracerebral oxy-Hb and deoxy-Hb levels after externa jugularis and interna jugularis ligature and decreased in total-Hb under radical neck dissection during general anesthesia.

During radical neck dissection, there was a slight increase in the oxy-Hb level after extra jugularis ligature and in the deoxy-Hb level after internal jugularis ligature. Generally, the simultaneous increase in the oxy-Hb and deoxy-Hb levels indicates a state of venous congestion since there are oxy-Hb (almost 70%) and deoxy-Hb (almost 30%) in venous blood which is measured mainly by NIRS. Radical neck dissection involves resection of the internal jugular and external jugular vein though the intra jugular vein is the most important pathway for venous blood returning from the brain [6]. When the unilateral radical neck dissection is performed with resection of the unilateral internal jugular and external jugular, the main pathway for venous blood returning from the brain is lost. Therefore, venous congestion should occur in intra-cerebral. In this study, an increase in the intracerebral oxy-Hb and deoxy-Hb levels after externa jugularis and externa jugularis ligature occurred and it was impossibility to suggest venous congestion in intra-cerebral. But an increase in the intracerebral oxy-Hb and deoxy-Hb levels was very slight. What clinical relevant changes in oxy-Hb and deoxy-Hb levels are not well known in NIRS. Though the changes in the intracerebral oxy-Hb and deoxy-Hb levels might indicate a state of venous congestion, really this observed increase in these was in the range of cerebral autoregulation limits and would not be expected to be associated with venous congestion. In this study, it is suggested that nilateral radical neck dissection, involving resection of the internal jugular and external jugular vein, do not influence on intra-cerebral oxygen.

CONCLUSIONS

We observed a slight increase in the intracerebral oxy-Hb and deoxy-Hb levels after the internal jugular and external jugular vein ligature during unilateral radical dissection. Since an increase in the intra-cerebral oxy-Hb and deoxy-Hb levels was very slight, it is suggested that unilateral radical neck dissection, involving resection of the internal jugular and external jugular vein, do not influence on intra-cerebral oxygen.

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