Malpositions of Central Venous Catheter

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== 국문초록 ==

중심정맥압 측정 카테테르 위치이상 3예 보고

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중심정맥압은 혈액량, 정맥tone, 우심장의 기능을 나타내는 지표로서, 중심정맥압을 측정하기 위해서는 상지의 말초혈관, 내외경정맥, 쇄골하정맥 등을 통해서 카테테르를 중심정맥내로 삽입하여야 한다. 그러나 카테테르 삽입조작 또는 카테테르 자체에 의해서 감염, 신경 또는 주위조직 손상, 혈종, 혈전성 정맥염, 공기색전증, 카테테르 색전증, 수흉 등의 각종 합병증이 발생할 수 있다. 따라서 이런 합병증을 예방하기 위한 각종 카테테르 거치 방법이 소개되어 있기는 하나, 아직까지 이러한 합병증을 완전히 없앨 수 있는 방법 및 카테테르 재료는 소개되어 있지 않다.

저자들은 개심술시 중심정맥압을 관찰하기 위해서 우쇄골하정맥, 우내경정맥을 통해 각각 삽입한 카테테르의 위치이상 3예를 경험하였는데, 제 1 예에서는 우내경정맥에 삽입한 카테테르가 우내경정맥내에서 2회 회전 한후 우내경정맥동을 향해 카테테르 끝이 제 4 경추 부위에 위치하고 있었으며, 제 2 예에서는 우내경정맥에 삽입한 카테테르가 제 3 늑간 부위에서 우내경정맥쪽으로 역행하여 제 1 흉추부위에 위치하고 있었고, 제 3 예에서는 우쇄골하정맥으로 삽입한 카테테르가 우내경정맥으로 삽입되어 카테테르끝이 제 5 경추부위에 위치하였다.

Key Words: Central venous catheter, Malposition

INTRODUCTION

Central venous cannulation is commonly used and indicated for central venous pressure(CVP) monitoring, lack of peripheral veins for cannulation, intravenous administration of various drugs likely to injure peripheral veins and tissues, rapid infusion of blood and fluid, frequent mixed venous blood sampling, aspiration of air emboli, hyperalimentation, and insertion of pulmonary artery catheter etc¹⁾.

However, regardless of the usefulness of central venous cannulation, it may cause some complications¹⁾ such as local and/or systemic infection, nerve, artery and vein injuries, hematoma and

extravasation of infused substances, thrombophlebitis, catheter shearing and embolization, air embolism, perforation of right atrium catheter, thoracic duct perforation and pneumothorax etc. which may occur in various ways according to the veins and techniques used. Therefore, various easy and safe techniques for central venous cannulation have been developed to minimize these complications, but, a few complications are still reported²⁻⁵⁾.

The authors experienced 3 cases of malpositioned central venous catheters for CVP monitoring two through the internal jugular vein (IJV) and one through the subclavian vein (SCV) in patients with open heart surgery (OHS).

CASE REPORTS

Case 1.

The 7-year-old male (weight 18 kg, height 112 cm) ASA class II patient was transferred to operating room for OHS because of ventricular septal defect. After induction of general endotracheal anesthesia, the patient was placed in Trendelenburg position with his head rotated completely to the left and his shoulders raised by inserting a rolled blanket beneath them. Skin preparation was done with Potadine® (povidone-iodine). A sterile drape covered the surrounding area and a sterile technique was followed until the procedure was completed. A 17 gauge Intracath® with wire stylet (catheter 19 gauge, 12 inch, Deseret, USA) was directed toward the right nipple at a 30 degree angle to the skin at the apex of the triangle made with two sternal and clavicular heads of the sternocleidomastoid muscle and clavicle, and advanced the needle while watching a free flow of venous-colored blood in the catheter. When IJV was identified by watching a free flow of venous-colored blood in the catheter, the catheter was inserted about 20 cm into the vessel after removing the wire stylet with a considerable feeling of resistance. When the catheter was connected to the pressure transducer to observe pressure wave forms on an oscilloscope, the pressure waves were flat regardless of enough inserted length of the catheter. But, there was a very good regurgitation of venous-colored blood by applying a slight negative pressure with syringe plunger. The cannula was secured in place and the puncture site of the skin dressed with a sterile gauze pad. The patient was returned to the supine position for operation.

The chest X-ray taken after surgery showed that the catheter had made two turns in the right IJV, and its tip had gone cephaladly into the jugular bulb and located at the level of the 4th cervical vertebra (Fig. 1).

Fig. 1. A chest x-ray showing the central venous catheter made two turns in the Rt. IJV bulb. Arrow indicates the catheter tip.

Case 2.

The 9-year-old female (weight 27 kg, height 123 cm) ASA class II patient was admitted for OHS under diagnosis of atrial septal defect and tricuspid stenosis. After anesthetizing the patient, central venous cannulation to the right IJV with a 17 gauge Intracath® with wire stylet (catheter 19 gauge, 12 inch, Deseret, USA) was performed as the same method described in case 1. When the catheter was administered into the vessel, there was a good central venous pressure waves on the oscilloscope and it was easy to regurgitate the venous-colored blood through the catheter. The catheter was secured in place and dressed with a sterile gauze pad. The patient was returned to the supine position for surgery.

The chest X-ray taken after the completion of surgery demonstrated that the catheter was turned backward into the right IJV at the level of the 3rd intercostal space and its tip was located at the level of the 1st thoracic vertebra (Fig. 2).

Case 3.

The 2-year-old female (weight 10 kg, height 81 cm),

Fig. 2. A chest x-ray demonstrating the catheter with a backward turn toward Rt.IJV at the level of the 3rd intercostal space and its tip located at the level of the 1st thoracic vertebra. Arrow indicates the catheter tip.

Fig. 3. A film of chest x-ray showing the catheter gone into the Rt.IJV from the Rt.SCV and ended at the level of the 5th cervical vertebra. Arrow indicates the catheter tip.

ASA class II patient received a right SCV cannulation for CVP monitoring during OHS because of atrial septal defect. After induction of general endotracheal anesthesia, the patient was placed in slight Trendelenburg position and her head rotated 90 degrees to the left. Skin preparation was done with Potadine and draped. A 17 gauge Intracath® with wire stylet (Cathter 19 gauge, 12 inch, Deseret, USA) was inserted at about one fingerbreadth below the inferior border of the midpoint of the clavicle and

slowly advanced under the clavicle toward the suprasternal notch as a target until free return of venous blood appeared. Thereafter, the catheter was inserted about 20 cm through the needle after removing the stylet. After identifying a free recovery of venous-colored blood from the catheter, the catheter was sutured to the skin and a dressing was applied over the site using a gauze pad.

A X-ray film of the chest taken after the completion of surgery revealed that the catheter had gone into the right IJV from the SCV and ended at the level of the 5th cervical vertebra (Fig. 3).

DISCUSSION

The choice of a particular site for central venous cannulation is determined by accessibility, convenience, success rate in directing the catheter to the central venous circulation, risk to the patient and probable duration of use. Many veins approaching central veins can be used: peripheral veins of extremities, external or IJV, SCV and femoral vein etc..

Cannulation of peripheral veins of upper extremities causes minimal complications and is easily accessible but success rate in directing the catheter to the superior vena cava (SVC) or right atrium is about 59~88% owing to difficulty in inserting the catheter into the central vein^{6,7)}. However, there is a 91% success rate of central cannulation by way of the antecubital vein using a J-wire guide with a 2~10% occurrence rate of phlebitis by Smith et al⁸⁾.

Because the external jugular vein is easy to see with the naked eye and a thin walled vessel, cannulation is easy with a success rate of 59~74% by use of J-wire guide⁹⁾.

The highest success rate (90~98%) of localizing the catheter in the SVC or right atrium is achieved through the IJV especially if the right IJV is used. There is a risk of cannulating the carotid artery with hematoma, pneumothorax, subcutaneous em-

physema, cardiac temonade and malignant dysrhythmias with about 2% occurrence rate of complications¹⁰⁻¹³). Right IJV is preferred to left IJV because of anatomical characteristics such as lower lung apex and straighter relationship of right IJV to right brachiocephalic vein and SVC than the left IJV and the absence of the thoracic duct on the right.

Cannulation of the SCV which is not fixed to the muscle or fascias and maintains its diameter even with hypovolemia is one of the most commonly used techniques because of advantages such as long duration of use, good accessibility and relatively high success rate. But, it has very high incidence of pneumothorax¹⁴). Contraindications to using the SCV route include barrel chest, pulmonary emphysema, coagulation disorder, and anomaly of the clavicle by Feiler et al¹⁵). There are two approaching techniques --- supraclavicular and infraclavicular --- to the central vein by way of the SCV. Of two techniques used, the infraclavicular approach method is clinically preferred to the supraclavicular one. Occurrence rate of malpositions by method of the infraclavicular technique is 5.5% by Malatinsky et al¹⁶) and 24% by Deitel et al¹⁷) respectively, and that by use of the supraclavicular technique is 1.4% by Malatinsky et al¹⁶).

Methods to know a successful placement of the catheter tip in the central veins include a measurement of inserted catheter distance from the skin, observation of P wave using transvenous ECG electrode, changes in CVP during respiration cycle, pressure wave tracing method on the oscilloscope, and chest X-ray which is the most reliable method⁵). In the authors' case, because chest X-ray were not taken immediately after the catheter placement, malpositions could not be found during surgery.

In summary, the authors experienced 3 cases of central venous catheter misplacement for CVP monitoring during OHS in patients including a 7-year-old male, a 9-year-old female, and 2-year-old female. One of the catheter misplacements was that

the catheter made two turns in the right IJV and its tip toward the jugular bulb and located at the level of the 4th cervical vertebra. Another was that the catheter was turned backward into the right IJV at the level of the 3rd intercostal space and its tip was located at the 1st thoracic vertebra. The other was that the catheter went into the right IJV from the SCV and ended at the level of the 5th cervical vertebra. It is recommended that methods for knowing a correct catheter placement should be taken immediately after completion of the procedure to insure a successful catheter placement.

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