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# Radial Nerve Paralysis due to Kent Retractor during Upper Abdominal Operation

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After general anesthesia, peripheral nerve paralysis is a rare complication. The frequently damaged nerves including: branches of the brachial plexus, the ulnar, radial and common peroneal nerves, and sometimes the facial nerve. The radial nerve is the most infrequently damaged one, accounting for only 3% of nerve damage. We report a case of radial nerve paralysis due to self retractor during abdominal operation, its clinical findings, and review of the literature on peripheral nerve paralysis.

**Key Words:** Paralysis, radial nerve, self retractor

## INTRODUCTION

Peripheral nerve paralysis is one of the rare complications following general anesthesia. The frequently damaged nerves including: branches of the brachial plexus, the ulnar, radial and common peroneal nerves, and sometimes the facial nerve. Direct damage through nerve block or surgery, pressure damage through a self retractor, a hard operating table or pneumatic tourniquet, and stretching due to malposition are the various causes of nerve damage.[1] Among the legal suits filed after anesthetic complications, 15% are because of damage to nerves. The most frequently damaged nerve is the ulnar nerve, accounting for one third of all nerve damages. The brachial nerve and lumbosacral nerve roots are the next most frequently damaged nerves, and account for 23 and 16% of damages, respectively. The radial nerve is the most infrequently damaged one, accounting for only 3% of nerve damage.[2] Here we present a case of radial nerve damage, following an abdominal operation. The patient had no neurological disease, or any history that might have caused it.

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## CASE REPORT

A 52-year-old female patient, with stomach cancer (signet ring cell cancer), was admitted to the General Surgery Department. She had no particular family history. She had received a total abdominal hysterectomy for a uterine sarcoma 6 years previously. She had been taking amlodipine (Novasc®, 5 mg/tablet, Pfizer, Korea) 2 tablets/day for 5 months under the diagnosis of hypertension. Her height and weight were 161.5 cm and 95.5 kg, respectively. She was obese, with a weight of 173% of her ideal body weight. Her blood pressure, heart rate and body temperature, were measured as 120/70 mmHg, 72/min and 36.4℃, respectively. She had no abnormal laboratory results. Glycopyrrolate, 0.2 mg, and midazolam, 2.5 mg, were intramuscularly injected, as a premedication, 1 hour prior to her operation. She was laid supine on the operating table with her left arm 90° abducted, and fixed on an arm board. Her right arm was cuffed to measure her blood pressure, with a large adult cuff (length; 50 cm, width; 14 cm). The blood pressure was measured constantly using an automated blood pressure monitor (Space Labs Inc., Model 90622A, Redmond, WA, USA), with her arm fully adducted to her side. Her left forearm was supinated, and her

right forearm was fixed in a neutral position. The blood pressure was measured at 3 minutes time intervals from her induction, and every 5 minutes thereafter.

After induction with 325 mg thiopental sodium and 75 mg succinylcholine, the patient was intubated with a 7.0 mm endotracheal tube. The anesthetic depth was maintained with $N_2O$ 2 l/min, $O_2$ 2 l/min and isoflurane (0.8-2 vol%) in a semi closed circle. Sixty minutes after initiation of the operation, a Kent retractor (Model TKZ-F10328, Takasago, Tokyo, Japan) was applied across the abdominal wall (Fig. 1). A radical subtotal gastrectomy and a gastroduodenostomy were performed. The operation took 280 minutes, and a total anesthesia time of 305 minutes. There were no particular events, such as blood pressure fluctuation, during the anesthesia.

On postoperative day one, the patient complained of pain in her right shoulder and the lateral side of her right hand. She also had paresthesia on the dorsal side of her right forearm (Fig. 2) and wrist drop (Fig. 3). On a neurological examination, the extensor muscle power, below the right elbow, was much decreased, and the ulnar nerve area, 5 cm below the right elbow, showed analgesia and hypoalgesia. The biceps and triceps reflexes of the right arm were normoactive. The radiological studies of right shoulder joint and cervical spine showed no particular lesions. The electromyography and nerve conduction test revealed incomplete right radial nerve injury above the elbow level. The patient received physiotherapy, and was discharged on postoperative day 19, with slightly a improved state. One month after her discharge, the analgesia disappeared and the hypoalgesia improved. After 2 months, the wrist drop resolved completely, with no neurological complication.

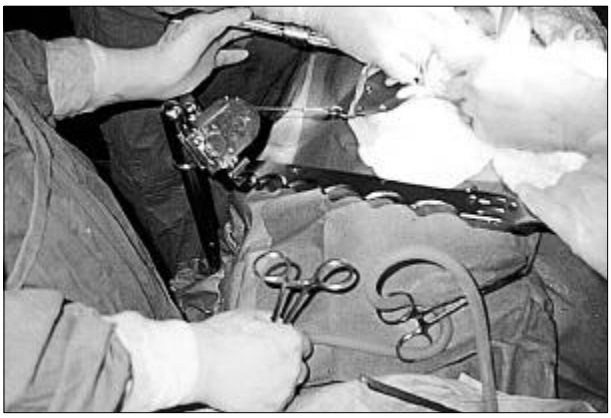

**Fig. 1.** Kent retractor being utilized during upper abdominal operation in another patient. The transverse bar with the supporting column can be seen.

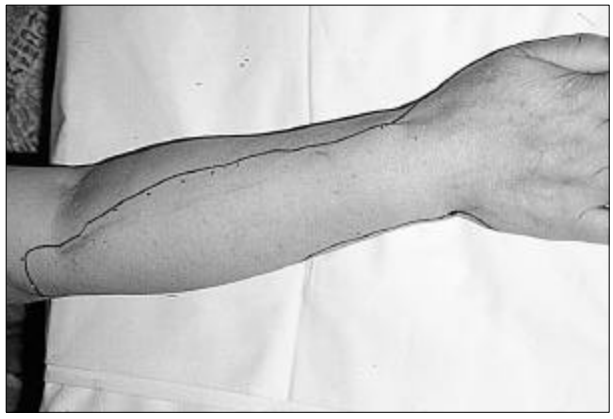

**Fig. 2.** A dermatome at right forearm which radial nerve innervates with sensory loss (outlined in black).

**Fig. 3.** A patient's arm held perpendicular showing "wrist drop".

## DISCUSSION

The radial nerve paralysis can result from a complex humerus fracture, direct nerve trauma, compressive neuropathies, neuritis, or rarely from malignant tumor formation. The most frequent site of non-traumatic radial nerve lesion is the upper arm.[3] The radial nerve traces along the spiral groove of the humerus, along with the deep radial artery, and exits through the lower 1/3 of

the lateral side of the upper arm, penetrating the external fascia.[4] The radial nerve is situated near the skin, and is covered with a thin fat layer. This is why there are high incidences of nerve injury caused by external mechanical forces.

Slocum, et al.[5] pointed out that one could damage peripheral nerves by malpositioning on the operating table. Clausen[6] reported several cases of brachial plexus injury of this type. Injury to the brachial plexus is easily seen when the upper arm is over-extended, over-abducted, and externally rotated, with the head turned to the other side.[7] In this case, the patient's right arm was fixed to her side, and there was no positional change that would stretch her right brachial plexus. Since the patient's left arm, which was extended and externally rotated, showed no nerve damage, one could not suspect inaccurate positioning as the cause of the nerve damage.

The radial nerve injuries, using automated blood pressure monitor, have been reported.[8-10] They thought a prolonged inflation time caused by artifact movement, had caused the damage. In our case, we used a Space labs model 90662A automated blood pressure monitor. The normal adult cuff (length; 50 cm, width; 14 cm) was applied to the patient's right arm. The distal edge of the cuff was situated where the right radial nerve passes. The maximum cuff pressure of the machine in an adult is 290 mmHg, and the pre-set limit of the overpressure is 300 ± 10 mmHg. The time taken to measure the blood pressure was less than 60 seconds, and the safety timeout was 115 seconds. The maximum inflation time was 30 seconds, and the limit of pump-up pressure was 165 mmHg or 37 mmHg higher than the last systolic blood pressure.[11]

To test the blood pressure monitor, a cuff was applied to the upper arm of a 75 kg man. After an automated measurement, a manual measurement was also made. The automated blood pressure was 127/74 mmHg, and the manual blood pressure was 125/70 mmHg. There was no significant difference between the two measurements. The inflation time, blood pressure measuring time, and maximum pump up pressure, of the automated blood pressure monitor were 8, 43 seconds, and 165 mmHg, respectively. Minimal to moderate movement, such as constant vibration of the arm, had no effect on the machine. The monitor did not work when violently moved, such as with flexion and extension of the arm, or when a compression force was applied to the cuff. The maximum inflation time was 30 seconds, and the cuff was automatically deflated after 100 seconds. Rorabeck[12] reported that to cause irreversible damage to the nerve passing under the tourniquet, one would need 250 mmHg of pressure for at least 45 minutes to an hour. The nerve segment distal to the tourniquet showed no complete block, even after 3 hours with a 250 mmHg cuff pressure. In this case, no malfunctioning of the blood pressure monitor, or blood pressure fluctuation (systolic blood pressure; 140 - 100 mmHg, diastolic blood pressure; 80 - 60 mmHg), was found. Even if the Kent retractor squeezed the cuff, the cuff could not have been the cause of the nerve injury because the cuff had deflated after 100 seconds.

Britt, et al.[13] reported cases of radial nerve injury caused by the pressure applied to the lateral side of the upper arm by a vertical bar of the anesthesia screen. The radial nerve injuries have been reported following the use of a self retractor for the dissection of the left internal mammary artery for coronary artery bypass grafting.[14-16] The Kent retractor was placed across the patient's abdomen (Fig. 1) an hour after the beginning of the operation. The self retractor's supporting column was fixed to the table rail 5 cm above the right elbow joint, which is where the nerve damage had developed. The shoulder width of the patient was 47 cm, and the width of the table was 51 cm. Considering the size of the patient's right upper limb, the Kent retractor would have borne down on the distal 1/3 of the right arm. The pressure applied by the retractor, over a long time, could have caused the radial nerve injury.

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