Predictors of Pressure Ulcer in Hospitalized Patient

Ananda Neupane[1*], Janardan Panthi[1], Suryaman Menyangbo[1], Jenice Chhatkuli[2]

[1] Department of General Surgery, Rapti Academy of Health Sciences, Ghorahi, Dang, Nepal
[2] Department of Pathology, Rapti Academy of Health Sciences, Ghorahi, Dang, Nepal
*Corresponding author: Dr. Ananda Neupane
Lecturer Department of General Surgery
Rapti Academy of Health Sciences
E-mail: ananda984596@gmail.com

Abstract

Introduction
Pressure ulcers have been described as one of the most costly and physically debilitating complications of 20th century. Incidence rates of pressure ulcer ranges from 0.4% to as high as 38% in the inpatient department while prevalence has been reported as 3.5% to 69%. Many intrinsic and extrinsic factors have an impact on the level and extent of tissue trauma and cause pressure ulcer. The objective of this study is to identify the independent predictors for development of pressure ulcer in hospitalized patient.

Methods
Hospital based longitudinal study was conducted among patients more than 18 years with an expected admission of at least 5 days without pressure ulcer at admission. Ethical approval was taken from the IRC-MCoMS, Pokhara, Nepal. The association of different risk factors (like age, weight, comorbidities, duration of surgery, nerve damage, immobility etc.) with development of pressure ulcer was obtained by using univariate and bivariate logistic regression analysis. p-value of less than 0.05 was taken as significant.

Results
Among the 80 patients enrolled in our study, 20 developed pressure ulcer. The mean age of patients included in the study was 60.7 (+ /- 19.53) years. 55 patients were male (68.75%) and 25 were female (31.25%). Weight, comorbidities, prolonged hospital stay, up and self-reliant posture, nerve damage, serum albumin and Braden scale were the significant risk factors seen in our study.

Conclusion
Pressure ulcers are a significant health problem and can be prevented. Early management play a vital role in determining the quality of life of a patient. Identification and early recognition of these predictors help in prevention of pressure ulcer in hospitalized patient thus decreasing the incidence of pressure ulcer and increasing the overall quality of life of a hospitalized patient.

Keywords: Braden Scale Score; Pressure ulcer, Risk factors

Introduction

The definition of pressure ulcer is "an area of localized soft tissue ischemic necrosis caused by prolonged pressure higher than the capillary pressure 30mmHg with or without shear, related to posture which usually occurs over a bony prominence".[1]They should be regarded as preventable but occur in approximately 5% of all hospitalized patients (range 3–12% in published literature).[2] Incidence rates of as low as 0.4% to as high as 38% have been reported in the inpatient department while prevalence has been reported as 3.5% to 69%.[3] About two thirds of pressure sores occur in the elderly above 70 years of age.

Classification of pressure ulcer was given by an orthopedic surgeon, Darrell Shea[4] in 1975, for the first time. He classified these ulcers into five categories defined by the anatomic depth of the soft tissue damage.

Table 1: Grading of pressure ulcer according to the anatomic depth of soft tissue damage

Grade	Anatomic depth of soft tissue damage
I	Limited to epidermis, exposing dermis
II	Full thickness skin loss
III	Full thickness skin and fat defect exposing deep fascia
IV	Full thickness defect exposing bone

The pressure ulcer hampers quality of life and prevention is an important goal. Furthermore, increased risk of nosocomial and renal infections is present in these patient because of increased hospital stay leading to high rates of hospital re-admission rate. This results in an exponential increase in the healthcare burden and financial requirement for these patients.

Early prediction and prevention of pressure ulcer development, helps decrease morbidity, mortality, economical burden of patients as well as bed occupancy rate of hospital and at present there is paucity of such predicting parameters. So, we conducted this study for the fulfillment of such paucity.

Methods

Hospital based longitudinal study was done in Manipal Teaching Hospital, Pokhara, Nepal for a duration of 12 months. Ethical approval was obtained from the Institutional Review Committee of Manipal College of Medical Sciences, Pokhara, before starting the study. The inclusion criteria were patients more than 18 years with an expected admission of at least 5 days without pressure ulcers at admission. Patients with pressure ulcer at admission and patients who did not give consent were excluded. The convenience sampling method was used, and the sample size was calculated as follows:

$n = Z^2\ P\ Q\ /\ d^2$ (CI = 95%, E = 5%, prevalence = 4.9 %)[5]

$Q = 1 - P$

n = required sample size
Z = reliability coefficient (1.96 for 95% reliability)
P = estimated prevalence.
$Q = 1 - P$
d = maximum tolerable error (up to 5% i.e. 0.05)
N = 71

Thus, a sample size of 80 was taken for this study. Adults of age greater than 18 years, admitted in Surgery, Orthopedics and Medicine ward with an expected admission of at least 5 days were taken for our study. A self-structured proforma was used as a data collection tool. Informed consent from the patients were obtained. A detailed history and complete physical examination was done. Patient were visited within 48 hours of admission and once a week thereafter until either they developed a pressure ulcer, were discharged, or had stayed in hospital for more than 12 weeks. During each visit patients were examined for the presence of pressure ulcers.

Variables included in the study were patient demographic characteristics, duration of hospital stay, comorbidities, up and self - reliant position,

duration of surgery, nerve damage, mental state, mode of hospitalization, Braden scale, hemoglobin level, serum albumin and random blood sugar. The data were collected and analyzed by the use of SPSS (Statistical Package for Social Science) Software; Version 21.0 and MS-Excel, p-value of <0.05 was considered statistically significant. Chi-square test, Student t – test; bivariate logistic regression model were the statistical tools used to analyze the results.

Results

This study included a total of 80 patients admitted in Surgery, Medicine and Orthopedic ward fulfilling all the inclusion and exclusion criteria in the duration of 12 months. A total of 20 among the 80 patients developed pressure sore which was 25% of the enrolled patients. The age group range was between 23-98 years. The mean age of patients included in the study was 60.7 (+ /- 19.53) years. Old age had higher rate of bed sore development but the data was statistically insignificant (p-value: 0.091).

In our study there were 55 male (68.75%) and 25 female (31.25%). Male gender was associated with higher rate of development of pressure ulcer than female (60% in male and 40% in female). In this study, 20 patients developed pressure ulcer which was 25% of the enrolled patients. The mean age of patients who developed pressure ulcer was 68.85 (+/- 17.69) years.

Figure 1: Development of pressure ulcer in relation to age.
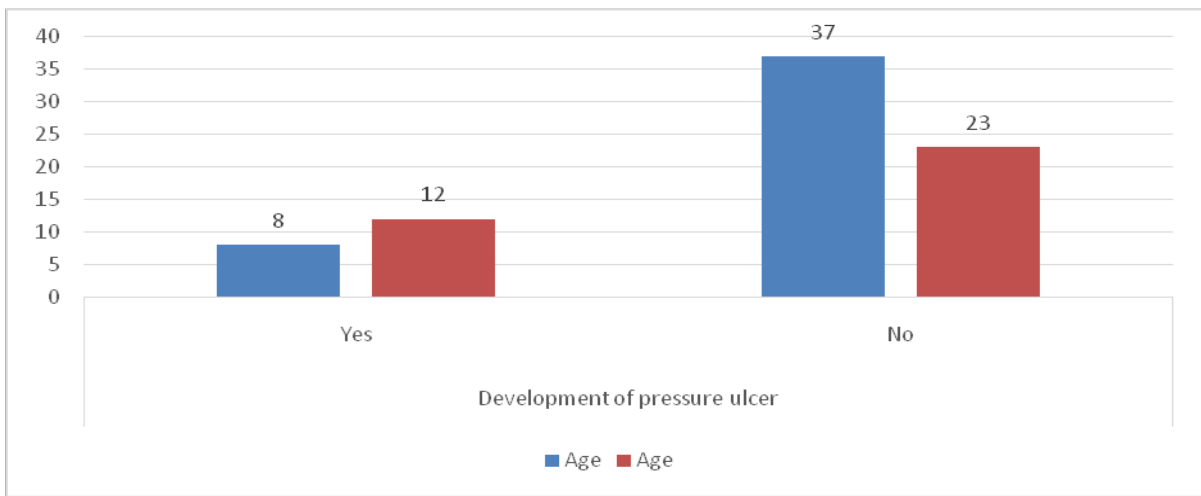

Figure 1: Represents patients in old age group (>= 65) and adult age groups (< 65), Old age had higher rate of bed sore development. Blue=age <65, Maroon= age >=65.

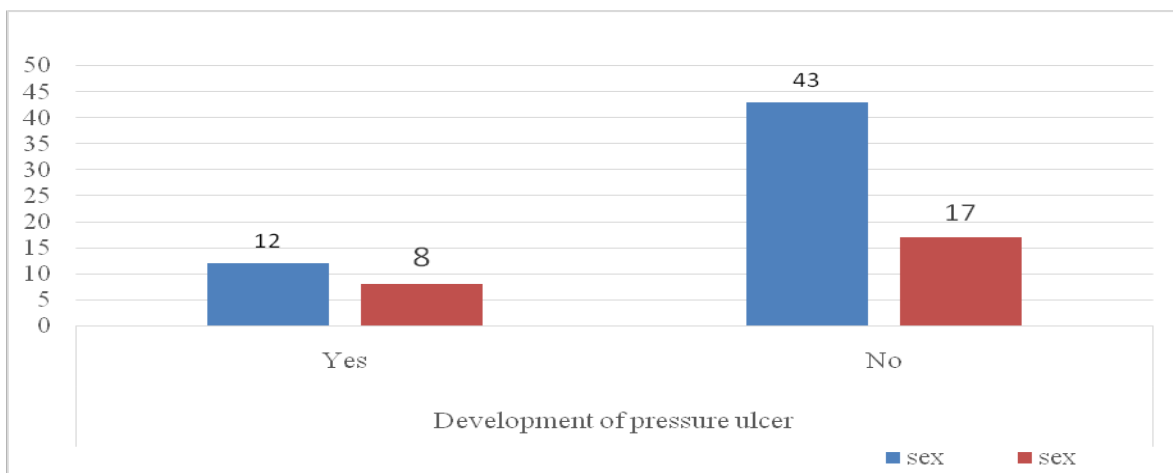**Figure 2: Development of pressure ulcer in relation to gender.**

Fig 2: Represents development of pressure ulcer in relation to gender which shows male gender was associated with higher rate of development of pressure ulcer than female (60% in male and 40% in female). Blue=Male Sex, Maroon=Female Sex.

Table 2: Association of Pressure ulcer with different predictors.

Predictors	p- value
Weight	0.01
Duration of hospital stay	0.001
Comorbidities	<0.001
Up and self-reliant position	<0.001
Nerve damage	0.03
Braden scale	< 0.001
History of surgery	0.669
Duration of surgery	0.75
Mental state	0.74
Mode of Hospitalization	0.148

Table 1 demonstrates that predictors of pressure ulcers such as weight, duration of hospital stay, comorbidities, up and self - reliant position, nerve Damage, higher Braden scale, serum albumin were statistically significant. Other predictors like history and duration of surgery, mental state, mode of hospitalization were not statistically significant.

Table 2: Association of variables with Pressure ulcer using Bivariate logistic regression.

	p-value	OR	95 % CI
Weight			
< 50 Kg	RC		
>=50 Kg	0.16	0.184	0.47 - 0.729
Comorbidities			
Yes	0.007*	7.429	2.199 - 25.095
No	RC		
Nerve damage			
Yes	0.002*	5	1.65 - 15.152
No	RC		
Braden scale score			
Favorable	<0.001*	0.050	0.014 - 0.181
Unfavorable	RC		
Serum albumin			
>=3.5 mg/dl	0.063	0.226	0.47 - 1.082
< 3.5 mg/dl	RC		
Duration of hospital stay			
< 2weeks	RC		
>=2 weeks	0.22	6.816	1.324 - 35.093
Up and self- reliant			
Yes	0.028*	0.023	0.003 - 0.182
No	RC		

Significant p-value

Table 2 shows that using bivariatelogistic regression comorbidities, nerve damage, Braden scale score were found statistically significant whereas weight, serum albumin, duration of hospital stay and up and self- reliant were not found to be statistically significant.

In the above table, we took one Reference Category in each independent variable and compared with results using Odds ratio. Comorbidities were found to be statistically significant by bivariate study and possibility of pressure ulcer increases 7.429 times (CI: 2.199 - 25.095) in patient with comorbidities. Patient with nerve damage had 5 times (CI: 1.65 - 15.15) greater risk of developing pressure ulcer as shown from our study. Calculating score using Braden scale, we got that patient in favorable group had 0.050 times (CI: 0.014 - 0.181) lesser chances of acquiring pressure sore than unfavorable group. In our study, patients who stayed in hospital for more than 2 weeks were associated with greater incidence of pressure ulcer by 6.81 times (CI- 1.324 – 35.093) than those who were hospitalized for less than two weeks.

Serum albumin was not found to be significantly (P – value: 0.063) associated with development of pressure ulcer and odds of development of pressure ulcer decreases by 0.226(C.I: 0.47 – 1.08) when serum albumin is >=3.5mg/dl. Also weight was not significantly related to development of bed sore. Patient with >= 50 kg weight had less chances (0.167) (CI: 0.056 – 0.499) of developing pressure ulcer than other group.

Discussion

Pressure ulcer is one of the common hospital acquired pressure injury of post – operative patient in surgery ward and bed ridden patients in medical ward.

Results of the systematic review and meta-analysis had shown that the overall incidence of pressure ulcers in inpatients is 12% worldwide.[6]Extensive studies which were done in the United States have estimated the frequency of pressure ulcers to be between 8% and 40%.[7]In our study, an incidence rate of 25 % was seen. The predictors of pressure ulcer were studied using univariate and bivariate analysis.

On analyzing development of pressure ulcer with weight, we found that in patients with weight < 50 Kg, they had more rate of development of bed sore and it was statistically significant. This finding is similar to the study done by Hyun S et al. which showed that underweight patients had lower total scores on the Braden scale than did normal weight patients (P = .003), indicating a higher risk for pressure ulcers in the underweight patients.[8]In the underweight individuals, risk for pressure ulcer development increases because of friction and pressure caused by the less tissue density that serves as a layer between skin and bone edges is lost.

Prolonged hospital stay has been found significant using logistic regression in causing pressure ulcer with a p-value of < 0.001. This finding is in correspondence to the result of study done by Baumgarten M et al.[9]The patients developing pressure ulcer tend to have multiple associated factors which leads to prolonged stay. Thus pressure ulcer and hospital stay are interdependent on each other.

Presence of comorbidities has also been significantly associated with development of pressure ulcer. In our study, patients had comorbidities like hypertension, diabetes mellitus, anemia, chronic kidney disease, cerebrovascular accident, seizure disorder etc. Similar result was obtained in a study conducted by Jaul E et al. This could be due to multiple chronic conditions which impairs mobility and also have a cumulative vascular, inflammatory, immune, hormonal and degenerative effect on the development of pressure ulcers.[10]Up and self-reliant patients had less chance of acquiring pressure ulcer which was found to be significant in our study which also matched with a study by Cichosz SL.[11]

In patients who underwent surgical procedure, only five had developed pressure ulcer and patients who underwent long surgical procedure (>= 3hrs) had more rate of pressure ulcer development. However, the result had no statistical significance in our study. Patients under general anesthesia cannot sense numbness or pain, and are unable to change position to relieve focal pressure and thus develop pressure ulcer if duration of surgery is prolonged. [12]

Patient with nerve damage had greater risk of developing pressure ulcer as shown from our study. 10 out of 20 patients with pressure ulcer had nerve damage associated with it. Significant association was found using logistic regression test. Loss of sensory perception prevents the patient from perceiving the pain of pressure and the need to relieve it and neurological conditions causing paralysis or motor weakness prevents change of posture when pressure is exerted, which might me the cause. [13]

We used Braden scale and compared it with development of pressure ulcer. For Braden scale, several parameters were used and scoring was done. We took "no risk" and "mild" as favorable parameters while "moderate" and "high risk" were taken as unfavorable parameters. Logistic regression was done where the result came as statistically significant. Similar result was obtained in study done by Iranmanesh S et al. which indicted that Braden scale could be a good predictor tool for pressure ulcer development among ill trauma patients. [14]

Serum albumin level was found to be significantly associated with development of pressure sore according to the results obtained using Student t – test and logistic regression. Patients with serum albumin > 3 mg/dl, had less chance of developing pressure sore. Albumin is considered to reflect protein synthesis and it also plays physiological roles in maintenance of oncotic pressure which may influence tissue tolerance. [15] Oncotic pressure serves as the main driving pressure (together with hydration status) for vascular refill, and subsequent lowering of albumin levels may be responsible for decreasing skin perfusion, causing pressure ulcer. [16]

The purpose of this study was to examine the significance of various risk factors in predicting occurrence of pressure ulcer in hospitalized patients, in an attempt to construct a real-life scenario of our daily work. The findings demonstrate that the coexistence of multiple factors play an integral role in developing pressure ulcer.

Conclusion

Pressure ulcers are significant health problem and their prevention and early management play a vital role in determining the quality of life of a patient. Our study shows that the factors like decreased body weight, length of hospital stay, comorbidities, nerve damage, limitation of physical activity, low serum albumin, lesser Braden scale are the predictors of pressure ulcer. Identification and early recognition of these predictors help in prevention of pressure ulcer in hospitalized patient thus decreasing the incidence of pressure ulcer and increasing the overall quality of life of a hospitalized patients.

References

1. Agrawal K, Chauhan N. Pressure ulcers: Back to the basics. Indian J Plast Surg. 2012 May; 45(2):244-54
2. Bailey H.H, Love R.J.M. Wounds, Healing and Tissue Repair. In- William N.S, O'Connell P.R, McCaskie A.W editor. Bailey and Love's Short practice of Surgery. 27th edition. New York: CRC Press; 2018. 29
3. Cuddigan J, Berlowitz DR, Ayello EA. Pressure ulcers in America: prevalence, incidence, and implications for the future. Advances in skin & wound care. 2001 Jul 1;14(4):208.
4. Shea JD. Pressure sores: classification and management. ClinOrthopRelat Res. 1975 Oct; (112):89-100
5. Chauhan VS, Goel S, Kumar P, Srivastava S, Shukla VK. The prevalence of pressure ulcers in hospitalized patients in a university hospital in India. J Wound Care. 2005 Jan;14(1):36-7
6. Gosnell DJ. An assessment tool to identify pressure sores. Nurs Res. 1973 Jan-Feb; 22(1):55-9
7. Borojeny LA, Albatineh AN, Dehkordi AH, Gheshlagh RG. The Incidence of pressure ulcers and its associations in different wards of the hospital: A systematic review and meta-analysis. Int J Prev Med. 2020 Oct 5;11:171
8. Hyun S, Li X, Vermillion B, et al. Body mass index and pressure ulcers: improved predictability of pressure ulcers in intensive care patients. Am J Crit Care. 2014 Nov; 23(6):494-501

9. Baumgarten M, Margolis DJ, Localio AR et al. Pressure ulcers among elderly patients early in the hospital stay. J Gerontol A BiolSci Med Sci. 2006 Jul;61(7):749-54

10. Jaul E, Barron J, Rosenzweig JP, Menczel J. An overview of co-morbidities and the development of pressure ulcers among older adults. BMC Geriatr. 2018 Dec;18(1):1-1

11. Cichosz SL, Voelsang AB, Tarnow L, Hasenkam JM, Fleischer J. Prediction of In-Hospital Pressure Ulcer Development. Adv Wound Care (New Rochelle). 2019 Jan 1;8(1):1-6

12. Linares HA, Mawson AR, Suarez E, Biundo JJ. Association between pressure sores and immobilization in the immediate post-injury period. Orthopedics. 1987 Apr;10(4):571-3

13. Horn SD, Bender SA, Ferguson ML et al. The National Pressure Ulcer Long-Term Care Study: pressure ulcer development in long-term care residents. J Am Geriatr Soc. 2004 Mar; 52(3):359-67

14. Iranmanesh S, Rafiei H, Sabzevari S. Relationship between Braden scale score and pressure ulcer development in patients admitted in trauma intensive care unit. Int Wound J. 2012 Jun;9(3):248-52

15. Izaka S, Sanada H, Matsui Y et al. Serum albumin level is a limited nutritional marker for predicting wound healing in patients with pressure ulcer: two multicenter prospective cohort studies. ClinNutr. 2011 Dec;30(6):738-45

16. Mistrík E, Dusilová-Sulková S, Bláha V, et al. Plasma albumin levels correlate with decreased microcirculation and the development of skin defects in hemodialyzed patients. Nutrition 2010 Sep;26(9):880-5.