Original Investigation / Özgün Araştırma

Health Care-Associated Infection Analysis of a Rehabilitation Hospital

Bir Rehabilitasyon Hastanesinin Sağlık Hizmeti İlişkili Enfeksiyon Analizi

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ABSTRACT

Objective: The aim of our study is to analyse Health care-Associated Infection (HAI) in a rehabilitation hospital.

Methods: The records of 6275 subacute/chronic rehabilitation patients who were hospitalized in the in-patient rehabilitation unit of our 270-bed tertiary rehabilitation hospital between January 1 2013 and April 30 2015 were analysed. Of 6275 patients, 133 had HAIs. These 133 patients were analysed retrospectively. HAIs were defined according to the criteria developed by 'Centers for Disease Control and Prevention'. Asymptomatic bacteriuria was not taken into account.

Results: HAI rate was 2.12 and HAI incidence density was 0.6. HAIs were the most common among spinal cord injury (SCI) patients (56.4%), and stroke patients (30.8%). The most common HAIs were urinary tract infections (UTI) (86.5%), and pneumonia (7.5%). Among all patients with HA-UTIs, the most common microorganism isolated was Escherichia coli (50.4%). SCI and stroke patients with HAI had longer duration of hospitalization compared to same patient groups without HAI, and it was statistically significant (p=0.004, p=0.027, respectively).

Conclusion: In a rehabilitation hospital, where the patients with neuromusculoskeletal system diseases are rehabilitated, HAIs are of considerable frequency and indwelling urethral catheterization is the most important risk factor for HAIs. Therefore indwelling urethral catheterization should be stopped as soon as possible. On the other hand, in stroke patients with swallowing problems and dysphagia and high level SCI patients, pneumonia should be kept in mind. Affecting the prognosis and rehabilitation process negatively, HAIs should be prevented by following the surveillance results closely.

Keywords: Health care-associated infection, nosocomial infection, spinal cord injury, stroke, rehabilitation

ÖZET

Amaç: Çalışmamızın amacı bir rehabilitasyon hastanesinin Sağlık Hizmeti İlişkili Enfeksiyon (SHİE) analizini yapmaktı.

Yöntemler: 270 yatak kapasiteli, üçüncü basamak rehabilitasyon hastanemizde 1 Ocak 2013 ile 30 Nisan 2015 tarihleri arasında yatırılarak rehabilite edilen, 6275 subakut/kronik dönem rehabilitasyon hastasının kayıtları incelendi. 6275 hastanın 133'ünde SHİE saptandı. Bu 133 hasta retrospektif olarak incelendi. SHİE tanımlanmasında "Centers for Disease Control and Prevention" tarafından geliştirilen tanı kriterleri kullanıldı. Asemptomatik bakteriüriler değerlendirmeye alınmadı.

Bulgular: SHİE hızı 2.12, SHİE insidans dansitesi 0.6 olarak saptanmıştır. SHİE'ler en sık, omurilik yaralanmalı (OY) (%56.4) ve inmeli (%30.8) hastalarda saptandı. En sık saptanan SHİE'ler; üriner sistem enfeksiyonu (ÜSE) (%86.5) ve pnömoni (%7.5) idi. SHİ ÜSE gelişen tüm hastalarda en sık üreyen mikroorganizma Escherichia coli idi (%50.4). SHİE gelişen OY ve inmeli hastalarda yatış süresinin, SHİE gelişmeyen OY ve inmeli hastalara göre istatistiksel olarak anlamlı düzeyde daha uzun olduğu görüldü (p değerleri sırasıyla 0.004 ve 0.027).

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Sonuçlar: Nöromuskuloskeletal sistem hastalığı olan hastaların rehabilite edildiği bir rehabilitasyon hastanesinde, SHİE azımsanmayacak orandadır ve SHİE için en önemli risk faktörü kalıcı idrar kateteri kullanımıdır. Bu nedenle mümkün olan en kısa sürede kalıcı üretral kateter kullanımı sonlandırılmalıdır. Özellikle disfajisi ve yutkunma sorunu olan inmeli hastalarda ve yüksek seviyeli OY hastalarda pnömoni açısından dikkatli olunmalıdır. Prognozu ve rehabilitasyon sürecini olumsuz bir şekilde etkileyen SHİE'leri azaltmak için, sürveyans sonuçları düzenli olarak takip edilmelidir.

Anahtar sözcükler: Sağlık hizmeti ilişkili enfeksiyon, nozokomiyal enfeksiyon, omurilik yaralanması, inme, rehabilitasyon

Introduction

Infections formerly known as 'hospital acquired infection' or 'nosocomial infection', are identified as 'health care-associated infection' (HAI) since 2008 (1) and are associated with increased mortality, morbidity, antibiotic use, duration of hospitalization and economic burden (2-4). As a result HAIs still continue to be an important health problem.

In rehabilitation hospitals, where the patients with neuromusculoskeletal system diseases are rehabilitated, HAIs are of considerable frequency (5-7). Apart from urinary tract infections associated with urinary catheters used frequently for neurogenic bladder rehabilitation; lung, skin and gastrointestinal infections can also be seen (5, 8).

HAIs cause prolonged of rehabilitation (9, 10), affect the rehabilitation period (11) and prognosis (12) negatively, and increase disability (13), and dependancy in activities of daily living (11).

In spite of the negative effects on the rehabilitation period, HAIs in rehabilitation hospitals haven't been studied far-more formerly in the literature. Only in some small number of studies conducted in acute rehabilitation units (8) or some special patient populations were investigated (6, 14, 15).

As a result, the purpose of the present study is to investigate the HAIs in a subacute/chronic rehabilitation center and analyse the incidence, types, associated microorganisms, clinical and demographic characteristics of the patients with HAIs and effects of HAIs on duration of hospitalization.

Material and Methods

The records of 6275 subacute/chronic rehabilitation patients who were hospitalized in the in-patient rehabilitation unit of our 270-bed tertiary rehabilitation hospital between January 1 2013 and April 30 2015 were analysed retrospectively. There wasn't an intensive care unit. The study was approved by the Training Planning and Coordination Committee of our hospital.

HAIs were defined according to the criteria developed by Centers for Disease Control and Prevention (CDC) (1). Asymptomatic bacteriuria was not taken into account.

Of 6275 patients, 133 had HAIs. These 133 patients were analysed retrospectively through patient forms and files including laboratory results, physical examination findings and treatment protocols. Age, sex, disease duration, cause of hospitalization, length of hospital stay, risk factors, invasive procedures performed, time of HAI occurence and urinary culture results were recorded.

Control group included stroke (n=35) and SCI (n=44) patients without HAIs hospitalized at our hospital between January 2013 and April 2015 and selected with simple random sampling method.

The total patient-days were calculated by summing the days of all patients hospitalized betweeen the mentioned dates. HAI rate was calculated by dividing the total number of HAI by the total number of patients hospitalized (X100) during the mentioned period of time. The incidence density rate of HAI was calculated by dividing the total number of HAI by the total patient-days (x1000) during the defined period of time.

Microorganisms isolated from the patients were identified by BBL Crystal Identification System (Becton&Dickinson) in the microbiology laboratory of our hospital.

Statistical Analysis

Statistical analyses were performed by using SPSS version 11.5 software. The Shapiro–Wilk test or Kolmogorov-Smirnov test was used to determine whether the continuous variable distribution was normal. Descriptive statistics were provided as mean±standard deviation or median (minimum–maximum) for continuous variables while the number of cases and percentages were used for nominal variables. Mann–Whitney U test was used to determine whether a statistically significant difference was present for continuous or orderable variables not normally distributed. Chi-square test was used for categorical comparisons. A p value <0.05 was considered statistically significant.

Results

Between January 1 2013 and April 30 2015, 6275 patients were hospitalized in our rehabilitation hospital. The distribution of patients according to diagnosis was presented on Table 1. A total of 133 out of 6275 patients developed HAIs. The total number of patient-days represented by the population was 220934. For those with HAIs, the gender distribution was 104 males (78.2%) and 29 females (21.8%). The median age of patients who developed HAIs was 48 (8 -85) years. A median duration of HAIs to develop was 28 (4-186) days.

The HAI rate was 2.12 (133 total HAIs divided by 6275 patients multiplied by 100). The incidence density rate was 0.6 (133 total HAIs divided by 220934 total patient-days multiplied by 1000).

HAIs were most common among spinal cord injury (SCI) patients 75 (56.4%), followed by stroke patients 41 (30.8%). Moreover 4 (3%) transverse myelitis, 4 (3%) multiple sclerosis, 3 (2.2%) total knee prosthesis, 3 (2.2%) cerebral palsy, 1 (0.8%) lumbar disc herniation, 1 (0.8%) traumatic brain injury and 1 (0.8%) hypoxic ischemic ensephalopathy patients also had HAIs during this period.

The most common HAIs were urinary tract infections (UTI) (86.5%) and pneumonia (7.5%). The distribution of HAIs according to systems were presented on Table 2.

The bladder drainage methods of 115 patients with Health care-Associated Urinary Tract Infection (HA-UTI) were presented on Table 3.

Table 1. Diagnosis of the patients hospitalized during the study period (n=6275).

Diagnosis	%
Degenerative joint disease and intervertebral disc disorder	26%
Stroke	25%
Spinal cord injury	17%
Cerebral palsy	10%
Other neurologic diseases (Traumatic brain injury, multiple sclerosis, Parkinson disease, transvers myelitis, meningomyelocele, motor neuron disease, hereditary ataxia, post polio syndrome, spinal muscular atrophy, hydrocephalia)	8%
Orthopedic joint implant	3%
Others	11%

Table 2. HAIs distribution among study population.

	SCI (n=75)	Stroke (n=41)	Others (n=17)	Total (n=133)
Urinary tract infection, n (%)	70 (60.9)	33 (28.7)	12 (10.4)	115 (86.5)
Pneumonia, n (%)	2 (20)	6 (60)	2 (20)	10 (7.5)
Genital infection, n (%)	2 (40)	2 (40)	1 (20)	5 (3.7)
Sinusitis, n (%)	0 (0)	0 (0)	2 (100)	2 (1.5)
Skin and soft tissue infection, n (%)	1 (100)	0 (0)	0 (0)	1 (0.8)

HAI: *Health care-associated infection,* ***SCI:*** *Spinal cord injury.*

Table 3. Bladder drainage methods among patients with health care-associated urinary tract infection.

Bladder drainage methods	Health care-associated urinary tract infection (n=115)
Catheter free, n (%)	32 (27.8)
Clean intermittent catheterization, n (%)	37 (32.2)
Indwelling catheterization, n (%)	46 (40)

When the SCI and stroke patients with HAIs were compared with control SCI and stroke patients, urinary catheter use (clean intermittant catheterization and indwelling catheterization) was statistically more common among the group with HAIs (Table 4).

Among all patients with HA-UTIs, the most common microorganism isolated was Escherichia coli (E. coli) (Table 5). The distribution of microorganisms isolated from the urine cultures of patietns with HA-UTIs were presented on Table 5.

There wasn't any statistically significant difference between the microorganisms isolated from the patients using three different bladder drainage methods (spontaneous, clean intermittant catheterization, indwelling catheterization) (Table 6).

When the duration of hospitalization of the patients with and without HAIs were compared, both stroke and SCI, patients with HAIs were found to have a longer duration of hospitalization (Table 7).

Table 4. Comparison of bladder catheter use in SCI and stroke patients with and without HAIs.

	Group with HAIs (n=116)	Group without HAIs (n=79)	X^2	p*
Spinal Cord Injury				
Catheterized, n (%)	71 (94.6)	33 (75)	9.36	0.002
Non-catheterized, n (%)	4 (5.4)	11 (25)		
Stroke				
Catheterized, n (%)	16 (39)	1 (2.9)	14.22	0.000
Non-catheterized, n (%)	25 (61)	34 (97.1)		

** Chi-square test,* ***HAI:*** *Health care-associated infection.*

Table 5. The distrubution of microorganisms isolated in HA-UTIs, in total and according to the primary diagnosis.

Microorganisms isolated	SCI (n=70)	Stroke (n=33)	Others (n=12)	Total (n=115)
Escherichia coli, n (%)	35 (50)	17 (51.5)	6 (50)	58 (50.4)
Klebsiella spp., n (%)	18 (25.7)	9 (27.3)	4 (33.3)	31 (27)
Pseudomonas spp., n (%)	11 (15.7)	3 (9.1)	2 (16.7)	16 (14)
Proteus spp., n (%)	4 (5.7)	1 (3)	0 (0)	5 (4.3)
Enterococcus spp., n (%)	2 (2.9)	2 (6.1)	0 (0)	4 (3.4)
Coagulase negative staphylococcus, n (%)	0 (0)	1 (3)	0 (0)	1 (0.9)

HA-UTI: *Health care-associated urinary tract infection,* ***SCI:*** *Spinal cord injury.*

Table 6. Comparison of the rate of the most commonly detected three microorganisms isolated from HA-UTI between three different bladder drainage methods.

Bladder drainage method	Escherichia coli n (%)	Klebsiella spp. n (%)	Pseudomonas spp. n (%)	X^2	p*
Catheter free (n=29)	20 (69)	6 (20.7)	3 (10.3)	4.11	0.39
CIC (n=34)	20 (58.8)	10 (29.4)	4 (11.8)		
IC (n=40)	18 (45)	15 (37.5)	7 (17.5)		

** Chi-square test,* ***HA-UTI:*** *Health care-associated urinary tract infection,* ***CIC:*** *Clean intermittent catheterization,* ***IC:*** *Indwelling catheterization.*

Table 7. Comparison of total hospitalization duration in SCI and stroke patients with and without HAIs.

SCI	Group with HAI (n=75)		Group without HAI (n=44)		
	Mean± SD	Median (Min-max)	Mean± SD	Median (Min-max)	p*
Hospitalization duration (days)	73.47±32.19	69 (26-165)	56.27±24.99	55 (20-133)	0.004
Stroke	**Group with HAI (n=41)**		**Control group (n=35)**		
	Mean± SD	Median (Min-max)	Mean± SD	Median (Min-max)	p*
Hospitalization duration (days)	52.47±21.32	51.5 (15-116)	41.69±20.09	39 (12-96)	0.027

** Mann-Whitney U test,* ***HAI:*** *Health care-associated infection,* ***SCI:*** *Spinal cord Injury.*

Discussion

During the study period, more than 30% of the investigated patients had non-neurogenic diseases such as degenerative joint disease, intervertebral disc disorder or orthopedic joint implantation, but only 3% of the HAIs were in this group. However, approximately 60% of the patients had some kind of neurogenic diseases and 97% of HAIs was observed in these patients. These findings confirmed that the patients with neurologic diseases are under greater risk for HAIs compared to patients without neurologic diseases.

During the 28 month study period, HAI rate was 2.12%, HAI incidence density was 0.6 and HA-UTI incidence density was 0.5. In a study performed at an acute rehabilitation unit HAI rate was 22.2%, HAI incidence density in SCI patients was 6.72 and in non-SCI patients (traumatic brain injury, stroke, cancer, etc) it was 5.48 (8). The high incidence rate and incidence density of HAIs in this study was attributed to the acute, traumatic and neurologic profile of the patients included. In another trial by Girard et al, 78 SCI and 208 non-SCI (traumatic brain injury, stroke, multiple trauma, cystic fibrosis) patients were investigated and HAI rate was found 9.79% (6). The patient profile of this study is also different from ours with a greater neurologic disease ratio. Yılmaz et al studied a group of acute and chronic SCI patients and found an incidence density of 7.2 for HAIs and 4.8 for HA-UTIs (14). This study was performed on SCI patients and asymptomatic bacteriurias were also assessed as HAI giving way to higher incidence ratios.

According to the results of the present study the most common HAI is UTI with pneumonia following it. In another study performed at an acute rehabilitation unit, the most common HAIs were UTIs, and surgical wound infection, clostridium difficile diarrhea and bloodstream infection respectively. In this study the infections observed other than the UTIs might be related to the acute neurologic/traumatic patient profile of the study (8). In the study performed on 78 SCI and 208 non-SCI patients by Girard et al, the most common HAIs were respectively UTI, skin/soft tissue infection and lung infection (6). Studies performed on SCI patients have also showed, the most common HAI as UTI (14, 15). As a result, in all of the above mentioned studies, including ours the most common HAI was UTI. This is probably due to the bladder catheters used for the neurogenic bladder treatment in these patient groups.

In our study, when the SCI and stroke patients with and without HAIs were investigated, urinary catheter use was statistically more common among patients with HAIs. In a study performed on SCI patients; age, lesion level, and vesicoureteral reflux were found to be risk factors for HAIs whereas the only independent risk factor was urinary catheterization (16). Likewise, Togan and colleagues identified urinary catheterization as the only independent risk factor for symptomatic UTIs in SCI patients (17). In another study performed on 110 stroke patients by Ersöz et al; indwelling catheterization, >50 ml residual urine after urination and lower Brunnstrom levels of upper extremity were found to be risk factors for symptomatic UTIs (18). These results are in accordance with ours. It can be recommended that for patients who have neurogenic bladder such as SCI or stroke, indwelling catheterization period should be as short as possible and clean intermittant catheterization or spontaneous urination should be started.

In our study in HA-UTIs of SCI patients and other patient groups, the most common microorganism isolated was E. coli. Like our study, in the other studies performed on SCI patients in the literature, E. coli is the most common microorganism isolated in UTI (17, 19-21).

Of the 133 HAIs in our study, 10 (7.5%) were pneumonia. In patients developing pneumonia, 60% were stroke, 20% were SCI, 10% was cerebral palsy and 10% was orthopedic joint implant patients. Post stroke HA pneumonia is frequent and associated with increased mortality, morbidity, length of hospital stay and economic burden (22). In a review about post stroke pneumonia, the incidence in acute rehabilitation patients was found about 1.1-5.9%, whereas the incidence was as high as 50% in intensive care units. Both post stroke aspiration due to swallowing problems and immunosupression lead up to pneumonia in stroke patients. Stroke severity, dysphagia, aspiration, advanced age, male gender, mechanical ventilation, organ failure, atrial fibrillation, diabetes mellitus, heart failure, chronic obstructive pulmonary disease, previous pneumonia history, smoking, low albumin and other infections at the time of hospitalization are found to be risk factors for pneumonia (23). As a result pneumonia risk can be minimized by the assessment and proper treatment of the above mentioned risk factors, especially dysphagia, as far as possible.

Pneumonia, one of the most common causes of mortality in SCI patients, also causes increase in morbidity (7, 24-27). Although rare compared to UTIs, pneumonia is the most common pulmonary complication in acute SCI (7, 27), and can be seen frequently in especially older patients and cervical or high thoracic SCIs in the first few months after the injury (7). In acute care units, pneumonia prevalence in SCI is 31.4% (28) and pneumonia and atelectasia prevalence in high level tetraplegia is 74% (29). In post-acute rehabilitation

units, pneumonia and atelectasia prevalence in complete tetraplegia is 21.6% (30). Community-acquired pneumonia is the most common cause of mortality in SCI and health care-associated pneumonia is also an important part of pneumonia related death in chronic SCI. In patients with chronic SCI, expiratory dysfunction, prolonged antibiotic treatment, sedative medications, feeding in supine position are risk factors for pneumonia (31). Consequently, especially in high level tetraplegia, respiratory functions should be closely monitored and risk factors for pneumonia should be minimalized even in chronic term.

In our study, median time for HAI development was 28 days. This time was 30 (5-186) days for UTI in SCI, 25 (4-100) days for UTI in stroke. In a similar rehabilitation setting, in SCI this period was 21.5 days for HA-UTI (14). In the study by Togan and colleagues, mean HA-UTI development time was 22.2 days (17), similar to our results. In an acute rehabilitation unit, median development time for 94 HAIs was 15 (3-41) days and there was no statistically significant difference between SCI and non-SCI patietns (8). The shorter HAI development time in this study may be attributed to the acute setting.

In our study, SCI and stroke patients with HAI had longer duration of hospitalization compared to same patient groups without HAI, and it was statistically significant. In patients with stroke, it was shown that UTIs prolong the length of hospital stay (9, 10). In accordance with our results in a rehabilitation center in Thailand, SCI patients with HAIs had longer length of hospital stay than their counterparts without HAIs (45.5 vs 30.4 days), and the difference was statistically significant (19).

Conclusion

According to the results of our study, in a rehabilitation center where the patients with neuromusculoskeletal diseases are rehabilitated, 1. HAIs are not uncommon, 2. HAIs are more common among patients with neurological diseases, 3. HAIs prolong the duration of hospitalization and 4. the most common HAIs are UTI and pneumonia. Estimating that the large part of HAIs are UTIs and an important part of patients with UTIs are on urethral catheters, in a center where subacute-chronic rehabilitation is carried the most important risk factor for HAIs is thought to be urinary catheter use. Besides, stroke patients with swallowing problems and dysphagia and high level tetraplegic patients are also under risk for pneumonia.

As the stroke, SCI and TBI patients' survival rates increase, the number of patients in need of rehabilitation increases. In these patients; a number of conditions like impairment of medical status, prolonged hospitalization, high level SCI, urinary catheterization, pressure sores, immunosupression and accompanying diseases increase the risk of HAIs. Increasing the mortality, morbidity, disability, dependency in activities of daily living and treatment cost, prolonging the rehabilitation period, affecting the prognosis and rehabilitation process negatively, HAIs should be prevented by following the surveillance results closely, avoiding the invasive procedures as well as possible, carrying out preventive strategies for infections and proper use of antibiotics.

Conflict of Interest

The authors have stated that they had no interests which might be perceived as posing a conflict or bias.

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