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Nerve Injury Associated with Intraoperative Blood Pressure Cuff Compression

MR van Ooijen*, R Ketelaars and GJ Scheffer

Abstract

Peripheral nerve injury is a rare complication of anesthesia. Although most symptoms of peripheral neuropathies after anesthesia resolve spontaneously, permanent nerve damage is a serious complication. Risk factors have been described in literature, but in the majority of cases the direct cause remains unclear. We describe two patients with transient neurological dysfunction of the median and ulnar nerve after general anesthesia and suggest blood pressure cuff compression as a possible cause. It may be a more frequently occurring cause of peripheral nerve injury than suggested in the literature so far. To reduce such damage we propose two alternative strategies.

Keywords

Peripheral nerve injury; Anesthesia; Postoperative dysfunction; Blood pressure

Introduction

Permanent peripheral nerve injury is a rare complication of anesthesia and occurs in about 0.03-0.2 percent [1,2]. However, few is known about transient neurological symptoms due to peripheral nerve damage since data is collected mainly retrospectively. Several prospective evaluations showed symptoms of peripheral neuropathies resolved spontaneously in most patients [2,3]. Nevertheless, nerve injury is one of the most frequent complications in the latest closed claims analysis [4]. It must be considered as a serious complication with significant morbidity for affected patients.

Of the upper extremity, injury to the ulnar nerve and brachial plexus are the most common entities of nerve damage associated with anesthesia. The radial and median nerve is less frequently involved: three and four percent respectively [5].

Analysis shows that peripheral nerve injury associated with anesthesia, is most often related to general anesthesia, and in a lesser extent to loco regional anesthesia [1,5]. However, in most cases with peripheral nerve injury, the exact mechanism of injury remains unclear. For example, in a closed claims analysis only nine percent of ulnar nerve injury the mechanism was apparent [5].

We describe two patients with transient postoperative dysfunction of the median and ulnar nerve. This may have been caused by

repeated blood pressure cuff compression during prolonged general anesthesia. A mechanism of injury that is reported only a few times for the ulnar and radial nerve, but has not been described for the median nerve to date [6-11].

We received approval from the local Ethics Committee for publication of this report without the need for informed consent from the described patients. Nevertheless we pursued to receive written informed consent. Despite reasonable efforts, we haven't been able to contact patient 1 to receive her consent.

Case Reports

Case 1

A 19-year-old female was scheduled for an elective Le Fort I osteotomy. She had no previously known medical condition, did not use any medication and there were no known allergies. Her body mass index was 20.6 (184 cm and 70 kg).

Intra operative monitoring included ECG, pulse oximetry and automatic blood pressure monitoring with a standard-size adult blood pressure cuff placed on her right upper arm. Induction of general anesthesia was performed through a 20 Gauge intravenous catheter inserted at the left cubital fossa. During surgery an 18 Gauge intravenous catheter inserted at the left lower arm replaced this catheter.

The patient was positioned supine, with both arms placed supine alongside her body. Possible pressure points were not found during a secondary survey. The surgical procedure lasted for 240 minutes. Blood pressure was measured every 5 minutes and ranged from 100/45 to 110/60 mmHg during surgery. After emergence and extubation, the patient was transferred to the recovery room.

In the recovery room, the patient complained about numbness and tingling of the fourth and fifth digit of the right hand. Physical examination revealed also less firm opposition of the thumb in comparison to the other side. Both sensory and motor function loss were in accordance with injury to the ulnar nerve. The complaints and the sensory and motor function deficit resolved spontaneously within a few hours postoperatively.

Case 2

A 54-year-old male was planned for a laparoscopic low anterior resection of the recto sigmoid colon because of carcinoma. His medical history stated a cholecystectomy, hypertension, atrial fibrillation and chronic obstructive pulmonary disease (COPD), GOLD (Global Initiative for Chronic Obstructive Lung Disease) classification type II. His prescribed medication consisted of sotalol, irbesartan, acetyl salicylic acid and tiotropium. There were no known allergies. His body mass index was 30.5 (190 cm and 110 kg).

After uneventful placement of a thoracic epidural catheter at level 7-8, general anesthesia was induced through an 18 Gauge intravenous catheter at the back of the left hand. Before surgery started, 20 micrograms of sufentanil and 10 milliliters of ropivacaine 0.2 percent were administered through the epidural catheter.

Intraoperative monitoring included ECG, pulse oximetry and automatic blood pressure monitoring with a standard-size adult blood pressure cuff placed on his right upper arm. During surgery the patient was placed supine in the Trendelenburg position. The left arm

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was abducted for slightly less than 90 degrees and positioned supine on a padded arm board. On request of the surgeon, the right arm was positioned alongside the patient and was also placed supine. No possible pressure points were found during a secondary survey.

The laparoscopic low anterior resection was performed in 160 minutes. Blood pressure measurements were made every 5 minutes and ranged from 95/45 to 110/55 mmHg during the operation. After emergence and extubation, the patient was transferred to the recovery room.

Before the patient was sent to the ward, he complained about numbness and tingling of the whole first, second and third digit, and radial side of the fourth finger of the right hand. Physical examination revealed no motor deficit. The sensory block of the epidural analgesia extended from the fifth thoracic to the first lumbar dermatome. The sensory deficit of the right hand was noticed after arriving and awakening at the recovery room and remained unchanged. Within 6 hours after surgery the symptoms resolved spontaneously. In conclusion, neurapraxia of the median nerve as a result of prolonged and repeated blood pressure measurement was the most accurate explanation for the complaints of the patient.

Discussion

Protracted peripheral nerve injury associated with anesthesia is a rare phenomenon with a major impact considering several closed claims analysis. By analyzing groups of patients with peripheral nerve injury the direct cause is found only in few cases. In these groups of patients, blood pressure cuff compression has never been mentioned as a presumed cause of injury, but it only has been described in a few case reports.

We described two patients with transient peripheral nerve injury under general anesthesia, in which repeated and prolonged blood pressure cuff compression is, in our opinion, a possible explanation for the symptoms described. Perhaps, this cause of injury might be an explanation in other peripheral nerve injury associated with anesthesia as well, although firm evidence is lacking in the literature.

In the available literature several risk factors associated with peripheral nerve injury are described. Patient characteristics associated with peripheral nerve injury are hypertension, tobacco use and diabetes mellitus [1]. Surgical risk factors are found to be neurosurgery, cardiac surgery, orthopedic surgery and general surgery [1]. Furthermore, general anesthesia is the type of anesthesia that is associated most often with peripheral nerve damage [1,5].

In our two patients, surgery lasted 160 and 240 minutes. During the entire procedure blood pressure measurements were performed non-invasively at least every 5 minutes with a single sided blood pressure cuff. If our hypothesis that transient peripheral nerve injury can be caused by repeated and prolonged blood pressure cuff compression is correct, we suggest two alternatives in order to avoid such damage. First, intra-arterial blood pressure measurement can be used. In about 10 percent of patients undergoing anesthesia continuous arterial beat-to-beat pressure monitoring is used, mainly for patients with significant morbidity and/or high-risk surgery [12]. In addition to the advantage of continuous arterial beat-to-beat pressure monitoring, arterial cannulation facilitates arterial blood sampling. Frequently occurring complications of arterial cannulation are occlusion (by spasm or thrombosis), thrombotic embolization and hematoma. In contrast, hand ischemia, infection, local skin necrosis, sepsis, bleeding, nerve damage and pseudo aneurysm are uncommon [13]. Second, when invasive blood pressure monitoring

is considered too invasive but the patient has to be anesthetized for several hours, we would like to suggest another noninvasive alternative in order to prevent nerve damage due to repeated blood pressure cuff compression. We suggest applying a blood pressure cuff at each of the upper arms. This creates the opportunity to alternate the compressions of both arms with a set time interval. Thus our hypothesis is that when the nerves in the upper arm are compressed less often, the incidence of peripheral nerve injury will decrease.

Conclusion

In conclusion, peripheral nerve injury associated with anesthesia is a rare complication, but can have a major impact. Based on our two patients described, we state that prolonged and repeated blood pressure cuff compression can be a cause of peripheral nerve injury. However, in order to prove our hypothesis more work is needed in the future. Meanwhile, blood pressure monitoring by two different cuffs can be considered to reduce the risk of peripheral nerve injury for patients without the need for invasive blood pressure monitoring undergoing surgery under general anesthesia for several hours.

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