

## Brachial plexus injury related to improper positioning during general anesthesia

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### Introduction

Brachial plexus injury is one of the most common nerve injuries associated with the improper positioning of the patient during general anesthesia [1,2]. Careful attention by the surgeon and anesthesiologist is essential to prevent such neurological injuries [3]. There have been a number of reports concerning brachial plexus injury following general anesthesia [2–4]. However, few of the reports are related to urological operations. We report an unusual case of brachial plexus injury related to the improper perioperative positioning of a patient who underwent laparoscopic radical nephrectomy.

### Case report

A 42-year-old man had a hand-assisted laparoscopic radical nephrectomy for renal cell carcinoma of the left kidney. His past medical history was remarkable for mild hypertension and renal insufficiency (creatinine clearance, 80 ml·min<sup>-1</sup>). He had no preexisting neurological disorder. His height was 170 cm and weight, 71 kg (body mass index [BMI], 24.6). Anesthesia was induced in the usual manner using fentanyl, thiopental, and atracurium. The patient was placed in the right lateral decubitus position and leaned backward about 60° with a supported roll under the left scapula. His head was in the neutral position. His left arm was in hyperabduction of 120° and was suspended from an L-shaped bar (Fig. 1). The procedure lasted for 7 h. The left radial arterial pulse was palpably strong and the pulse oxim-

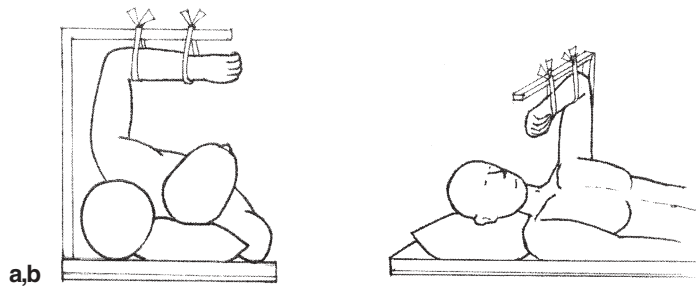
etry wave from the left hand was normal throughout the operation. There were neither prolonged hypotensive episodes nor other intraoperative complications. The core temperature of the patient was kept above 35°C. Anesthesia was maintained with N<sub>2</sub>O, O<sub>2</sub>, isoflurane, atracurium, and morphine.

Postoperatively, the patient complained of weakness in his left upper extremity. The motor power was graded as follows: deltoid, 4; supraspinatus, 5; biceps, 4; brachioradialis, 4; triceps, 4; and wrist and finger flexors/extensors, 3. Pinprick sensation was also decreased along his C7-T1 dermatome. Deep tendon reflexes of the left biceps and brachioradialis muscles were absent. A diagnosis of incomplete, total arm-type, brachial plexus injury was suspected. Four weeks after the injury, an electrodiagnostic study was performed to confirm the diagnosis. The patient was treated conservatively with physiotherapy and a rehabilitation program. Over the next few days, sensation and motor power completely returned. At follow-up 1 month after discharge, the patient had hyperesthesia in the affected limb.

### Discussion

Brachial plexus injury is one of the most common nerve injuries related to malpositioning of the patient during general anesthesia. It is also an important cause of malpractice claims [1].

The distribution of motor weakness and decreased sensation defined the lesion at the level of the brachial plexus in our patient. The absence of deep tendon reflexes effectively ruled out an upper motor neuron lesion. In addition, the pattern of motor weakness and sensory loss observed, combined with the absence of radicular pain, made a nerve root lesion quite unlikely as well. The extent of involved muscle was too great to be attributed purely to a peripheral nerve injury [5].



**Fig. 1a,b.** Patient's position. **a** Sagittal view; **b** lateral view

Direct trauma, excessive stretching, external pressure, or some combination of these effects, was reported to have caused the acute onset of brachial plexus injury in such cases [3,4,6]. Our patient had no prior history of trauma or bleeding tendency. The surgical procedure was noninvasive, and there was no hematoma formation noted subsequently in his limb. These facts made stretching the most likely cause of his brachial plexus injury.

The brachial plexus is susceptible to injury during anesthesia and surgery because it is long and firmly attached to the vertebrae and prevertebral fascia proximally, and the axillary fascia distally. Its lack of mobility and close proximity to bony structures such as the first rib, clavicle, coracoid process, and head of the humerus cause it to be easily compressed when there is improper positioning of the patient [2]. This is especially true during general anesthesia, when muscle tone is already reduced by muscle relaxants and anesthetic agents [6]. Moreover, the anesthetized patient is unable to perceive pain or numbness caused by ischemia of the vasa nervorum arising from stretching and compression of the nerve bundle.

In our patient, the injury to the brachial plexus was distal to the trunk level because of the sparing of the supraspinatus muscle. This muscle is supplied by the suprascapular nerve, the first branch from the upper trunk of the brachial plexus. The most likely cause of the injury was thought to be a combination of the downward tilting of the head and the hyperabduction of the arm, which probably stretched the brachial plexus, especially at the cord level where it passes beneath the coracoid process of the scapula.

The spectrum of injuries can vary from neurapraxia to axonotmesis [7]. Treatment of brachial plexus injury varies depending on the mechanism and the time the injury is discovered in relation to the inciting trauma [6]. Current treatments include protection of the hypesthetic skin from further injuries, physical therapy to avoid muscle wasting and joint change, daily intermittent galvanic stimulation to the affected muscle, or

surgery if recovery does not occur [3]. The recovery times may vary anywhere from hours to months. Sensation always returned first, followed by motor function of the lower roots, then the upper roots [6].

Not only the lateral decubitus position in urological procedures but also other types of operation and other positions cause brachial plexus injury [8,9]. In order to prevent or minimize the severity of brachial plexus injuries that may be related to the perioperative positioning of patients, the following recommendations have been made [7,10]:

- Avoid extension and external rotation in the supine position by limiting arm abduction to no more than 90° in the neutral position, using padded arm boards.
- Avoid extreme abduction in the prone position by tucking in and padding the arms by the patient's side, rather than abducting the arm above the head by more than 90°, which will unduly stretch the brachial plexus.
- In the steep head-down position, tuck the arms in at the patient's side with draw sheets. Suspension of the patient by the wrists or the use of shoulder braces to prevent the patient from sliding cephalad may increase the risk of brachial plexus injury.
- In the lateral decubitus position, always use a chest roll and avoid suspension of the arm from a L-shaped bar.
- In any position, always keep the head in neutral position. Rotation and lateral flexion of the neck increase tension in the brachial plexus on the opposite side.

In summary, although brachial plexus injury is one of the most common neuropathies occurring during anesthesia, awareness of the risk factors and positions which are likely to cause brachial plexus injury can limit their extent and occurrence. Constant attention to the positioning of the patient on the operating table can help to prevent this type of injury or the potential disability of patients.

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