EJMI

DOI: 10.14744/ejmi.2017.43153
EJMI 2018;2(1):12–17

Research Article

Determination of Risk Factors in the Development and Prevalence of Pressure Sores in Patients Hospitalized in a Cardiovascular and Thoracic Surgery Intensive Care Unit

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Abstract

Objectives: The incidence of pressure sores, which can cause morbidity and mortality in chest and cardiac surgery patients, was reported to be up to 41% in intensive care patients. However, pressure sores can be avoided if the appropriate precautions are taken. In this study, the objective was to determine risk factors that play a role in the development and prevalence of pressure sores in cardiac surgery patients.

Methods: The study included 1956 patients who underwent cardiothoracic surgery and who stayed in the intensive care unit (ICU) for more than 48 hours. The data were obtained retrospectively from nurse and physician follow-up records. The patients were evaluated in terms of demographic and clinical characteristics, and factors such as the presence of a pressure ulcer on admission to the ICU, the grade of the pressure sore, and a Braden pressure sore risk score. The risk factors were compared in patients who did and did not develop pressure sores during their ICU stay.

Results: In this study, the prevalence of pressure sores was 2.1%. Advanced age (62.17±41 years), a high Euroscope value, the presence of diabetes mellitus, peripheral vascular disease, preoperative atrial fibrillation, ejection fraction <30%, and urgency of operation were among the preoperative risk factors for the development of decubitus ulcers, and significant postoperative risk factors were a level of low hemoglobin or glucose, hypoalbuminemia, and a lengthy period of mechanical ventilation or intensive care.

Conclusion: Patients in cardiovascular and thoracic surgery ICUs should be evaluated for pressure sores in the early period. Prompt identification and control of risk factors reduces hospitalization time, morbidity, and most importantly, mortality.

Keywords: Cardiothoracic surgery, pressure sore risk factors

Defined as pressure ulcer, bedsore, decubitus ulcers, or decubitus, the "pressure sore" is one of the important health problems in our country. Pressure sores are an important burden both on patients and their relatives and/or caregivers. These injuries not only cause pain and discomfort but also have a major negative impact on quality of life.

In addition, pressure sore is a health problem that increases the risk of mortality and morbidity, prolongs the length of stay in the hospital, increases the treatment costs, and reflects the quality of patient care services.[1-6] The European Pressure Ulcer Advisory Panel (EPUAP) defines the pressure sore as the localized tissue damage that occurs with pressure, friction, irritation or ulcer as a result of extreme and prolonged pressure on the skin or in subcutaneous tissues.[7] The most important feature of pressure sores is that they can be prevented if appropriate precautions are taken.

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Submitted Date: December 15, 2017 **Accepted Date:** January 09, 2018 **Available Online Date:** January 30, 2018

Differing data are reported about the prevalence of pressure sores. Pressure sores may develop in 9-13% of hospitalized patients, 41% of intensive care patients, 60% of quadriplegic patients, and 66% of those having a hip fracture operation.[8-12]

The prevalence of pressure sore in our country has been reported as 7.2%[13] in hospitalized patients and 54.8% in patients who underwent an operation.[14] It is considered that the initiation of preventive interventions in patients with defined risks will prevent the development of pressure sores.[15]

Assessment scales such as Braden, Waterlow, and Norton are used to assess the risk of pressure sore development during the intensive care. The use of the Braden risk assessment scale is more common. The Braden Risk Assessment Scale was developed by Braden and Bergstorm (1987) on the basis of the pressure sore risk factors of the patients. The Braden risk assessment scale is the most widely used scale and is the most reliable and valid scale available for patient groups from a wide age range.[16] The scale consists of 6 sub-dimensions including stimulus perception, humidity, activity, movement, nutrition, friction, and irritation (Table 1). The maximum score is 23 and the score between 15 and 18 is defined as mild-risk, 13-14 moderate-risk, 10-12 high-risk, 0-9 very high-risk patient.

This study aims to determine the prevalence of pressure sore in patients staying in the Cardiothoracic Surgery Intensive Care Unit (ICU) and the risk factors that may play a role in the development of pressure sore.

Methods

The present study was performed on 1956 patients aged 18 years and older who stayed in the Cardiothoracic Surgery (IC) ICU of Kartal Koşuyolu Highly Specialized Training and Research Hospital for more than 48 hours between 1 January 2013 and 1 February 2014. The data of the patients were obtained retrospectively from the follow-up records of the nurses and physicians. The patient information was obtained from the anamnesis records in the files, from the results of laboratory tests, and from the doctor-nurse follow-up and order records. The data such as age, sex, service before the ICU admission, presence of pressure sore at the ICU admission, Braden decubitus ulcer risk score, hospitalization weight, albumin level, inotropic use, body temperature, smoking, fecal incontinence, renal insufficiency, Acute Physiology and Chronic Health Assessment II (APACHE II), New York Heart Association's classification of cardiac functions according to the physical activities (NHYA), mechanical ventilation, unconsciousness, duration of hospital stay, impaired tissue perfusion, an unstable hemodynamic status, anemia, sedation, inactivity and malnutrition were recorded.

The SPSS software (Version 17.0) was used for statistical analysis. Descriptive statistical methods (Frequency, Percentage, Mean, and Standard Deviation) were used to evaluate the study data. The Kolmogorov-Smirnov distribution test was used to examine the normal distribution. The Pearson Chi-square (χ^2) test was used to compare the qualitative data. The Mann Whitney U test was used for the comparison of the non-normal distribution of the parameters in the case of two groups. The Kruskal Wallis test was used for the comparison

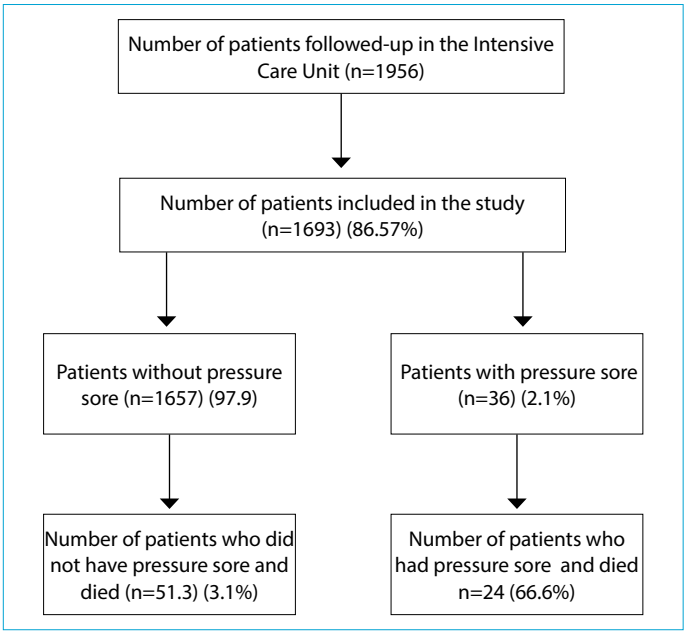

Figure 1. Workflow chart.

Table 1. Braden pressure sore risk assessment scale

Stimulus perception	Completely inadequate	Very inadequate	Slightly adequate	Completely adequate
humidity	Continuously wet	Very wet	Sometimes wet	Rarely wet
activity	Confined to bed	Confined to wheelchair	Able to walk sometimes	Able to walk frequently
Movement	Completely immovable	Very immovable	Slightly movable	Movable
Nutrition	Very bad	Inadequate	Adequate	Very good
Friction and irritation	Problem	Possible problem	No problem	
Score	1	2	3	4

High risk: ≤12; Moderate risk: 13-14; Mild risk: 15-16 (15-18 for the age group >75)

of the non-normal distribution of the parameters and the Mann Whitney U test was used to determine the group that caused the difference in the case of more than two groups. The Logistic Regression analysis and Odds Ratio were used to examine the risk factors determined to be significant in the univariate analyzes. The results were evaluated at the confidence interval of 95% and the significance was evaluated bilaterally at $p<0.05$.

Results

The data of 1956 patients who stayed in the CS ICU more than 48 hours were reviewed (Table 2). Patients with missing data were excluded from the study (Fig. 1). The number of patients included in the study was 1693, of which 1369 (70%) were male. The risk of pressure sore was analyzed by the Braden Risk Assessment Scale, which was filled by the wound care nurses at the CS intensive care unit for each patient (Table 1). In the present study, the incidence of pressure sore was found to be 2.1% (Fig. 1). Of the 36 patients in the study, 27 (74%) had Stage I, 6 (17.3%) had Stage II and 3 (8.6%) had Stage III pressure sore. None of the patients had a Stage IV pressure sore. It was determined that 18 patients (50%) had pressure sore between the days 4 and 8 following the admission to the intensive care unit, 3 patients (0.8%) between the days 8 and 10 and 15 patients (41%) between the days 15 and 25. It was observed that most of the patients had the pressure sore in the sacral region, followed by the scapula and heel regions.

Table 2. General characteristics of the 1956 patients who stayed in the intensive care unit

Patient characteristics	**Total number of patients n=1956**
Age, year, median (IQR)	56 (24-87)
Sex, male, n (%)	1369 (70)
NYHA Class III/IV n (%),	586 (30)
EuroScore	4.1 (2.2–12)
Postop 24 h APACHE II score	18.3±3.2
Commorbidity	**n (%)**
COPD	70 (3.5)
Diabetes mellitus	391 (20)
Hypertension	332 (17)
Coronary failure	137 (7)
Peripheral vascular disease	254 (13)
Preoperative atrial fibrillation	72 (3.7)
Liver disease	20.5 (1.08)
Cerebrovascular disease	15.6 (0.8)
Ejection fraction <30%	320 (16.3)
Intra-aortic balloon pump	9.7 (0.5)
Pressure sore	36 (1.8)
Total mortality	58.6 (3)
Mortality with pressure sore	24 (1.2)

Abbreviations: Apache II; Acute Physiology and Chronic Health Evaluation II, NHYA; New York Heart Association's classification of cardiac functions according to the physical activities.

The risk factors such as advanced age, Euroscope value, presence of diabetes mellitus, peripheral vascular disease, preoperative atrial fibrillation, ejection fraction <30%, and urgency of operation, preoperative hemoglobin, glucose, albumin levels were found to be statistically significantly different in patients with pressure sore compared to those who did not have decubitus ulcer (Table 3). The NYHA Class III/IV, smoking, liver disease, albumin, triglyceride, and creatinine values were determined to be other risk factors (Table 3). The number of patients who died without pressure sore was 51.3 (%3.1), while the number of patients who died with pressure sore was 24 (%66.6). The mean duration of hospital stay of the patients with pressure sore was found to be significantly higher than those without pressure sore (Table 4).

The risk factors such as reoperation due to bleeding, excessive blood loss, low hemoglobin, hypoalbuminemia, high lactate level, prolonged mechanical ventilation duration and long intensive care were found to be statistically significantly different in patients with pressure sore compared to those who did not have decubitus ulcer (Table 4).

No significant difference was found between the patients with and without pressure sore in terms of daily intake of calories and protein. The patients were not different in terms of mobilization, constraints, and positioning. When the parameters of age, sex, diabetes mellitus, blood lactate >1.2 mmol/L, postoperative albumin (g/dl), hemoglobin level, ejection fraction <30%, postoperative >24th hour medications (inotropic agents), immobilization (catheters, restrictions) >24th hour, length of intensive care unit stay to be more than 10 days were evaluated in the logistic regression model, the age, diabetes mellitus, blood lactate >1.2 mmol/L, low albumin and hemoglobin levels and the length of intensive care unit stay to be more than 10 days were found to be associated with the formation of decubitus ulcer (Table 5).

Discussion

Pressure sore is localized tissue damage that occurs in the skin and subcutaneous tissues under the influence of pressure, friction, tear and other factors. These are the injuries caused by constant pressure on the skin and muscle. Pressure sores are caused by the ischemia and necrosis in any part of the body, due to the effects of long-term pressure.

The incidence of pressure sore in this study is 2.1%. The reported incidence of pressure sore in studies performed in

Table 3. The preoperative risk factors of decubitus ulcer

Patient characteristics	Patients without pressure sore n=1657 (%97.9)	Patients with pressure sore n=36 (%2.1)	p
Age, year, median (IQR)	46 (24-87)	66 (37-87)	0.001**
Sex, male, n (%)	1169(70.6)	24 (66)	0.443
NYHA Class III/IV n (%),	200 (12)	6 (18)	0.012*
EuroScore, points	4.0 (2.0–6.5)	7.0 (5.0–9.0)	0.001**
Comorbidity n (%)			
COPD	112 (6.8)	3 (8.3)	0.201
Diabetes mellitus	152 (9.2)	29 (80)	0.001**
Current smoking	199 (12)	6 (17)	0.031*
Peripheral vascular disease	91 (5.5)	20 (55)	0.001**
Preoperative atrial fibrillation	84 (5.1)	7 (19)	0.001**
Liver disease	16 (1)	2 (3.50)	0.014*
Cerebrovascular disease	50 (3)	2 (5.5)	0.244
Ejection fraction <30%	161 (9.7)	27 (77)	0.001**
Operation type			
Emergency	28 (1.7)	7 (21)	0.001**
Preoperative basal laboratory results			
Hemoglobin level	13.13±2.17	12.05±0.98	0.134
Glucose (mg/dl)	105±21	136±53	0.001**
CRP (mg/L)	3.0±3.3	3.6±4.2	0.143
Albumin (g/dl)	4.1±0.3	3.07±0.9	0.021*
WBC (103/mm)	7.8±2.9	7.3±3.1	0.430
HDL (mg/dl)	59±14	54±17	0.212
LDL (mg/dl)	136±41	138±39	0.618
Triglycerides (mg/dl)	122±55	188±85	0.014*
Creatinine (mg/dL)	0.89±0.4	1.1±0.5	0.021*

*p<0.05; **p<0.01

Table 4. The postoperative risk factors of decubitus ulcer

Patient Characteristics	Patients without pressure sore n=1657 (%97.9)	Patients with pressure sore n=36 (%2.1)	p
Post-op APACHE II (24 hours)	17.1±2.7	18.5±5.2	0.245
Reoperation due to bleeding n (%)	71.2 (4.3)	3.9 (11)	0.001**
Blood loss >1000 mL n (%)	364.5 (22)	18.7 (52)	0.001**
Hemoglobin level±Sd	9.34±0.51	8.02±0.78	0.001**
Albumin (g/dl) ±Sd	3.02±1.4	2.41±0.3	0.000**
Blood lactate >1.2 mmol/l n (%)	314 (19)	16 (45)	0.000**
Postoperative 24th hour medications (inotropic agents) n (%)	248 (15)	10 (28)	0.042*
Immobilization (catheters, restrictions)	480 (29)	19.8 (55)	0.039**
Mechanic ventilation >48 h n (%)	132.4 (8)	15.4 (43)	0.001**
Length of intensive care unit stay >10 day	165 (10)	19 (52)	0.001**

*p<0.05; **p<0.01

the intensive care units in our country is between 18.3% and 28.6%.[17-19] The frequent use of analgesia and sedation in intensive care patients causes loss of sensation and this increases the likelihood of decubitus ulcer.[20, 21]

The present study was performed with a population of patients who underwent chest and/or cardiac surgery and stayed in intensive care unit for longer than 48 hours postoperatively, differently from the patients who stayed in the gen-

Table 5. The risk factors of decubitus ulcer (multivariate analysis)

	B	P	OR	95% C.I.for OR	
				Lower	Upper
Age	1.54	0.031*	3.15	1.41	9.87
Sex	0.24	0.754	1.32	0.53	3.69
Diabetes mellitus	1.4	0.025*	4.6	2.23	23.47
Blood lactate >1.2 mmol/L	1.04	0.021*	2.06	1.32	12.47
Postoperative Albumin (g/dl)	0.79	0.037*	2.12	1.36	8.34
Hemoglobin level	1.32	0.045*	3.12	1.38	9.09
Ejection Fraction <30%	1.20	0.006	3.32	1.88	12.12
Postoperative >24th h. medications (inotropic agents)	0.09	0.987	1.07	0.51	2.75
Immobilization (catheters, restrictions) >24th h	0.69	0.187	2.15	0.93	6.38
length of intensive care unit stay >10 days	-1.49	0.000**	9.55	1.98	28.32

*p<0.05; **p<0.01

eral intensive care unit or the anesthesia reanimation clinic.

It has been reported that the incidence of pressure sore in cardiac surgery patients may be up to 29.5%.[19] The most important risk factors known for the development of pressure sore are friction and tearing. Friction alone causes damage to the epidermis and the upper layer of the dermis. However, when friction is combined with the effect of gravity, it creates a shearing effect, causing tearing in deeper tissues, deterioration of tissue perfusion and tissue damage. It is, therefore, useful to know the specific risk factors associated with pressure sores in a particular population to effectively prevent pressure sores.

When patients with and without pressure sore were compared the NYHA Class III/IV, high EuroScore, advanced age, diabetes mellitus, current smoking, peripheral vascular disease, preoperative atrial fibrillation, liver disease, cerebrovascular disease, ejection fraction <30%, and emergency operation were among the preoperative risk factors (Table 3). Advanced age is one of the intrinsic factors in the development of pressure sores. Cardiac dysfunction (NHYA), skin perfusion and deterioration of the skin turgor, collagen regeneration, weakness due to decreased fat tissue, loss of tissue elasticity, weakening of the connection between epidermis and dermis, decrease in serum albumin level and immune response and deterioration in mental status are factors that play a role in the development of pressure sores in the elders.

In this study, an evaluation was made in terms of intraoperative risk factors. Particularly elderly patients are at risk for pressure sore development during cardiac surgery. The oxygen supplementation must be provided in this patient population considering the requirements related to heat and circulation.[22]

The sensitive temperature management and precise blood pressure management during and after the surgical procedure are essential to ensure adequate tissue perfusion. In addition, normalization of the albumin level should be considered to prevent the development of pressure sores in the presence of existing diseases (diabetes mellitus, renal failure, and cerebrovascular disease).[22-25] Hemodilution may result in increased catabolism and inflammation hypoalbuminemia in cardiac surgical patients. The fall in albumin level in a way to cause interstitial edema affects the wound healing.[24-26] Pressure sores are determined at a rate of up to 75% in patients with serum albumin levels below 3.5 mg/dL, while this rate was found to be 16% in patients with higher serum albumin levels.[27]

The etiology of pressure sores is multifactorial and is not just a result of the pressure alone and malnutrition, local perfusion, infections, applied drugs, and other factors can also be effective in this health problem.

Factors contributing to the formation of tissue ischemia may contribute to the development of the pressure sore as well. Long-term follow-up in ICU, highness of APACHE II, reoperation due to bleeding, blood loss rate, and postoperative pressure scar are among the relevant risk factors.

Conclusion

In cardiac surgery patients who are followed-up postoperatively in intensive care units, the evaluation of the patients in terms of pressure sore, determination of the risk factors and development of prevention strategies for medium and high-risk patients are important to reduce mortality and morbidity, to enhance the life quality of the patients and to reduce the formation of new pressure sores.

Disclosures

Ethics Committee Approval: The study was approved by the Local Ethics Committee.

Peer-review: Externally peer-reviewed.

Conflict of Interest: None declared.

Authorship contributions: Concept – T.A.A.; Design – T.A.A.; Supervision – A.K.; Materials – A.K.; Data collection &/or processing – A.K., Y.G.; Analysis and/or interpretation – D.O.; Literature search – T.A.A.; Writing – T.A.A., D.O.; Critical review – T.A.A., D.O.

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