Original article

KNOWLEDGE REGARDING POST-TRAUMATIC COMPARTMENT SYNDROME AMONG NURSES WORKING IN A TERTIARY HOSPITAL, KATHMANDU

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ABSTRACT

Background: Post-traumatic compartment syndrome (PTCS) of the limb is a collection of symptoms that occur when the pressure inside a muscle compartment of the limb rises. Failing to recognize PTCS in a timely manner can be life-threatening and almost always leads to negative outcomes for the patient. Nurses' understanding is essential in the management and prevention of PTCS through early recognition of clinical signs.

Methods: A descriptive cross-sectional study was conducted to investigate post-traumatic compartment syndrome among nurses at a tertiary hospital in Kathmandu. The study utilized a non-probability purposive sampling technique for data collection. A self-administered structured questionnaire was used to collect data from 124 respondents, which were then analyzed using SPSS (version 16) and interpreted using descriptive and inferential statistics.

Results: The study found that 74.2% of respondents correctly identified the meaning of post-traumatic compartment syndrome. Causes of compartment syndrome included a tight splint (95.9%), a tightly applied plaster cast (94.3%), prolonged compression due to skin traction (91.1%), and compression bandage (87.9%). Common complications included pain as the first symptom (79.03%) and permanent nerve damage (83.9%). Respondents indicated that splitting the cast in half (83.1%) and loosening the skin traction and splint (81.5%) were common management techniques for PTCS. Hourly neurovascular assessment (87.1%) was identified as the nursing action to manage PTCS. Only 37.9% of respondents demonstrated a high level of knowledge.

Conclusions: The majority of respondents demonstrated adequate knowledge of the management and prevention of compartment syndrome. However, only one-third of respondents showed a high level of understanding of post-traumatic compartment syndrome.

***Key words:** Compartment syndrome, nurses' knowledge, post-traumatic disorder*

INTRODUCTION

Compartment syndrome of the limb is an orthopaedic emergency, potentially causing significant mortality and morbidity. Post-traumatic compartment syndrome is a surgical emergency that represents tissue ischemia that is associated with an increase in pressure within a closed osteofascial compartment.[1]

The incidence of compartment syndrome is 3.1 per 100000, 10 times more in men than women, high prevalence in men below 35 years of age. It can occur due to trauma accounting for 70% of cases.[2] This condition is more prevalent in males with an average age of 32 and most cases happen as a result of traumatic events.[3] The prevalence rate was only 2.81%. The study showed that male young adults were the most affected group, with 44.4% of cases related to tibial fractures, 22.2% due to tight traditional bone settlers, and 11.1% from burn eschars.[4] Among admitted patients in a hospital, 34.78% of earthquake victims had developed compartment syndrome.[5]

It can occur within any myofascial compartment in the body, but it most commonly occurs in the lower leg[6], followed by upper limbs, thighs, abdomen, and buttocks (Mehta et al., 2018). The commonest cause of compartment syndrome is fracture and, 75% of cases are

associated with long bone fractures.[7] 9.5% of patients needed to perform amputation, and hospital death occurred in 6.6% of patients with acute compartment syndrome.[8] Traumatic compartment syndrome leads to muscle necrosis within 3 hours of muscle injury. The incidence of muscle necrosis was reported to be 46%. In response, fasciotomy was performed on 80.77% of patients, while amputation was performed on 3.85% of patients. [9]

Despite advancements in diagnosis and treatment, nurses are still unable to identify patients who are at risk, leading to higher death rates.[10] Among 90 nurses,42.22% had an adequate level of knowledge, 32.22% had a moderate level of knowledge and 25.56% had an inadequate level of knowledge regarding the prevention of post-traumatic compartment syndrome of limbs.[11]

An important factor for the devastating outcome following compartment syndrome is a delay in the initial recognition and diagnosis of the syndrome due to insufficient awareness of this condition either from a nursing assessment or because of the inexperience of the surgeon.[12]

Post traumatic compartment syndrome (PTCS) is a serious orthopedic emergency, often caused by trauma, and patients suffering from traumatic compartment syndrome can experience muscle necrosis within 3 hours of injury. Early recognition and diagnosis are crucial for avoiding devastating outcomes, but a lack of knowledge and experience among healthcare providers can lead to delays in diagnosis and treatment. Nurses with adequate knowledge play a vital role in the early detection and prevention of PTCS.

METHODS

A descriptive cross-sectional research design was utilized to evaluate the knowledge of post-traumatic compartment syndrome among 124 nurses employed in various departments of Tribhuvan University Teaching Hospital (TUTH). Ethical permission was obtained from the relevant authority, and written consent was obtained from each respondent prior to data collection. Anonymity and confidentiality were maintained through the use of code numbers, and the information was used solely for research purposes. Non-probability convenience sampling was employed to select the sample. Data was collected in February 2079 using a self-administered structured questionnaire. The data was analyzed using SPSS (16 version) and descriptive statistics such as frequency and percentage were utilized. Information was presented using descriptive statistics (mean, frequency, percentage) and inferential statistical methods (Chi-Square).

RESULTS

Table1. Respondents' socio-demographic and professional characteristics n=124

Characteristics	Number	Percent
Age		
20-30	92	74.2
31-40	30	24.2
41-50	2	1.6
Mean SD 28.74 ±4.062		
Education level		
Proficiency Certificate Level	17	13.7
Bachelor in Nursing	104	83.9
Master in Nursing	3	2.4
Current working area		
Orthopedic ward	58	46.8
Emergency	32	25.8
Gastro medicine ward	16	12.9
Female surgical ward	12	9.7
Burn ward	6	4.8
Year of work experience		
1-5	110	88.7
6-10	2	1.6
>10	12	9.7
Mean 5.99		
Previous experience inpatient care with PTCS	70	56.5
Training in trauma management	0	0.0

Table 1 shows that the majority (74.2%) of the respondents belong to the age group 20-30 years and the mean and SD was 28.74 ±4.062. Most of them (83.9%) had completed a bachelor's education in nursing and (88.7%) had work experience of 1-5 years. Nearly half of the respondents were working (46.8%) in the orthopedic ward and 56.5% had previously provided care to patients with compartment syndrome. Cent percent of respondents did not receive any training regarding trauma management.

Table 2. Respondents' knowledge of general information on post traumatic compartment syndrome (PTCS) n= 124

Characteristics	Number	Percent
The meaning of PTCS is increased pressure within the muscle compartment	92	74.2
Acute and chronic compartment syndrome is a type of PTCS	78	62.9
The common site for PTCS of the leg is the Anterior compartment	58	46.8
Causes*		
Tight splint	119	95.9
Tightly applied plaster cast	117	94.3
Prolonged compression due to skin traction	113	91.1
Compression bandage	109	87.9
Malfunctioning sequential compression device	78	62.9
Risk factors*		
Long bone fracture	103	83.1
Injured limb that has been placed in a cast	99	79.8
Crush injury	90	72.6
High energy trauma	90	72.6
Sift tissue injuries	74	59.7
Prolonged surgery for a limb injury	86	69.4

**** Multiple responses***

Table 2 shows that the majority of the respondents correctly stated the meaning (74.2%) and type (62.9%) of PTCS. Nearly half (46.8%) of respondents responded that the anterior compartment is the most common site for compartment syndrome of the leg. Most (83.1%) of them responded that long bone fracture is a risk of PTCS followed by (79.8%) with an injured limb that has been placed in a cast, and (72.6%) with crush injury and high trauma injury.

Table 3. Respondents' knowledge of signs, symptoms, and complications of PTCS n= 124

Characteristics	Number	Percent
Signs and symptoms		
The first symptom is pain	98	79.0
A late sign is paresthesia	52	41.9
6 P's associated with PTCS are pain, pressure, pallor, paralysis, pulselessness, paresthesia	82	66.1
Nature of pain*		
Severity appears out of proportion to the injury	86	69.4
Burning, deep, and aching in nature	77	62.1
Worsened by passive stretching of the involved muscle	74	59.7
Not relieved by pain medication	69	55.6
Complications*		
Permanent nerve damage	104	83.9
Permanent disability	104	83.9
Muscle contracture	84	67.7
Chronic pain	61	49.2
Irreversible muscle damage occurs within 4-6 hours	47	37.9

**** Multiple responses***

Table 3 demonstrates that the majority of the respondents (79.03) responded pain is the earliest symptom, and 41.9% responded paresthesia is the last sign of PTCS. A majority (66.1%) of respondents correctly responded that Pain, Pressure, Pallor, Paralysis, Pulselessness, and Paresthesia are the 6 P's associated with PTCS. The majority (69.4%) of respondents responded that pain severity appears out of proportion to the associated

injury followed by pain burning, deep, and aching in nature (62.1%). Most (83.9%) respondents responded to the permanent nerve damage and permanent disability, followed by muscle contracture (67.7%), and chronic pain (49.2%) as common complications of PTCS. More than one-third (37.9%) of respondents correctly responded that irreversible muscle damage occurs within 4-6 hours in PTCS.

Table 4. Respondents' knowledge of management and prevention of PTCS **n= 124**

Characteristics	Number	Percent
Diagnosis*		
History taking	116	93.5
Physical examination	111	89.5
Compartment pressure measurement	103	78.2
Neurovascular assessment of limbs*		
Capillary refill time	111	89.5
Ability to move and sensation	106	85.5
Temperature	102	82.3
Assess edema	96	77.4
Check pulse	90	72.6
The definitive surgical treatment is decompressive fasciotomy		
Nursing considerations*		
Loosen the skin traction, and splint	87	70.2
Split the cast in half (Bivalving)	121	97.5
Removal of circumferential bandages	117	94.4
Cut the under-cast padding	110	88.7
Maintaining the ankle in a neutral position	98	79
Keep the affected limb at the heart level	79	63.7
Apply ice to the injured limb	76	61.3
Nurses' actions for patients with skin traction*		
Ensure that skin traction is not too tight	58	46.8
Hourly neurovascular assessment should be done	122	98.3
Notify the physician	107	86.2
Isometric exercise of the affected limb should be taught	103	83.0
Support the arm with a sling after the upper limb cast application	99	79.8
Neurovascular assessment of the distal part of extremities in a cast for early	55	44.4
PTCS signs	73	58.9

**** Multiple responses***

Table 4 reflects that almost all (93.5%) respondents responded that history taking was the diagnosis followed by physical examination (89.5%). 89.5% of respondents responded to assess capillary refill time, followed by ability to move and sensation (85.5). 70.2% answered that fasciotomy is a surgical treatment. Most of them responded that loosened the skin traction, and splint (97.5%) and split the cast in half (94.4%) as the nursing consideration. 98.3% responded to ensure that skin traction is not too tight, 58.9% responded that the arm should be placed in a sling well supported, and 58.9% answered to neurovascular assessment of the distal part of the extremities in a cast to detect early manifestation of PTCS.

Table 5. Respondents' sources of knowledge n= 124

Sources of information	Number	Percent
Self-study	109	87.9
Discussion with peers	45	36.3
Curriculum	41	33.1

Table no. 5 depicts that 87.9% of the respondents had gained information on post-traumatic compartment syndrome through self-study.

Table 6. Respondents' knowledge level n= 124

Level of Knowledge	Number	Percent
High Level (80-100%)	47	37.9
Moderate Level (60-100%)	42	33.9
Low Level (<60%)	35	28.2

Table 6 reveals that among 124 nurses, 37.9% of respondents had a high level of knowledge regarding post-traumatic compartment syndrome.

Table 7. Association between level of knowledge and selected variables of respondents n= 124

Variables	Level of Knowledge		X^2	P Value
	High level No. (%)	Low level No. (%)		
Age				
≤29	60 (73.2)	22 (26.8)		
>29	29 (69.0)	13 (31.0)	0.233	0.629
Mean SD 28.74 ±4.062				
Education level				
Certificate Level	13 (76.5)	4 (23.5)	0.214	0.643
Bachelor and above	76 (71.0)	31 (29.0)		
Working area				
Orthopedic ward and Emergency	68 (75.6)	22 (24.4)	2.317	0.128
Others (Burn, Gastro Medicine, Female Surgical ward)	21 (61.8)	13 (38.2)		
Professional experience				
<6	63 (71.6)	25 (28.4)	0.05	0.943
≥6	26 (72.2)	10 (27.8)		
Mean 5.99				
Experience in patient care with PTCS				
Yes	51 (72.9)	19 (27.1)	0.093	0.760
No	38 (70.4)	16 (29.6)		

Table 8 shows that there was no statistically significant difference in the level of knowledge across age, educational level, working area, professional experience, and experience of patient care previously with PTCS.

DISCUSSION

The study reveals that the majority (74.2%) of the respondents responded with the correct meaning of post-traumatic compartment syndrome. Other study shows that 54.4%[11] and 87%[12]of respondents mentioned the correct meaning of PTCS.

Regarding causes almost all (95.9%) of the respondents answered tight splint followed by a tightly applied plaster cast (94.3%), prolonged compression due to skin traction (91.1%), compression bandage (87.9%), and malfunctioning sequential compression device (62.9%) are the causes of compartment syndrome. This finding is inconsistent with another study which showed that 51.1% of respondents had correctly answered that the main condition causing compartment syndrome is increasing internal pressure in the muscle.[11] The variation in this study might be due to differences in the working area and educational level of respondents as in this study majority (72.5%) of the respondents had currently working in the emergency and orthopedic ward, most (86.2%) had bachelor and above bachelor level of education whereas half (50.1%) of the respondents were working in the emergency and orthopedic ward and more than half (54.4%) had bachelor level of education.[11]

Regarding risk factors, most (83.1%) of respondents responded with long bone fracture followed by (79.8%) with an injured limb that had placed in a cast, (72.6%) with crush injury and high energy trauma, (69.4%) with prolonged surgery for a limb injury, and (59.7%) soft

tissue injury as the risk factors of compartment syndrome. A systematic review and meta-analysis studies revealed that factors that were significantly associated with the development of ACS were age 18-64 (OR: 1.34, 95% CI: 1.07-1.68), male (OR: 2.18, 95% CI: 1.53-3.10), gunshot wound with fracture and vascular injury (OR: 12.5, 95% CI: 5.69-27.46), combined forefoot and midfoot injury (OR: 3.3, 95% CI: 2.39-4.57), injury severity score (ISS) 0-9 (OR: 1.58, 95% CI: 1.27-1.97), OTA/AO type C fractures (OR: 2.75, 95% CI: 1.04-7.28), vascular injury (OR: 9.05, 95% CI: 6.69-12.26), and high-energy trauma (OR: 3.10, 95% CI: 1.60-5.82).[13]

The present study showed that 66.1% of the respondents responded that pain, pressure, pallor, paralysis, pulselessness, and paresthesia are the 6 P's associated with PTCS. The present study showed that 79.03% of the respondents responded with pain as the first symptom and 41.9% paresthesia as the late sign of compartment syndrome. Similar findings show that 46.6% of the respondents gave the information on 6 P's associated with PTCS. 80% of the respondents responded pain was the first symptom and 68.8% of the respondents responded paralysis was the late sign of PTCS.[11]

Regarding the typical nature of pain 69.4% of respondents responded pain severity appears out of proportion to the associated injury followed by pain is burning, deep, and aching (62.1%), pain is worsened by passive stretching of the involved muscle (59.7%), and pain is not relieved by pain medication (55.6%). Another study shows that 73% of respondents responded pain is worsened by passive stretching of the involved muscle.[12]

Regarding common complications 83.9% of respondents responded permanent nerve damage and permanent disability, muscle contracture (67.7%), and chronic pain (49.2%). A study report showed that 92.8% of respondents responded permanent distal muscle weakness, and permanent distal sensory weakness as common complications of compartment syndrome.[14]

Most (83.1%) of respondents responded that splitting the cast in half followed by (81.5%) loosening the skin traction and splint, (79%) cutting the undercast padding, (78.2%) removal of circumferential bandages, (63.7%) maintaining the ankle in the neutral position, (61.3%) keep affected limb at the heart level, (46.8%) apply ice to the injured limb. Another study report showed that 47% of respondents responded to splitting the cast in half, (9.3%) remove plaster, (90.6%) call the physician, and (21%) limb elevation.[12]

Regarding nursing action to prevent PTCS in patients with skin traction most of the respondents responded with hourly neurovascular assessment (87.1%) followed by ensuring that skin traction is not too tight (80.6%), notifying the physician (79.8%), and isometric exercise (52.4%) of the affected limb. Another study report showed that 63.33% of respondents responded hourly neurovascular assessment should be done, 68.89% that isometric exercise of the affected limb, and 77.1% notify the physician.[11] In this study, 44.4% of the respondents responded the arm should be placed in a sling well supported across the shoulder as the position of the patient limb after application of the cast. A study revealed that 45.5% of the respondents responded that the arm should be placed in a well-supported sling.[11]

The study reveals that 37.9% of respondents had a high level of knowledge, 33.9% had a moderate and 28.2% had a low level of knowledge. A study showed that 42.22% of respondents had an adequate level of knowledge, 32.22% of respondents had a moderate level of knowledge and 25.56% of respondents had an inadequate level of knowledge regarding post-traumatic compartment syndrome.[11]

In this study, there is no significant association between level of knowledge and age, educational level, professional experience, current working area, and patient care. Contrast findings show that there was a significant association between knowledge level and experience in the orthopedic ward.[11] The variation in this study might be due to differences in the study population and the educational level of respondents.

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CONCLUSIONS

Cent percent of respondents had not received training on

trauma management. Over one-third of respondents were aware that irreversible muscle damage occurs within 4-6 hours in PTCS. The majority of respondents had sufficient knowledge of management and prevention. One-third of respondents had a high level of knowledge about post-traumatic compartment syndrome. Similarly, the level of knowledge does not appear to be affected by socio-demographic characteristics.

CONFLICT OF INTEREST

The study has no conflict of interest.

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