

# Effect of Various Body Positions on the Incidence of Peripheral Nerves Injury after Different Surgeries, a Retrospective Comparative Clinical Study

Alaa Ali M. Elzohry MD<sup>1</sup>, Mohammed Lotfy Helmy MSc<sup>2</sup>

<sup>1</sup>Lecturer of Anesthesia, Intensive Care Unit and Pain Relief, South Egypt Cancer Institute, Assiut University, Assiut, Egypt, <sup>2</sup>Master of Anesthesia, Intensive Care Unit and pain relief, Faculty of Medicine, Assiut University, Assiut, Egypt

## ABSTRACT

**Background:** Patient positioning is typically optimized after induction of either general or regional anesthesia. Positioning is the joint responsibility of both; the surgeon and anesthesiologist. Peripheral nerve injury during the perioperative period can occur when a nerve is subjected to stretch, compression, hypoperfusion, direct trauma, exposure to neurotoxic material, or a combination of these factors. **Aim of the Study:** The aim of this retrospective comparative study to investigate the effect of various body positions on the incidence of peripheral nerve injury after different surgeries. **Methods:** A retrospective, comparative study was carried out on 210 patients of both gender, anterior superior alveolar (ASA) I and II, aged between 21 and 60 years old, scheduled to undergo elective different surgeries. After stabilization of the patient and before the surgery started, all patients were positioned according to the surgical field and this documented in the patient's chart. Then, all patients transmitted to post-anesthesia care unit or intensive care unit and followed up till discharge from hospital and any peripheral nerve injury was documented and recorded and also the duration of this injury till improvement. **Results:** No significant data were found in demographic data between studied patients. All type of surgery was listed under various position and the most common frequent position was the supine position (39%) followed by prone (21%) and finally lithotomy (10%). The mean duration of peripheral nerve injury was (11.3 + 1.6) days in ulnar neuropathy versus (8.2 + 2.6) common peroneal nerve. **Conclusion:** There are many positions during surgery aiming to improve surgical access and most of these positions associated with peripheral nerve injury which should be avoided by careful practice and following the ASA protocols and if happened it should manage carefully.

**Key words:** Anesthesia, prone position, peripheral neuropathy, lithotomy position

## INTRODUCTION

Many positions are commonly used during the surgery such as supine, lithotomy, Lloyd Davies, lateral, seated, and prone. Many of these positions are modified with the addition of a vertical tilt (Trendelenburg or reverse Trendelenburg) and the aim of these positions is to provide the best surgical access while minimizing potential risk to the patient.<sup>[1]</sup>

Peripheral nerve injury during the perioperative period can occur when a nerve is subjected to stretch, compression,

hypoperfusion, direct trauma, exposure to neurotoxic material, or a combination of these factors. Peripheral nerve injury during the perioperative period can occur when a nerve is subjected to stretch, compression, hypoperfusion, direct trauma, exposure to neurotoxic material, or a combination of these factors. Peripheral nerve injury during the perioperative period can occur when a nerve is subjected to stretch, compression, hypoperfusion, direct trauma, exposure to neurotoxic material, or a combination of these factors. Patient positioning is typically optimized after induction of either general or regional anesthesia and placement of arterial and venous lines. Positioning

### Address for correspondence:

Alaa Ali M. Elzohry MD, Lecturer of Anesthesia, Intensive Care Unit and Pain Relief, South Egypt Cancer Institute, Assiut University, Assiut, Egypt.

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is the joint responsibility of both; the surgeon and anesthesiologist.<sup>[2-25]</sup>

Peripheral nerve injury during the perioperative period can occur when a nerve is subjected to stretch, compression, hypoperfusion, direct trauma, exposure to neurotoxic material, or a combination of these factors.<sup>[4,5]</sup>

Safe positioning for surgery requires careful planning, communication, and compromise between surgical, anesthetic, and nursing staff. The anesthetist must be vigilant during initial positioning for surgery and during the course of the operation, when deliberate or accidental movement and repositioning of the patient may lead to injury.<sup>[6]</sup>

The long duration of some surgical procedures undertaken in high-risk positions (e.g., laparoscopic or robot-assisted surgery in the lithotomy position) makes it prudent to set limits on the amount of time patients can be maintained in a particular position.<sup>[7]</sup>

In addition, there are significant circulatory and respiratory changes with changes in body position in both awake and anesthetized patients. These changes may affect blood-gas exchange and cerebral hemodynamics which in turn affect supply to the central nervous system and peripheral nerves.<sup>[8]</sup>

Moreover, quadriplegia which is a rare but devastating complication may result from cervical spine ischemia with neck and head hyperflexion. Elderly patients with cervical spine deformities and vascular pathologies have a higher risk. During positioning, sufficient distance between chin and neck (at least 2 finger-breadth) is recommended to avoid neck hyperflexion.<sup>[9,10]</sup>

The aim of this a retrospective comparative study was to investigate the effect of various body positions on the incidence of peripheral nerves injury after different surgeries in during period from May 2018 to May 2020.

## METHODOLOGY

This is a comparative study that was carried out in Assuit University Hospitals of Egypt at the period from May 2018 to May 2020, written informed consent was obtained by the researchers from the patient's after explaining the aim of the study and confidentiality of data, privacy, voluntary participation, and right to refuse to participate in the study was informed to them by the researchers through personal communication. A convenient sample of (210) patients was selected conveniently during a period of 2 years. The inclusion criteria included all operative patients, ages between 18 years and 60 years, from both genders (male and female), the patient operated under general or neuraxial anesthesia. The following data were collected by the researchers who were

blind to the study design as: Patient's age, sex, type of surgery, and medical history also patient's position parameters as type, duration, and post-operative neuropathic complication.

Validity of the study: Was tested by a jury panel of 7 experts in the field of anesthesia and surgery and the reliability: Was done using Cronbach's alpha test, it was (90%) for the first tool and (85%) for the second tool.

A pilot study: Was done on 10% (21) of patients to test the feasibility of the study and applicability of the tool and there are no modifications done.

## Study procedure

After stabilization of the patient and before the surgery started, all patients were positioned according to the surgical field and this documented in the patient's chart. Then, all patients transmitted to post-anesthesia care unit or intensive care unit and followed up till discharge from the hospital and any peripheral nerve injury was documented and recorded and also the duration of this injury till improvement.

## Statistical analysis

Data entry and analysis were done using statistical package for social science version 20<sup>®</sup>. Data were presented as number, percentage, and mean  $\pm$  standard deviation. A Chi-square test was used to compare between qualitative variables. Mann-Whitney test was used to compare quantitative variables between the studied groups. Wilcoxon signed-rank test was done to compare between each 2 times in the same group. *P*-value considered statistically significant when *P* < 0.05.

## RESULTS

No significant data were found in demographic data between [Table 1]. studied patients. All type of surgery was listed under various position [Table 2] and the most common frequent position was the supine position (39%) followed by prone (21%) and finally lithotomy (10%) [Table 3]. The mean duration of peripheral nerve injury was (11.3 + 1.6) days in ulnar neuropathy versus (8.2 + 2.6) common peroneal nerve [Table 4].

## DISCUSSION

Ideal patient positioning involves balancing surgical comfort against the risks related to the patient position. Therefore, patient positioning during surgery should be considered during the pre-operative evaluation.<sup>[11]</sup>

The present study investigated (210) patients with different positions and different surgeries to investigate the incidence and duration of different nerve injuries and illustrate the causes of this complication, as shown in the results.

According to the American society of anesthesiologists, closed claims project database perioperative nerve injury is

**Table 1: Demographic and surgical data of the studied sample (No. 210)**

Personal data	No.	%
Sex		
Male	122	58.1
Female	88	41.9
Age/Year		
25–35	70	33.3
36–45	84	40.0
46–55	56	26.7
Mean±SD	40.6±8.9	
Medical data diagnosis		
General and obstetric surgery	106	50.5
Orthopedic and trauma surgery	67	31.9
Abdominal and gastrointestinal tract surgery	37	17.6
Oxygen saturation		
90–94	70	33.3
95–100	140	66.7
Mean±SD	95.1±2.3	
Heart rate (b/m) (Mean±SD)	93.6±7.5	
Map (°C) (Mean±SD)	67.7±0.6	

the second most common class of injury (16%). Death (32%) and brain damage (12%) are rated first and third. These injuries can be severely debilitating and, to complicate matters, are often asymptomatic for several days after surgery.<sup>[12]</sup>

The injury of peripheral nerves as a result of incorrect/ incautious patient positioning is an avoidable complication of anesthesia and anesthetists should be watchful of nerve injury due to positioning in patients undergoing sedation, regional, or general anesthesia; each technique brings risk to insensate and malpositioned body parts.<sup>[13,14]</sup>

There are four underlying pathological mechanisms behind nerve injuries which are: Stretch, compression, generalized ischemia, and metabolic derangement. However, the definite mechanism of injury is found in <10% of cases. It is logical to identify patients at risk of developing neuropathy (elderly, underlying neuropathy, diabetes, etc.) and then to reduce stretch/pressure on nerves during anesthesia by careful positioning and padding.<sup>[15,16]</sup>

According to most studies, the ulnar nerve, brachial plexus, and common peroneal nerve are anatomically most vulnerable to injury due to intraoperative positioning, which is similar to our results.<sup>[17,18]</sup>

The following are the summary procedures for prevention of perioperative peripheral neuropathies relevant to different positions (1) [Figure 1 and Table 5]:

**Table 2: The sequences of the 6 applied body positions included in the study**

Frequency the of position (%)	Position		Surgeries in this position
	Type of applied position	Position action	
(39)	Supine	Typically, the head is rested on a foam pillow, keeping the neck in a neutral position. The patient's arms are either tucked at their side or abducted to <90° on padded arm boards	Intracranial procedures, most otorhinolaryngology procedures, and surgery on the anterior cervical spine. The supine position also is used during cardiac and abdominal surgery
(21)	Prone	The arms are either positioned and secured at the patient's side or placed on arm boards with the arms abducted to <90° at the shoulder and flexed at the elbow	Posterior cranial fossa surgery, posterior spine surgery at all levels, buttock and perirectal procedures, and operations on the posterior components of the lower extremity. In addition, endoscopic retrograde cholangiopancreatography
(9)	Lateral	High fowler position with 45° back and head up	Kidney surgery Thoracic surgery
(14)	Trendelenburg	The term is now often used to describe any head-down position	Pelvic surgery Laparoscopic surgery
(7)	Reverse Trendelenburg	The term is now often used to describe any head-up position	Neck surgery Maxillofacial surgery
(10)	Lithotomy position	The key difference between the lithotomy and supine position is the degree of hip and knee flexion	Obstetric surgery Anal surgery

**Table 3: Positioning checklist**

Systematic check list	How to check
<b>A- Airway</b>	
Endotracheal tube/LMA	Patent and in correct position
<b>B- Breathing</b>	
Ventilation	Pulmonary compliance satisfactory
Auscultation	Both axillae
Monitoring	SaO <sub>2</sub> Capnography trace and shape
<b>D- Disability/neurology</b>	
Eyes	Closed and protected
Neurovascular	Padded vulnerable areas and avoidance of excessive passive stretch
<b>E-Exposure</b>	
All cables, catheters, and electrode checked and removed from the patient/operating table interface	Access maintains access for review of at-risk areas if possible

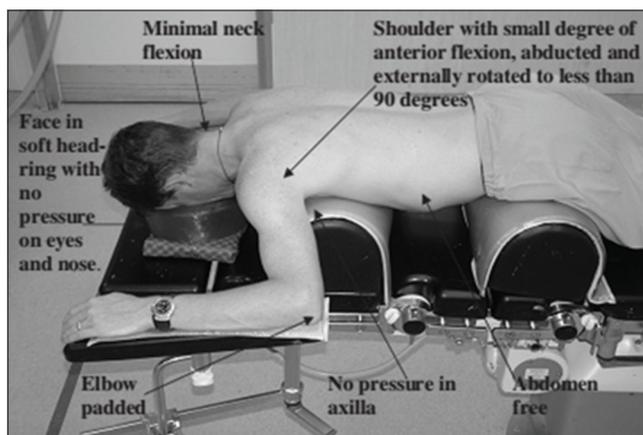
**Table 4: Frequency distribution of surgeries during each patient position (No. 210)**

Patient positions	No	%
<b>Supine position</b>		
General surgeries	140	70.0
Ortho surgeries	49	21.0
Head and neck surgeries	21	9.0
<b>Prone position</b>		
Disk surgeries	62	30
Neurosurguries	32	16
Endoscopic retrograde cholangiopancreatography	90	54
<b>Lithotomy position</b>		
Obstetric surgeries	106	51
Anal surgeries	105	49
<b>Trendelenburg position</b>		
Laparoscopic abdominal	49	42
Laparoscopic pelvic	42	38.0
Cancer surgeries	24	20.0
<b>Lateral position</b>		
Upper GIT endoscopy	81	39
Lower GIT endoscopy	79	36
Kidney surgeries	40	15

- Pre-operative assessment: Ascertain that patients can comfortably tolerate the anticipated operative position.

**Table 5: The correlation between different positions and incidence of nerve injury in study patients**

Variable	Incidence of nerve injury (%)	Mean duration (days)	Type of nerve injury
Supine position	2.061	9.4	Lower trunk injury ulnar nerve injury
Lateral	3.133	7.6	Upper and middle Trunk C5.6
Trendelenburg position	2.009	11.2	Superior gluteal nerve
Lithotomy position	4.843	8.4	Common peroneal nerve
Reverse Trendelenburg	1.018	7.8	Lower limb numbness
Prone position	2.190	3.2	Lateral cutaneous nerve of the thigh



**Figure 1: A careful prone positioning**

- Upper extremity positioning
  - Arm abduction should be limited to 90° in supine patients; patients who are positioned prone may comfortably tolerate arm abduction greater than 90°
  - Position arms to decrease pressure on ulnar groove (humerus). When arms are tucked at the side, neutral forearm position is recommended. When arms are abducted on arm boards, either supination or a neutral forearm position is acceptable
  - Prolonged pressure on the radial nerve in the spiral groove of the humerus should be avoided
  - Extension of the elbow beyond a comfortable range may stretch the median nerve.
- Lower extremity positioning
  - Prolonged pressure on the peroneal nerve at the fibular head should be avoided
  - Neither extension nor flexion of the hip increases the risk of femoral neuropathy.

- Protective padding
  - Padded armboards may decrease the risk of upper extremity neuropathy
  - The use of chest rolls in laterally positioned patients may decrease the risk of upper extremity neuropathies
  - Padding at the elbow and at the fibular head may decrease the risk of upper and lower extremity neuropathies, respectively.
- Equipment
  - Properly functioning automated blood pressure cuffs on the upper arms do not affect the risk of upper extremity neuropathies
  - Shoulder braces in steep head-down positions may increase the risk of brachial plexus neuropathies.
- Post-operative assessment
  - A simple post-operative assessment of extremity nerve function may lead to early recognition of peripheral neuropathies.
- Documentation

Charting specific position actions during the care of patients may result in improvements of care by;

1. Helping practitioners focus attention on a relevant aspect of patient positioning; and
2. Providing information that continuous improvement processes can use to lead to refinement in patient care.<sup>[19,21]</sup>

Ulnar nerve injury presents with pain, paresthesia, or weakness in the distribution of the ulnar nerve during the early post-operative period; it is important to document the timing of symptom-onset which relieved within 6 weeks; however, the remaining 50% are likely to remain impaired at 2 years.<sup>[22]</sup>

The clinical picture of brachial plexus injury includes weakness of shoulder abduction and elbow flexion. Such injuries have been seen following surgery in the supine, lateral decubitus, Trendelenburg, and prone positions and it is prevented by avoidance of shoulder abduction to more than 90° and avoidance of contralateral neck rotation/flexion is reasonable and practical measures to reduce plexus stretch and plexus compression by the humeral head and clavicle.<sup>[5,23]</sup>

The common peroneal nerve and saphenous nerve are particularly at risk of compression injury in the prone position as they wind round the neck of the fibula and medial tibial condyle, respectively. Furthermore, extreme flexion of the hip joints can cause neural damage by stretch (sciatic and obturator nerves) or by direct pressure (compression of the femoral nerve as it passes under the inguinal ligament).<sup>[24,25]</sup>

## CONCLUSION

There are many positions during surgery aiming to improve surgical access and most of these positions associated with

peripheral nerve injury which should be avoided by careful practice and following the anterior superior alveolar protocols and if happened it should manage carefully.

### Limitation of the study

The study needs to be repeated on a larger sample size with different types of surgeries and objective methods of a diagnosis other than the clinical diagnosis.

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