Characteristics of Hospital Acquired Pressure Ulcer and Factors Affecting Its Development: A Retrospective Study

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Abstract

Background

Worldwide, pressure ulcers (PUs) have been implicated in costing billions annually, with 60,000 deaths out of 2.5 million hospitalized patients resulting from complications related to PU. The prevention of PU reduces the incidence of other illnesses, decreases the financial costs, and improves the quality of life for patients. We aimed to identify the most influential factors that increased the risk of developing PUs among hospitalized patients at a university hospital according to the Waterlow scale.

Methods

Data were collected retrospectively from patients who developed PUs between January 2016 and December 2018 at King Abdulaziz University Hospital, Jeddah, Saudi Arabia, and were evaluated using the Waterlow PU risk assessment tool. The analysis was performed using the Statistical Package for Social Science (SPSS), version 23.0 (IBM, Armonk, NY).

Results

A total of 272 cases were included in this study. The highest number of cases (n = 83, 30.5%) belonged to the age group of 50 to 64 years. The majority of patients had stage 2 PUs (165, 60.7%). The most frequent location of PU was the “back” (97, 35.7%). A history of undergoing major surgery was significantly associated with a higher stage of PU (p = 0.040). The mean Waterlow PU score for all cases was 27.19 ± 13.143. There was a moderate positive correlation between the neurological deficit score and the Waterlow PU score (correlation coefficient: 0.447, p < 0.001). Multinomial logistic regression analysis revealed that increasing age is a significant predictive factor for developing higher stages of PUs (p = 0.046).

Conclusion

Major surgery, neurological deficit, low hemoglobin level, and increasing age were strong predictors for developing higher stages of PU. Therefore, healthcare contributors should consider these risks when applying a comprehensive PU management plan.

Categories: Plastic Surgery, Preventive Medicine, Quality Improvement

Keywords: pressure injury, hospital acquired, risk factors, characteristics, age, saudi arabia, wound

Introduction

Pressure ulcer (PU) is a common medical problem that affects patients in healthcare settings worldwide [1]. A PU is also known as bedsore, pressure injury, pressure sore, or decubitus ulcer, and its defined as damage that is localized to the skin or/and underlying soft tissue, be it linked to a medical device or skin over a bony prominence. Pressure injuries may occur as an intact skin or as an open painful or painless ulcer, resulting from prolonged or/and intense pressure in combination with shear [2]. Across the Middle East, the prevalence of a PU is estimated to be 7–44.4% [3,4]. Previous research has been conducted in a 144-bed governmental hospital in Saudi Arabia, and they have found that the prevalence of hospital-acquired PU was 7.5% [5].

In fact, the prevalence of PU also defers long-term care, acute care, home care, and rehabilitative care by healthcare setting [3]. Patients in the intensive care unit (ICU) have a high risk of developing PU, with an estimated incidence between 3.3% and 52.9% [6,7]. Globally, PU has been implicated in $11 billion in costs annually, and in the United States, 60,000 deaths out of 2.5 million hospitalized patients have resulted from complications related to PU, each year [8]. The cost to establish PU prevention to our patients at risk can tremendously affect the healthcare systems’ resources [9]. Prevention of PU by involving the patient and their families plays a major role in reducing the incidence of other illnesses, decrease the financial costs,
and improve the quality of life for our patients [10-12]. Preventing PUs from occurrence is the key principles in its management. The multidisciplinary managing team should not only focus on the wound but also take a broad approach that needs the patient and their family [13]. PU represents an interplay of a combination of factors contributing to its development from both the patient and the environment [14]. According to various prospective studies, factors such as low serum albumin level, age, mobilization, exercise, diabetes intake, and skin PU status have been found to increase the risk of developing PU [15,16]. However, there has been no single factor that can determine the risk of PU development [17]. Therefore, this observational retrospective study aimed to identify and determine the most influential factors that increase the risk of developing PUs among hospitalized patients at a university hospital according to the Waterlow scale.

**Materials And Methods**

**Study design and setting**

We performed a retrospective cohort study targeting patients of both sexes who developed PUs between January 2016 and December 2018 at King Abdulaziz University Hospital (KAUH), Jeddah, Saudi Arabia. In order to better reflect our results, we intended to include all patients who experienced hospital-acquired PUs, were over 18 years of age, were not reported to have PUs prior to admission to KAUH, and were assessed using the Waterlow score throughout hospitalization. A list of the medical record of a number of patients who satisfied the inclusion criteria was obtained.

**Data collection sheet**

After reviewing the literature, we formulated a collection sheet to enter the data based on several published ones [14,17]. The data were collected retrospectively from the Phoenix (KAUH database) using excel sheets composed of 20 variables, including the patients’ demographic characteristics (sex, age, length of stay (LOS), comorbidities, admitted unit), stage and site of the PU, those of the Waterlow PU risk assessment tool (including body mass index (BMI), appetite, mobility, continence, skin type/visual risk areas, special risks/medications, tissue malnutrition, neurological deficit, and major surgery/trauma), and laboratory findings (albumin and hemoglobin levels).

**Statistical analysis**

Data were checked for errors and completeness. Descriptive statistics were used to present the baseline characteristics and all PU-related variables. Continuous variables were checked for normality using the Kolmogorov-Smirnov test and Shapiro-Wilk test. Feeding route, mobility status, continence, risk of medications, tissue nutrition, major surgery, and comorbidities were presented for all stages of PU, and the relationship of the former variable to the latter was observed by chi-square test. Correlations between all continuous variables (neurological deficit score, LOS, albumin, hemoglobin, and Waterlow PU score) were assessed using Spearman’s rank correlation test. A multinomial logistic regression model was performed by counting the stages of PU as the dependent variable and LOS, albumin level, hemoglobin level, Waterlow PU score, neurological deficit score, sex, comorbidities, and age as independent variables. The analysis was performed using the Statistical Package for Social Science (SPSS), version 23.0 (IBM, Armonk, NY, USA).

**Ethics approval and consent to participate**

Patient medical records were obtained after participants’ written consent, and the data were collected after we received ethical approval for this study from the Institutional Review Board and the Research Ethics Committee of King Abdulaziz University in Jeddah, Saudi Arabia. (Reference No. 26-18).

**Results**

A total of 272 cases were included in this study, of which 145 (53.3%) were males. The highest number of cases (n = 83, 30.5%) belonged to the age group of 50 to 64 years (Table 1).

| Characteristics | N | % |
|-----------------|---|---|
| Unit            |   |   |
| MICU            | 68| 25.0|
| SICU            | 51| 18.8|
| ER              | 41| 15.1|
| FMW             | 32| 11.8|
| MMW             | 14| 5.1|
| Gyn             | 13| 4.8|
| Table 1: Baseline characteristics of all cases (n = 272). |
|-----------------------------------------------------|
| **MSW** | 11  | 4.0 |
| **Others** | 42  | 15.4 |
| **Gender** | | |
| **Male** | 145 | 53.3 |
| **Female** | 127 | 46.7 |
| **Age group (years)** | | |
| 14-49 | 67  | 24.6 |
| 50-64 | 83  | 30.5 |
| 65-74 | 63  | 23.2 |
| 75-80 | 31  | 11.4 |
| 81+ | 28  | 10.3 |
| **BMI** | | |
| Below average (BMI <20) | 36 | 13.2 |
| Average (BMI 20-24.9) | 122 | 44.9 |
| Above average (BMI 25-29.9) | 55 | 20.2 |
| Obese (BMI >30) | 59 | 21.7 |
| **Feeding** | | |
| Poor | 48 | 17.6 |
| No/anorexia | 58 | 21.3 |
| Nasogastric tube/fluids only | 93 | 34.2 |
| Average | 73 | 26.8 |
| **Motility** | | |
| Apathetic (sedated/depressed/reluctant to move) | 15 | 5.5 |
| Bedbound (unconscious/unable to change position/traction) | 143 | 52.6 |
| Chair bound (unable to leave the chair without assistance) | 12 | 4.4 |
| Fully mobile | 45 | 16.5 |
| Restless/fidgety | 8 | 2.9 |
| Restricted (restricted by severe pain or disease) | 49 | 18.0 |
| **Continence** | | |
| Catheterized with fecal incontinence | 90 | 33.1 |
| Complete/catheterized | 131 | 48.2 |
| Urinary and fecal (double) incontinence | 43 | 15.8 |
| Urine incontinence | 8 | 2.9 |
| **Major surgery** | | |
| No surgery | 241 | 88.6 |
| On table >2 hours (up to 48 hours post-op) | 12 | 4.4 |
| On table >6 hours | 13 | 4.8 |
| Orthopedic below waist/spinal (up to 48 hours post-op) | 6 | 2.2 |
One hundred sixty-five (60.7%, n = 165) patients had stage 2 PUs, 57 (21%) had stage four, and 45 (16.5%) had stage one. The most frequent location of PU was the “back” (97, 35.7%), followed by the “sacral region” (96, 35.3%). The most common skin type was “dry/itchy” (179, 65.8%). Only 73 (26.8%) cases had “normal/average” food intake while others required a nasogastric tube or parenteral nutrition. More than half of the patients were bedbound (143, 52.6%). Urinary and fecal (double) incontinence was present in eight (2.9%) cases. The clear majority (241, 88.6%) did not undergo surgery.

Table 2 presents the distribution of feeding, mobility, continence, risk of medications, tissue malnutrition, major surgery, and comorbidities according to stages of PU. Major surgery was significantly associated with a higher stage of PU (p = 0.040).

| Variables                          | Stage 1 (%) | Stage 2 (%) | Stage 3 (%) | Stage 4 (%) | p-Value |
|-----------------------------------|-------------|-------------|-------------|-------------|---------|
| Feeding                           |             |             |             |             |         |
| Poor                              | 15.6        | 17.0        | 20.0        | 21.1        | 0.196   |
| No/anorexia                       | 11.1        | 21.2        | 60.0        | 26.3        |         |
| Nasogastric tube/fluids only      | 44.4        | 35.2        | 20.0        | 24.6        |         |
| Average                           | 28.9        | 26.7        | 0.0         | 28.1        |         |
| Mobility                          |             |             |             |             |         |
| Fully mobile                      | 17.8        | 15.8        | 0.0         | 19.3        | 0.526   |
| Not fully mobile                  | 82.2        | 84.2        | 100.0       | 80.7        |         |
| Continence                        |             |             |             |             |         |
| Catheterized with fecal incontinence | 37.8   | 32.7        | 40.0        | 29.8        | 0.941   |
| Complete/catheterized             | 37.8        | 49.7        | 40.0        | 52.6        |         |
| Urinary and fecal (double) incontinence | 20.0   | 15.2        | 20.0        | 14.0        |         |
| Urine Incontinence                | 4.4         | 2.4         | 0.0         | 3.5         |         |
| Risk of medications               |             |             |             |             |         |
| Yes                               | 75.6        | 74.5        | 80.0        | 73.7        | 0.988   |
| No                                | 24.4        | 25.5        | 20.0        | 26.3        |         |
| Tissue malnutrition               |             |             |             |             |         |
| No                                | 26.7        | 21.8        | 20.0        | 28.1        | 0.764   |
| Yes                               | 73.3        | 78.2        | 80.0        | 71.9        |         |
| Major surgery                     |             |             |             |             |         |
| No                                | 91.1        | 84.8        | 100.0       | 96.5        | 0.040   |
| Yes                               | 8.9         | 15.2        | 0.0         | 3.5         |         |
| Comorbidities                     |             |             |             |             |         |
| No                                | 77.8        | 84.8        | 80.0        | 57.9        | 0.073   |
| Yes                               | 22.2        | 15.2        | 20.0        | 42.1        |         |

**TABLE 2:** Distribution of all cases by feeding, mobility, continence, risk of medications, tissue malnutrition, major surgery, and comorbidities by stage of pressure ulcer.
The mean Waterlow PU score for all cases was 27.19 ± 13.143. Table 3 shows the correlation between the continuous variables; a moderate uphill correlation between neurological deficit score and Waterlow PU score was observed (correlation coefficient: 0.447, p < 0.001). Multinomial logistic regression analysis revealed that increasing age was a significant predictive factor for developing higher stages of PUs (p = 0.046).

| Correlation matrix | Neurological deficit score | LOS | Albumin | Hemoglobin | Waterlow PU score |
|--------------------|----------------------------|-----|---------|------------|-------------------|
| Correlation coefficient | 1.000 | 0.035 | −0.100 | −0.210 | 0.447 |
| p-Value | - | 0.561 | 0.123 | 0.001 | 0.000 |

| Correlation coefficient | 1.000 | −0.092 | −0.125 | −0.015 |
| p-value | - | 0.156 | 0.040 | 0.804 |

| Correlation coefficient | 1.000 | 0.204 | −0.121 |
| p-value | - | 0.002 | 0.062 |

| Correlation coefficient | 1.000 | −0.223 |
| p-value | - | 0.000 |

TABLE 3: Correlation between neurological deficit score, LOS in hospital, albumin, hemoglobin, and Waterlow PU score.

PU: pressure ulcer, LOS: length of stay.

Discussion

Overall, 272 patients were involved in this article. The majority of our patients aged from 50 to 64 years (83 cases, 30.5%). Most of them had two pressure injuries (165, 60.7%). The "back" was the most common location of the PU (97, 35.7%). Having a history of undergoing a major surgical procedure was a significant factor associated with a deeper stage of PU (p = 0.04). The overall mean of the Waterlow PU score for all the involved cases was 27.19 ± 13.143. PU can occur in various settings, at home and in any hospital ward or department. In admitted patients, pressure damage has a prevalence of 3-6% [18,19]. Meanwhile, the incidence of developing a PU after surgery is 54.8% [20]. Hence, adequate perception and knowledge regarding PU prevention strategies play a major role in preventing PUs [21]. PU does not only cause a significant economic burden and raise the workload of healthcare providers but also disturbs the patient as it causes pain, and the pain, exudation, and body look disruption have negative effects on the quality of life of the patient and prevent wound healing [22]. Identifying risk factors is the most significant and important method to reduce this burden. Therefore, the goal of this study was to identify and evaluate the most influential factors for the development of PUs among hospital patients according to the Waterlow scale. We found that the mean length of hospital stay was 47 days, but this finding was contradictory to that of Sayar et al. [23]. Moreover, the mean Waterlow PU score for all participants was 27.19 ± 13.145, which suggested very high-PU risk, and this result was consistent with previous studies [23,24]; thus, the Waterlow scoring system was an adequate instrument for risk assessment. The majority of patients included in the study had second-degree PUs (165 patients, 60.7%). However, higher grades and more severe injury to pressure were seen in another study, including grades 3 and 4 [25]. Another important finding was that the most common location of a PU in our article was the "back" (55.7%), followed by the "sacral region" (55.3%), and this was also observed in a study conducted by Sayar et al. [23]. This finding was explained by the fact that for the majority of patients with the head and trunk raised between 15 and 45 degrees, known as the semi-fowler position, PUs are situated on their back. Therefore, understanding the position most vulnerable to the PU can be of great help in preventing PUs. In our research, multinomial logistic regression analysis revealed

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that increasing age was a major predictive factor for developing higher stages of PU (p = 0.046) when it comes to aging as a risk factor for PU. This was consistent with most previous research [26,27]. Furthermore, over half of our participants were over 50 years old as most older people tend to have less mobility and movement as well as an increased risk of comorbidities [28]. In our sample, the rate of bedbound cases (unconscious/incapable of changing position/traction) was 52.7%. Immobilization has a detrimental impact on the body as a whole, which increases the risk of developing a PU [16]. Statistically significant variations in PU and hemoglobin level were observed. Anemia has been shown to have significant implications in PU [29]; however, another study concluded that low hemoglobin level has no effect on the occurrence of PU [30]. Although this present article has reached its target, there are some important limitations. The study’s main limitation was the unreliable, vague, contradictory, and/or incomplete details in the medical records. This could be explained by the lack of continuity that potentially had an indirect effect on follow-up and clinical treatment in the reporting process. Another drawback was that the data did not specify whether the PU was sustained in the hospital or community as well as the exact site of the PU. Moreover, the sample was collected from a single medical institution. Therefore, we suggest prospective studies with a larger sample size to analyze all variables in compliance with the Waterlow parameters and their relationships.

Conclusions
This retrospective study of patient pressure injury medical records found that major surgery, limited mobility, neurological impairment, low hemoglobin level, inadequate oral nutrition, and older age are factors and good predictors for the occurrence of higher pressure injury levels. According to the results of our single-centered study, healthcare contributors should consider these risks when applying a comprehensive pressure injury management plan.

Additional Information
Disclosures
Human subjects: All authors have confirmed that this study did not involve human participants or tissue. Animal subjects: All authors have confirmed that this study did not involve animal subjects or tissue. Conflicts of interest: In compliance with the ICMJE uniform disclosure form, all authors declare the following: Payment/services info: All authors have declared that no financial support was received from any organization for the submitted work. Financial relationships: All authors have declared that they have no financial relationships at present or within the previous three years with any organizations that might have an interest in the submitted work. Other relationships: All authors have declared that there are no other relationships or activities that could appear to have influenced the submitted work.

References
1. Kaltenthaler E, Withfield MD, Walters SJ, Akehurst RL, Paisley S: UK, USA and Canada: how do their pressure ulcer prevalence and incidence data compare?. ] Wound Care. 2001, 10:530-5. 10.12968/jwoc.2001.10.1.26059
2. Prevention and treatment of pressure ulcers: clinical practice guideline . (2016). Accessed: December 09, 2020: http://epuap.org/wp-content/uploads/2016/10/quick-reference-guide-digital-npuap-eputap-ppiajan2016.pdf.
3. Saleh M, Anthony D, Parboteeah S: The impact of pressure ulcer risk assessment on patient outcomes among hospitalised patients. ] Clin Nurs. 2009, 18:1925-9. 10.1111/j.1365-2702.2008.02717.x
4. Tubaihat A, Anthony D, Saleh M: Pressure ulcers in Jordan: a point prevalence study. ] Tissue Viability. 2011, 20:14-9. 10.1016/j.jtv.2010.08.001
5. Al-Otaibi YK, Al-Nowaiser N, Rahman A: Reducing hospital-acquired pressure injuries. BMJ Open Qual. 2019, 8.e000464. 10.1136/bmjopen-2018-000464
6. Tescher AN, Branda ME, Byrne TJ, Naessens JM: All-at-risk patients are not created equal: analysis of Braden pressure ulcer risk score to identify specific risks. ] Wound Ostomy Continence Nurs. 2012, 59:282-91. 10.1097/WON.0b013e3182435715
7. Oliveira AC, Sabino CP, Almeida AD, Santos AC: Ulcera por presión: incidencia y factores demográficos, clínicos y nutricionales asociados en pacientes de una unidad de cuidados intensivos. Nutr Hosp. 2015, 32:2242-52. 10.3305/nh.2015.32.5.9646
8. Preventing pressure ulcers in hospitals. (2014). Accessed: October 15, 2020: http://www.unicef.org/professionals/systems/hospital/pressureulcer/toolkit/putool1.html.
9. Demarré L, Van Lancer A, Van Hecke A, et al.: The cost of prevention and treatment of pressure ulcers: a systematic review. Int J Nurs Stud. 2015, 52:1754-74. 10.1016/j.ijnurstu.2015.06.006
10. Sumarno AS: Pressure ulcers: the core, care and cure approach. Br J Community Nurs. 2019, 24:38-42. 10.12968/bjcn.2019.24.Sup12.S38
11. Edlich RF, Winters KL, Woodard CR, Buschbacher RM, Long WB, Gehart JH, Ma EK: Pressure ulcer prevention. ] Long Term Eff Med Implants. 2004, 14:285-304. 10.1615/longtermeffmedimplants.v14.i4.20
12. Roaf R: The causation and prevention of bed sores. ] Tissue Viability. 2006, 16:6-8. 10.1016/s0965-206x(06)00202-0
13. Jaul E: Assessment and management of pressure ulcers in the elderly: current strategies . Drugs Aging. 2010, 27:311-25. 10.2165/11318540-000000000-00000
14. Lindgren M, Unosson M, Fredrikson M, Ek AC: Immobility - a major risk factor for development of pressure ulcers among adult hospitalized patients: a prospective study. Scand J Caring Sci. 2004, 18:57-64. 10.1046/j.1399-0258.2004.00250.x
15. Ek AC: Prediction of pressure sore development. Scand J Caring Sci. 1987, 1:77-84. 10.1111/j.1471-6712.1987.tb00605.x
16. Allman RM, Goode FS, Patrick MM, Burst N, Bartolucci AA: Pressure ulcer risk factors among hospitalized patients with activity limitations. JAMA. 1995, 11:865-70. 10.1001/jama.1995.03520350047027
17. Coleman S, Gorecki C, Nelson EA, et al.: Patient risk factors for pressure ulcer development: systematic review. Int J Nurs Stud. 2015, 1:974-1003. 10.1016/j.ijnurstu.2012.11.019
18. Kemp MG, Keithley JK, Smith DW, Morreale B: Factors that contribute to pressure sores in surgical patients. Res Nurs Health. 1990, 13:295-301. 10.1002/nur.4770130505
19. Ek AC, Unosson M, Larsson J, Von Schenck H, Bjurulf P: The development and healing of pressure sores related to the nutritional state. Clin Nutr. 1991, 10:245-50. 10.1016/0261-5614(91)90002-1
20. Theaker C: Pressure prevention in the critically ill: what you don’t know, what you should know and why it’s important. Intensive Crit Care Nurs. 2003, 19:163-8. 10.1016/S0966-3397(03)00025-9
21. Spruce L: Back to basics: preventing perioperative pressure injuries. AORN J. 2017, 105:92-9. 10.1016/j.aorn.2016.10.018
22. Mervis JS, Phillips TJ: Pressure ulcers: pathophysiology, epidemiology, risk factors, and presentation. J Am Acad Dermatol. 2019, 81:881-90. 10.1016/j.jaad.2018.12.069
23. Sayar S, Turgut S, Doğan H, et al.: Incidence of pressure ulcers in intensive care unit patients at risk according to the Waterlow scale and factors influencing the development of pressure ulcers. J Clin Nurs. 2009, 18:765-74. 10.1111/j.1365-2702.2008.02598.x
24. Boyle M, Green M: Pressure sores in intensive care: defining their incidence and associated factors and assessing the utility of two pressure sore risk assessment tools. Aust Crit Care. 2001, 14:24-50. 10.1016/S1036-7314(01)80019-9
25. Clark M, Callum N: Matching patient need for pressure sore prevention with the supply of pressure redistributing mattresses. J Adv Nurs. 1992, 17:310-6. 10.1111/j.1365-2648.1992.tb01979.x
26. Burd C, Langemo DK, Olson B, Hansson D, Hunter S, Savage T: Epidemiology of pressure ulcers in a skilled care facility. J Gerontol Nurs. 1992, 18:29-39.
27. Gonnell DJ, Johannsen J, Ayres M: Pressure ulcer incidence and severity in a community hospital. Decubitus. 1992, 5:62.
28. Braden B, Bergstrom N: A conceptual schema for the study of the etiology of pressure sores. Rehabil Nurs. 1987, 12:8-12. 10.1002/j.2048-7940.1987.tb00514.x
29. Williams DF, Stotts NA, Nelson K: Patients with existing pressure ulcers admitted to acute care. J Wound Ostomy Continence Nurs. 2000, 27:216-26. 10.1067/mow.2000.107875
30. Phillips LB: Pressure ulcers - prevention and treatment guidelines. Nurs Stand. 1999, 14:56-8. 10.7748/nst.14.12.56.s48