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## **Correlation between surgical patient supine positioning and the neurovascular injuries: Proposed nursing safety measures**

**Dr. Zeinab M. El-Sayed**

Assistant Professors & Researchers Medical-Surgical Nursing Department-Faculty of Nursing-Cairo University-Egypt

**Dr. Amel Gomaa Abd EL-Naby**

Assistant Professors & Researchers Medical-Surgical Nursing Department-Faculty of Nursing-Cairo University-Egypt

Corresponding author email: [gomaaamel@yahoo.com](mailto:gomaaamel@yahoo.com)

**Abstract**---Background: The surgical supine position is the most common position used in the operating room. Even though, there are many risks to patients under anesthesia that result from supine position on the operating table. The aim was to investigate the relationship between surgical supine positioning and the related neurovascular injuries among patients undergoing elective surgeries. Question: What was the relationship between surgical supine positioning and the related neurovascular injuries among patients undergoing elective surgeries? Descriptive correlational design was utilized. Tools: I- Preoperative Assessment Data Form. II- Risk Assessment Scale for the Development of Injuries Due to Surgical Positioning III- Postoperative Neurovascular Assessment Form and IV- Numerical Pain Rating Scale. A convenience sample of 50 male and female adult patients over a period of 6 months; who had undergone elective surgeries and were positioned on surgical supine position and not suffering from neuropathy and neuromuscular diseases at one of Cairo University Hospitals, Egypt constituted the study sample. Results: There was a positive correlation between supine surgical positioning and postoperative neurovascular injuries among the study sample in relation to tissue perfusion, sensory alteration and postoperative pain as  $r = .503, .551 \text{ \& } .440$  and  $p \text{ value} = .000, .000 \text{ \& } .001$  respectively. The study recommended that replication of the study on a larger sample from different OR settings; in addition to provide continues education for OR nurses regarding safety practice measures of surgical supine positioning.

**Keywords**---surgical supine position, neurovascular injuries, nursing safety measures.

## Introduction

Patient positioning is crucial to the success of most surgeries. It is an important issue that needs to be well-prepared preoperatively. Proper patient positioning is essential for safe surgical procedures and its aim is to provide optimal exposure and access to the surgical site; maintaining body alignment; supporting circulatory and respiratory function; protecting neuromuscular and skin integrity; as well allowing access to intravenous sites and anesthesia support devices. There are five basic positions used for surgery “supine, lithotomy, sitting, prone and lateral” position. Improper surgical positions can lead to a variety of risks to patient’s injuries which cannot communicated by the anesthetized patients as pain, pressure, and other types of discomfort (Alaska Perioperative Nursing Consortium, 2016; Heizenroth, 2016 ; Nascimento & Rodrigues, 2020) .

Supine surgical position is the most common position for surgery with a patient lying on his or her back with head, neck, and spine in neutral positioning and arms either adducted alongside the patient or abducted to less than 90 degrees (Armstrong & Moore, 2021). Improper supine surgical positioning places the patient at potential risk of several potential complications including short and long term intraoperative positioning injuries (Gillespie, 2021). Short-term, such as a neuropathy that resolves in 24 to 48 hours, while long-term, such as pressure ulcers that can lead to a stage IV ulcer. The main intraoperative positioning injuries or complications from improper positioning includes postoperative musculoskeletal pain, joint dislocation, nerve damage, to skin and underlying tissues injuries in addition to cardiovascular and respiratory compromise (Lopes, Haas, Dantas, Oliveira & Galvão, 2016; Zillioux & Krupski, 2017).

Additionally, all surgical positions are associated with abnormal amounts of pressure on relatively small parts of the body surface. A decline in perfusion can result in tissue ischemia, tissue breakdown and development of a pressure sore. Intraoperatively, patients may face a variety of preexisting risk factors for surgical supine positioning injuries, some of which are modifiable while others are difficult to amend as the length and type of procedure, the anesthesia requirements for the procedure, patient’s age and body weight, and the patient’s current medication regime (Zillioux & Krupski, 2017).

Positioning of the surgical patient intraoperatively is a complex; highly technical; difficult and relatively different task compared with other settings. This is due to the necessity for bearing in mind existing standards, the individual patient and time limitations for the total time under anesthesia. As a result, optimal positioning cannot always be achieved, thus exposing patients to the risk of injury and of infringement of their personal integrity (Sørensen, Kusk, & Grønkjær, 2015; Blomberg, Bisholt & Lindwall, 2018).

In the context of care provision for surgical patients, the main responsibility of nurses with the surgical team is how to best position the patient to facilitate

activities during anesthesia and surgery. For this purpose, perioperative nurses must understand thoroughly the anatomic and physiological alterations associated with patient supine positioning in addition to the equipment and devices available to be of help in the completing of the procedure; permitting the planning and implementation of effective interventions to guarantee the prevention of intraoperative positioning injuries that can arise due to the prolonged stay of the patient in supine or each type of surgical positions (Lopes, et al., 2016).

Moreover, operative nurse plays a crucial role in performing and documenting of neurovascular assessments before and after surgery. In addition to, identifies patients who are at high risk for surgical supine position injuries. Hence, planning and the implementation of correct nursing safety measures based on recent evidence is critical to maintain safe and comfortable patient's position, so as to prevent variety of complications in the neurovascular and respiratory system (Menezes, 2013; Lopes, et al 2016 & Nascimento & Rodrigues 2020).

Although extensive review provides attention of the risk factors and complications associated with surgical positioning, the significance of nursing for optimal positioning receives no further consideration. Among the gaps in the research theme, the need to conduct studies on correlation between anaesthetized surgical patients' supine positioning and the development of the neurovascular injuries is highlighted. In addition, neurovascular injuries is a significant problem that need for more focused proposed nursing safety measures to optimize positioning practices. Also, it is hoped that the current study can provide evidence base data to promote nursing knowledge and practice in this field, improve quality of patient's provided care and consequently enhance patient's outcomes. Therefore, the aim of the current study was to investigate the relationship between surgical supine positioning and the related neurovascular injuries among patients undergoing elective surgeries as well suggested nursing safety measures.

### **Research question**

What is the relationship between surgical supine positioning and the related neurovascular injuries among patients undergoing elective surgeries?

### **Materials and Methods**

**Research Design:** Descriptive, correlational design was utilized to achieve the aim of the current study. Descriptive design provides a relatively complete picture of what is occurring at a given time. Allows the development of questions for further study while correlational design is used to describing relationships among variables and to allow the prediction of impending events from present knowledge without seeking to establish a causal (Gray, Grove, Sutherland, Burns, 2017).

**Setting:** The study was established on operating room of general surgery at 2<sup>nd</sup> and 3<sup>rd</sup> floor and the related general surgical wards (25, 27, 28, and 30) at a University Hospital, affiliated to Cairo University-Egypt.

**Sample:** A convenience sample of 50 male and female adult patients over a period of 6 months; who undergoing elective surgeries and were positioned on supine

surgical position and not suffering from neuropathy and neuromuscular diseases were recruited in the current study.

Tools: Four tools were used to collect the related data as follows:

First tool: Preoperative Assessment Data Form. It was developed by the researchers and divided into two parts: a- Demographic data includes: age, gender...etc. b- Medical and surgical background it covers items related to type of surgery, smoking, BMI, body deformity and Hgb, Blood glucose level, PT, PTT, Na and K.

Second tool: Risk Assessment Scale for the Development of Injuries Due to Surgical Positioning (ELPO) was developed and validated for the purpose of guiding the perioperative nurse practice. It contains seven items: type of surgical position, duration of surgery, type of anesthesia, support surface, limb position, comorbidities and patient age with five subitems each. The score ranges from one to five points and the total score from seven to 35 point, the higher the patient's score, the greater the risk of developing injuries due to surgical positioning. The Content Validity Index of the scale corresponded to 0.88. The interrater reliability was verified using the intraclass correlation coefficient, equal to 0.99 ( $p < 0.001$ ) (Lopes, Haas, Dantas, Oliveira, & Galvão, 2016).

Third tool: Postoperative Neurovascular Assessment Form of Affected Pressure Points was designed by the researchers and covered main four items a-Tissue Perfusion through observing skin color, skin temperature, capillary refill and swelling b- Peripheral pulses by measuring right and left upper and lower extremities pulse points (brachial, radial, ulnar, femoral, popliteal, posterior tibialis and dorsalis pedis) and its grading interpreted as following 0 = absent. 1+ = faint but detectable. 2+ = slightly more diminished pulse than normal. 3+ = normal. 4+ = bounding guided by American Heart Association (2016). c- Questions related to sensation as; tingling, numbness (paresthesia), pressure and burning, each item answered by yes =1 or no =zero d- Motor function was assessed through observing right and left upper and lower extremities range of motions for each patient as (flexion, extension, abduction and adduction) and interpreted as performed =1 or not performed = zero. Reliability was done using Cronbach's alpha test which yielded 0.70.

Fourth tool: Numerical Pain Rating Scale (NPRS). It consists of a straight line with the endpoints defining extreme limits such as 'no pain at all' and 'pain as bad as it could be'. The patient is asked to mark his/her pain level on the line between the two endpoints. The scores of NPRS ranged from 0 up to 10; 0=no pain, 1-3=mild pain, 4-6=moderate pain, 7-10=severe pain (McCaffery & Beebe... et al., 1989). Its reliability was conducted by Ferraz, Quaresma, Aquino, Atrá & Tugwell, (1990) with a high test-retest reliability ( $r = 0.96$  and  $0.95$ , respectively).

Validity and Reliability: Content validity of the current study tools was reviewed by three experts in the field of medical-surgical nursing while reliability of tool 3 was conducted by the researchers using test-retest reliability.

Ethical considerations: An official approval was obtained from Research Ethics Committee-Faculty of Nursing Cairo University (IRB 2019041701) as well as the

director of operating units and the related surgical wards. Written consent for patients' agreement was obtained after explanation of the nature, purpose and significance of the study. Each patient was free to either participate or not in the current study and had the right to withdraw at any time without any rationale and it will not affect upon care provided. The researchers emphasized that participation in the study is entirely voluntary; anonymity and confidentiality were assured through coding the data.

### **Operational definitions**

**Supine Surgical Positioning:** Is the practice of placing a patient in a specific physical position as the patient lies on the back, arms at sides or on arm boards with straight leg not crossed during the surgical procedure that allowing access to the surgical site and were assessed by using risk assessment scale for the development of injuries due to surgical positioning (ELPO) (Lopes, Haas, Dantas, Oliveira & Galvão, 2016).

**Neurovascular Injuries:** Are injuries affected both nerves and blood vessels during the surgical supine positioning that can be detected through using Postoperative Neurovascular Assessment form of affected pressure points.

### **Procedure**

Once official permission was granted to proceed with the proposed study, data collection was carried out as the following; at the day before surgery the researchers were interviewed patients who met the inclusion criteria individually at the general surgical ward for about 20 to 30 minutes in order to explain the nature and purpose of the study; in case of patient's acceptance, written consent was obtained from each patient then at the same time the demographic and medical background data form (tool I) were obtained.

After that at the day of surgery in the operating room, Risk Assessment Scale for the Development of Injuries due to Surgical supine Positioning (ELPO) (tool II) was collected to assess the patient at risk for injuries related to surgical supine positioning through observing the supine surgical position; duration of surgery, type of anesthesia, support surface and limb position. Postoperatively, injuries associated to surgical positioning were assessed using (tool III) Postoperative Neurovascular Assessment Form of Affected Pressure Points to observe tissue perfusion; peripheral pulses; sensation and motor function of the pressure points and also; (tool IV) Numerical Pain Rating Scale (NPRS) to assess pain. All patients were observed in the postoperative period after 24 hours, for detection of any sign related to neurovascular injuries based on Clinical Guidelines (Nursing) (2019).

### **Statistical analysis**

Obtained data were tabulated, computed and analyzed using Statistical Package for the Social Sciences (SPSS) program version 23. Descriptive and Inferential statistics were utilized; descriptive statistics included frequency; percentage distribution; mean and standard deviation. Inferential statistics as compare of

means, correlation were utilized. Statistical significance was considered at  $p\text{-value} \leq 0.05$ .

## Results

Table (1) showed that, as regards age 32% of the studied patients their age ranged between 48 to less than 60 years, with a mean age of  $48.2 \pm 16.3$ . In relation to gender, smoking, co-morbid diseases and body mass index (BMI); a high percentage of them 70%, 66%, 78% & 72% respectively were male, no smokers, hadn't co-morbid diseases and had normal bodyweight. On the other hand, figure (1) illustrated that, the main risk factors for supine surgical positioning injuries among the studied sample were support surface, anesthesia type and duration of surgery with a total mean score of 3.9, 3.7 & 3 respectively followed by limb position, patient's age and comorbidities 2.4, 2.1 & 1.7 respectively.

In relation to the level of risk for neurovascular injuries, table (2) displayed that, 98% of the studied patients who had undergone supine surgical positioning had moderate risk for neurovascular injuries according to assessment scale of risk for surgical positioning injuries. Pertaining to neurovascular injuries table (3) illustrated that 20% of the studied patients had pallor skin color, 98% of them suffered from cool skin and swelling. In relation to capillary refill, 30% of the studied patients represent  $>2$  seconds where all the previous sign and symptoms indicated impairment of tissue perfusion with  $\text{Mean} \pm \text{SD} = 5.7 \pm 1.2$ . Concerning sensation impairment 60% of the studied patients had feeling of pressure on the affected parts followed by 40% had numbness and burning while 38% had tingling with  $\text{Mean} \pm \text{SD} = 1.8 \pm 1.6$ .

Regarding peripheral pulse volume for the upper extremities among the studied sample postoperatively, table (4) clarified that the highest percentage of the studied sample had normal pulse at right and left brachial, radial and ulnar points represents 64%, 70%, 54%, 60%, 42%, & 48% respectively. Followed by 34%, 26%, 40%, 34%, 44%, & 38% respectively of them had slightly diminished pulse than normal. while 2%, 4%, 6%, 6%, 14% and 14% respectively of the studied sample had pulse volume 1+ (Faint but detectable) at the same pulse points.

Concerning peripheral pulse volume for the lower extremities among the studied sample postoperatively, table (5) showed that the highest percentage of the studied sample had normal pulse at right and left femoral, popliteal, posterior tibialis and dorsalis pedis represents 82%, 82%, 58%, 60%, 52%, 52%, 48% & 48% respectively. Followed by 18%, 18%, 34%, 36%, 34%, 36%, 38%, & 38% respectively of them had slightly more diminished pulse than normal. While, 0%, 0%, 8%, 4%, 14%, 12%, 14% and 14% respectively of the studied sample had pulse volume 1+ (Faint but detectable) at the same pulse points.

As regards motor function postoperatively, table (6) revealed that 86% and 94% studied sample can flex and extend the right and left upper extremities respectively. While 14% and 6% of them couldn't perform flexion and extension of the right and left upper extremities respectively. In relation to abduction & adduction of right and left upper extremities; 10% & 4% of the studied sample

cannot performed it respectively. According motor function of lower extremities; 20% and 18% of the studied sample couldn't perform flexion of the right and left lower extremities respectively. While 14% of them couldn't perform extension, abduction, and adduction of right lower limb. Moreover, 14% of the sample couldn't perform extension, abduction, and adduction of left lower limb. Although, there was no correlation between supine surgical positioning and motor function

In reference to postoperative pain level according to Numerical Pain Rating Scale, it was observed in table (7) that 78% of the studied patients who had undergone supine surgical positioning suffered from severe pain during the first day postoperatively followed by 18% moderate pain and only 4% mild pain. Additionally, and as can be seen from table (8) clarified that, there was a positive correlation between supine surgical positioning and postoperative neurovascular impairment among the study sample in relation to tissue perfusion, sensory alteration and postoperative pain as  $r = .503, .551 \& .440$  and  $p \text{ value} = .000, .000 \& .001$  respectively. While, there was no correlation between surgical supine positioning and motor dysfunction.

## Discussion

Nurses, along with other members of the team, are responsible for evaluating the patient as a whole, observing the conditions of the support brackets and any situation that could compromise patient positioning on the operating table and cause complications (Steris, 2021). Concerning the demographic characteristics, about one third of the studied sample their age ranged between forty eight to less than sixty years, with a mean age of  $48.2 \pm 16.3$ . Relatively, the highest percentages of the studied sample were male, no smokers, had normal body weight, hadn't co-morbid diseases and physical deformity. This finding means most of the studied patients hadn't preexisting risk factors for neurovascular injuries. However the rest of patients which represent nearly one third of the studied sample were smoker; had co-morbid diseases as diabetes mellitus & hypertension in addition to their weight classified as overweight. From the researchers point of view improper positioning lead to neurovascular injuries but the presence of risk factors such as smoking, co-morbid diseases and obesity increase the possibility of injuries which emphasize on the crucial role of the nurse in evaluating surgical patients who undergoing surgery and ensure proper safety position.

In the light of this results Miranda, Fogaça, Rizzetto and Lopes (2016) pointed that the surgical team must consider the patient's medical comorbidities and their limitations on positioning. There are several factors may contribute to the occurrence of adverse events, including some characteristics of the patient, such as age, weight, nutritional status, and preexisting conditions. Also, they added that preexisting conditions should be considered when planning nursing care to surgical patients, especially those affecting neurovascular injuries. All risk factors should be identified in the preoperative evaluation and documented, contributing to the care plan.

Furthermore; Steris (2021) mentioned that in addition to the intrinsic and extrinsic factors which can interact to contribute to the risk of developing surgical

positioning injuries the musculoskeletal system of the patient may be subjected to stress during patient positioning. When anesthetics and muscle relaxants depress pain, pressure receptors and muscle tone, the normal defense mechanisms cannot guard against joint damage or muscle stretch and strain. One of the main goals of proper patient positioning is to keep the patient's body as naturally aligned as possible while providing the surgical staff access to the surgical site, and quick, jerky movements should be avoided.

As regards the level of risk for neurovascular injuries according to assessment scale of risk for surgical positioning injuries. The majority of the studied patients who had undergone supine surgical positioning had moderate risk for neurovascular injuries. Besides, the main risk factors for supine surgical positioning injuries among the studied sample were support surface (surgical table foam mattress plus cushions made out of sterilization wraps), anesthesia type (general anesthesia) and duration of surgery (more than 2 hours).

The finding of the current study was consistent with Lopes, et al (2016) who carried study entitled "Assessment scale of risk for surgical positioning injuries" they found that their patients at moderate risk due to the surgical positioning. Similarly; Nascimento & Rodrigues (2020) who carried study entitled "Risk for surgical positioning injuries: scale validation in a rehabilitation hospital" they found that there was a predominance of patients at high risk for developing injuries. Their finding might due to most patients have more than comorbidity and more than half of patients had a neuropathy. Additionally, high percentage of their study sample undergoing surgery for up to 2 hours and underwent general anesthesia but regarding type of surgical support used to position their patients, surgical table foam mattress plus foam cushions.

According to postoperative neurovascular injuries; the current study was reported that in relation to tissue perfusion the majority of the study sample suffered from cool skin and swelling followed by increasing capillary refill time ( $>2$  seconds) and pallor skin color. Concerning sensation assessment, around two third of the studied patients feeling of pressure on the affected parts followed by numbness, burning and tingling. Moreover, allied peripheral pulse more than one third of patients had slightly diminished pulse than normal at right and left upper and lower extremities pulse points. This finding could be interpreted as neurovascular injuries occurrence at some degree as a result of the patients predominantly remained in supine position with the upper limbs open at an angle less than  $90^\circ$ . The supine position, in this study, is the position chosen for anesthetic induction, and the patient remains in the same position until the end of the surgical procedure. It is the position that mostly respects body alignment, and complications only occur in cases where positioning is improperly performed and/or when the patient remains in such position for a long time as a result of the pressure points against the operating table, type of anesthesia and type of support system.

In the same context Chaverneff (2017) mentioned that the supine position is related to several potential complications including peripheral nerve injury. Among all adverse outcomes, peripheral nerve injury was the second most common event, present in 22% of all claims. The mechanism of nerve injury is not



always clear, internal and external compression, stretch, ischemia, metabolic derangement, direct trauma, and direct nerve laceration can all lead to postoperative nerve injury. Besides; Zillioux and Krupski (2017) stated that; the mechanism of positioning injury is thought to be intraneural disruption from stretching or pressure, which results in decreased perfusion. On a larger scale, this vascular compromise can lead to ischemia. Moreover; Tapar, et al (2018) added that different body positions can cause changes in tissue perfusion. This should be considered in patient's follow-up.

Nascimento and Rodrigues (2020) added that the duration and type of the anesthesia are considered the main significant risk factors for neurological injuries during intraoperative period, ever since it depresses pain receptors, influences the level of depression of the nervous system and relaxes the muscles, causing the patient's defense mechanisms to no longer provide protection against pressure, stretching, muscular effort and/or damage resulting from the exacerbated rotation of the limb, making it susceptible to pressure injury and pain. Also, McInnes, et al (2015) pointed failure to use support surface during the intraoperative period increases the risk for injuries resulting from surgical positioning,

Moreover, Miranda, Fogaça, Rizzetto and Lopes (2016) ensure that pressure a sedated or anesthetized patient is not always able to communicate physical feeling such as numbness, tingling, tissue temperature, and other issues. Guideline for positioning the patient (2017) added that supine position, also known as Dorsal Decubitus, is the most frequently used position for procedures. In Supine position, the patient may risk for pressure ulcers and nerve damage. This position causes extra pressure on the skin and bony prominences over the occiput, scapulae, elbows, sacrum, coccyx and heels.

Furthermore; Lopes, et al (2016) mentioned that in the literature, there is a lack of data on the incidence of peripheral nerve injuries due to surgical positioning. While their study revealed that peripheral nerve injury is usually a preventable complication of poor patient positioning. Nerves are injured by one of two mechanisms: stretch or compression. If the nerve is pulled between two fixed points, stretch injury occurs. Compression injury is largely due to loss of protective muscle tone and pressure between two fixed points. The final result is the same: nerve ischemia related to poor blood flow. Whereas a wake patients usually feel the effects of nerve ischemia and adjust body position.

In relation to postoperative pain arising from supine surgical positioning according to Numerical Pain Rating Scale it was observed that more than three quarters of the studied patients suffered from severe pain while less than quarter of them had moderate pain and the rest of them had mild pain on the first postoperative day. As a study carried out by Lopes, et al (2016), showed that in the postoperative period, forty percentage presented moderate pain due to the surgical positioning using Numerical Pain Rating Scale.

The current study finding illustrated that, there was a positive correlations between supine surgical positioning and alteration in postoperative tissue perfusion, sensory and pain. Which ensure the effect of supine surgical

positioning in addition to the duration of surgery, type of anesthesia and supporting device while, there was no correlation between supine surgical positioning and motor function as all patients encouraged to move out of bed postoperatively. This finding is in accordance with Nascimento and Rodrigues (2020) who reported that the risk scale scores are associated with the appearance of injuries resulting from positioning; the injuries investigated were the development of pressure injuries and the presence of pain. Zillioux and Krupski (2017), shown a small but significant number of neurovascular injuries associated with supine surgical positioning. On the same line, Lopes et al (2016) study revealed that there was association between surgical positioning and development of pressure ulcer and the presence of pain deriving from surgical positioning and emphasized that at the health services, the use of a risk assessment scale can help the nurse to identify factors predisposing to the development of injuries and the implementation of prevention measures and, consequently, to the improvement of health care.

### **Nursing Safety Measures**

1. Patients with cardiorespiratory disease may experience dyspnea when lying flat and need to be temporarily raised up on pillows until the induction agent is given.
2. Confirm the spine is in alignment with no flexion or torsion present and the legs are parallel.
3. Arms should be placed on well-padded arm boards with additional padding for the elbows. Arm boards are not extended more than 90.
4. Pillow should be placed posterior to the knees joints to decrease pressure on the lumbar region of the back.
5. The ankles/legs must not be crossed to prevent pressure injury.
6. The safety strap should be placed 2" above the knees. It should not be restrictive to avoid compression and friction injuries.
7. The heels must be protected from pressure by placing a pillow, ankle roll or donut.
8. No body part is extending beyond the OR table edges, in particular the feet, in order to avoid a footdrop injury.

AST Standards of Practice for Surgical Supine Positioning, (2011)

### **Conclusion**

The current study concluded that there was a positive correlation between supine surgical positioning and postoperative neurovascular injuries in relation to tissue perfusion, sensory, peripheral pulse alteration and pain. In addition the most risk factors for neurovascular injuries from supine surgical positioning were support surface, type of anesthesia and duration of surgery.

### **Nursing Implication**

This study shows that nurses should assess surgical patients who at risk for supine positioning injuries and apply proper surgical supine positioning through

following safety measures to prevent neurovascular injuries and other associated problems.

### Recommendations

1. Replication of the study on a larger sample from different OR settings in Egypt.
2. Replication of the study on different surgical positioning.
3. Continues education for OR nurses regarding safety practice measures of surgical supine positioning

Table (1) Percentage distribution of demographic and medical data among the study sample (n=50)

| Variable                                  | No          | %  |
|---|-------------|----|
| Age                                       |             |    |
| - 18-<33                                  | 10          | 20 |
| - 33-<48                                  | 14          | 28 |
| - 48- < 60                                | 16          | 32 |
| - ≥ 60                                    | 10          | 20 |
| Mean + SD                                 | 48.2 + 16.3 |    |
| Gender                                    |             |    |
| - Male                                    | 35          | 70 |
| - Female                                  | 15          | 30 |
| Smoking                                   |             |    |
| - Yes                                     | 17          | 34 |
| - No                                      | 33          | 66 |
| Co-morbid diseases                        |             |    |
| - No Co-morbid diseases                   | 39          | 78 |
| - Diabetes                                | 7           | 14 |
| - Hypertension                            | 2           | 4  |
| - Diabetes & hypertension                 | 2           | 4  |
| BMI                                       |             |    |
| - Underweight ( < 18.5kg/m <sup>2</sup> ) | 0           | 0  |
| - Normal (18.5- 24.9 kg/m <sup>2</sup> )  | 36          | 72 |
| - Overweight (25-29.9 kg/m <sup>2</sup> ) | 14          | 28 |
| - Obese (30 or more)                      | 0           | 0  |
| Mean + SD                                 | 24.9+ 1.8   |    |

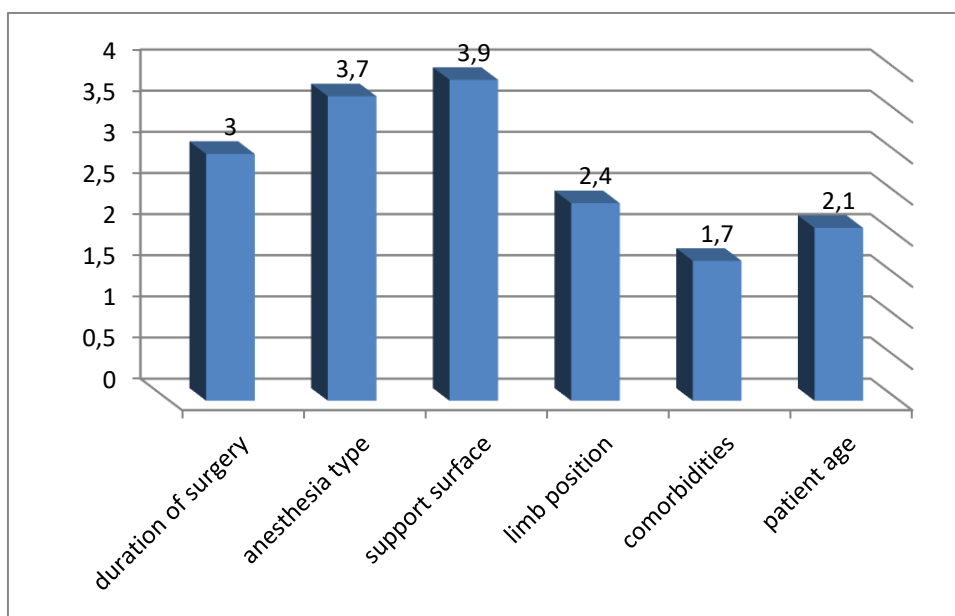


Figure (1) Total mean scores of risk factors for supine surgical positioning injuries among the studied sample (n=50)

Table (2) Level of risk for neurovascular injuries among the study sample according to assessment scale of risk for surgical positioning injuries (n=50)

| Level of risk |          | No | %  |
|---------------|----------|----|----|
| -             | Mild     | 1  | 2  |
| -             | Moderate | 49 | 98 |
| -             | Severe   | 0  | 0  |

Table (3) Description of neurovascular injuries related to tissue perfusion & sensation as a result of surgical supine positioning among the study sample (n=50)

| A- Tissue Perfusion |             | No       | %  |
|---------------------|-------------|----------|----|
| Skin color          |             |          |    |
| -                   | Pink        | 40       | 80 |
| -                   | Pallor      | 10       | 20 |
| Skin temperature    |             |          |    |
| -                   | Warm        | 1        | 2  |
| -                   | Cool        | 49       | 98 |
| -                   | Hot         | 0        | 0  |
| Capillary refill    |             |          |    |
| -                   | ≤ 2         | 35       | 70 |
| -                   | >2          | 15       | 30 |
| Swelling            |             |          |    |
| -                   | Present     | 49       | 98 |
| -                   | Not present | 1        | 2  |
| Mean±SD             |             | 5.7 ±1.2 |    |

| B-Sensation |          |    |
|-------------|----------|----|
| - Tingling  | 19       | 38 |
| - Numbness  | 20       | 40 |
| - Pressure  | 30       | 60 |
| - Burning   | 20       | 40 |
| Mean+SD     | 1.8 +1.6 |    |

Table (4) Description of neurovascular injuries related to upper extremities peripheral pulses as a result of surgical supine positioning among the study sample (n=50)

| Pulse volume                        | Upper extremities peripheral pulse points |    |     |    |        |    |     |    |       |    |     |    |
|-------------------------------------|---|----|-----|----|--------|----|-----|----|-------|----|-----|----|
|                                     | Brachial                                  |    |     |    | Radial |    |     |    | Ulnar |    |     |    |
|                                     | Rt.                                       |    | Lt. |    | Rt.    |    | Lt. |    | Rt.   |    | Lt. |    |
|                                     | No  | %  | No  | %  | No     | %  | No  | %  | No    | %  | No  | %  |
| 0= absent                           | 0   | 0  | 0   | 0  | 0      | 0  | 0   | 0  | 0     | 0  | 0   | 0  |
| 1+ = Faint but detectable.          | 1   | 2  | 2   | 4  | 3      | 6  | 3   | 6  | 7     | 14 | 7   | 14 |
| 2+ =Slightly diminished than normal | 17  | 34 | 13  | 26 | 20     | 40 | 17  | 34 | 22    | 44 | 19  | 38 |
| 3+ = Normal                         | 32  | 64 | 35  | 70 | 27     | 54 | 30  | 60 | 21    | 42 | 24  | 48 |
| 4+ =Bounding                        | 0   | 0  | 0   | 0  | 0      | 0  | 0   | 0  | 0     | 0  | 0   | 0  |

Table (5) Description of neurovascular injuries related to lower extremities peripheral pulses as a result of surgical supine positioning among the study sample (n=50)

| Pulse volume                         | Lower extremities peripheral pulse points |    |     |    |           |    |     |    |                    |    |     |    |                |    |     |    |
|--------------------------------------|---|----|-----|----|-----------|----|-----|----|--------------------|----|-----|----|----------------|----|-----|----|
|                                      | Femoral                                   |    |     |    | Popliteal |    |     |    | Posterior Tibialis |    |     |    | Dorsalis Pedis |    |     |    |
|                                      | Rt.                                       |    | Lt. |    | Rt.       |    | Lt. |    | Rt.                |    | Lt. |    | Rt.            |    | Lt. |    |
|                                      | No  | %  | No  | %  | No        | %  | No  | %  | No                 | %  | No  | %  | No             | %  | No  | %  |
| 0 = absent                           | 0   | 0  | 0   | 0  | 0         | 0  | 0   | 0  | 0                  | 0  | 0   | 0  | 0              | 0  | 0   | 0  |
| 1+ = Faint but detectable            | 0   | 0  | 0   | 0  | 4         | 8  | 2   | 4  | 7                  | 14 | 6   | 12 | 7              | 14 | 7   | 14 |
| 2+ = Slightly diminished than normal | 9   | 18 | 9   | 18 | 17        | 34 | 18  | 36 | 17                 | 34 | 18  | 36 | 19             | 38 | 19  | 38 |
| 3+= Normal                           | 41  | 82 | 41  | 82 | 29        | 58 | 30  | 60 | 26                 | 52 | 26  | 52 | 24             | 48 | 24  | 48 |
| 4+ = Bounding                        | 0   | 0  | 0   | 0  | 0         | 0  | 0   | 0  | 0                  | 0  | 0   | 0  | 0              | 0  | 0   | 0  |

Table (6) Description of neurovascular injuries related to motor function as a result of surgical supine positioning among the study sample (n=50)

| Range of motion | Motor function    |    |     |    |                   |    |     |    |
|-----------------|-------------------|----|-----|----|-------------------|----|-----|----|
|                 | Upper extremities |    |     |    | Lower extremities |    |     |    |
|                 | Rt.               |    | Lt. |    | Rt.               |    | Lt. |    |
|                 | No                | %  | No  | %  | No                | %  | No  | %  |
| Flexion         |                   |    |     |    |                   |    |     |    |
| No              | 7                 | 14 | 3   | 6  | 10                | 20 | 9   | 18 |
| Yes             | 43                | 86 | 47  | 94 | 40                | 80 | 41  | 82 |

|           |    |    |    |    |    |    |    |    |
|-----------|----|----|----|----|----|----|----|----|
| Extension |    |    |    |    |    |    |    |    |
| No        | 7  | 14 | 3  | 6  | 7  | 14 | 7  | 14 |
| Yes       | 43 | 86 | 47 | 94 | 43 | 86 | 43 | 86 |
| Abduction |    |    |    |    |    |    |    |    |
| No        | 5  | 10 | 2  | 4  | 7  | 14 | 7  | 14 |
| Yes       | 45 | 90 | 48 | 96 | 43 | 86 | 43 | 86 |
| Adduction |    |    |    |    |    |    |    |    |
| No        | 5  | 10 | 2  | 4  | 7  | 14 | 7  | 14 |
| Yes       | 45 | 90 | 48 | 96 | 43 | 86 | 43 | 86 |

Table (7) Description of postoperative pain level according to Numerical Pain Rating Scale among the study sample undergoing supine surgical position (n= 50)

| Postoperative pain level | No | %  |
|--------------------------|----|----|
| - Mild                   | 2  | 4  |
| - Moderate               | 9  | 18 |
| - Severe                 | 39 | 78 |

Table (8) Correlation between risk for surgical supine positioning injuries and postoperative neurovascular impairment among the study sample (n=50).

| Variables                                 | Supine surgical positioning |         |
|---|-----------------------------|---------|
| A- Postoperative neurovascular impairment | r                           | P-value |
| - Tissue perfusion                        | .503                        | .000 ** |
| - Sensory alteration                      | .551                        | .000 ** |
| Motor dysfunction                         |                             |         |
| - RT upper limb                           | .148                        | .306    |
| - LF upper limb                           | .125                        | .388    |
| - RT lower limb                           | .107                        | .458    |
| - LT lower limb                           | .161                        | .265    |
| B- Postoperative pain                     | .440                        | .001 ** |

\*\* Highly significant at p-value  $\leq 0.001$

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