



ORIGINAL ARTICLE

Analysis of Dermatologic Diseases in Neurosurgical In-Patients: A Retrospective Study of 463 Cases

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Background: Both the skin and the neurologic system are derived from the ectoderm during embryogenesis, and thus patients with neurologic disorders may have accompanying dermatologic diseases. For example, seborrheic dermatitis is more frequently observed in patients with Parkinsonism and other neurologic disorders. To date, however, there has been limited review on dermatologic diseases in neurosurgical in-patients. **Objective:** The purpose of this study was to characterize dermatological problems encountered in a neurosurgery unit and to compare these data to previous reports of in-patient dermatologic consultations. **Methods:** A retrospective review was conducted over all in-patient dermatology consultations from the neurosurgery unit during a 3-year period. **Results:** Of 2,770 dermatology consultations, 463 (16.7%) came from the department of neurosurgery. The most frequent age group was the 6th decade of life, and the ratio of men to women was 1.07. Consults were most frequently placed from patients with intracranial hemorrhage (23.8%). Eczema/dermatitis (36.5%; n = 204) and cutaneous infections (27.0%; n = 151) accounted for more than half of

all dermatological consultations, followed by cutaneous adverse drug reactions (11.8%; n = 66). Additionally, seborrheic dermatitis was significantly more frequent ($p=0.048$, odds ratio = 1.96) in patients with intracranial hemorrhage.

Conclusion: This study characterizes the distribution of skin disorders in patients admitted to the neurosurgery service based on the consultations that have been made for dermatologic evaluation. Collaboration between the neurosurgeons and dermatologists may improve the quality of patient care and help to better predict the occurrence of these conditions. (Ann Dermatol 28(3) 314~320, 2016)

-Keywords-

Dermatology, Neurosurgery, Referral and consultation

INTRODUCTION

Dermatologic issues may represent primary cutaneous disorders or underlying systemic disease. While dermatologic practice occurs primarily in the out-patient setting, dermatologists also provide essential consultative services for in-patients admitted to other disciplines.

Several studies on the characteristics of dermatologic consultations have been reported. Although internal medicine (IM) was found to place the most requests for in-patient dermatologic services¹⁻⁴, we observed that patients from the neurosurgery (NS) unit also accounted for a significant portion of referrals as reported by Lyu et al.⁵ The epidemiology of in-patient skin diseases and the impact of in-patient consultation has been described in the fields of obstetrics and gynecology⁶, rheumatology⁷, pediatrics⁸, hematology⁹, and the intensive care unit¹⁰, in order of frequency. However, data describing dermatology consults for NS in-patients are limited.

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The epidermal and neuronal tissues are derived from a common neuroectodermal precursor¹¹. It is well known that neurologic and dermatologic abnormalities occur concurrently in hereditary disorders such as tuberous sclerosis, neurofibromatosis, and xeroderma pigmentosum. Moreover, much evidence has accumulated supporting an association between acquired neurological disturbances, Parkinsonism, or spinal cord injury and changes on skin such as seborrheic dermatitis (SD) or fungal infections occurring below the neurologic level of injury^{12,13}.

The aim of our study was to analyze the care provided by consultant dermatologists to hospitalized NS patients.

MATERIALS AND METHODS

Study subjects and methods

This was a retrospective study conducted at a 764-bed multidisciplinary tertiary hospital (Incheon St. Mary's Hospital, Korea). All cases were evaluated and reviewed by dermatology trainees and a senior consultant dermatologist. The diagnoses were made according to the International Classification of Disease, 10th Revision.

We reviewed all in-patient referrals for dermatology consultations made from the department of NS between July 1, 2010 and June 30, 2013. Data were extracted from electronic medical records and included the clinical record number, age, gender, requesting service, date of application, reason for admission to the hospital, and the final dermatological diagnosis. If the patient was not hospitalized, or had no apparent skin lesion or clinical symptoms related to the skin at the time of the visit, the case was excluded. Neurosurgical conditions were divided into ten categories, as shown in Table 1. Diagnoses made by the consulting dermatologist were divided into twenty categories (Table 2). In addition to the number of consultations, we also determined the relative frequency of consultations made for NS in-patients compared with other specialties.

Statistical analysis and ethics statement

Statistical analyses were performed using PASW Statistics ver. 18.0 (IBM Co., Armonk, NY, USA), and *p*-values <0.05 were considered to be statistically significant. Comparisons of dermatologic variables between the groups (patients with specific neurosurgical disorders and without those diseases) were performed using chi-squared tests and Fisher's exact tests, as appropriate. Characteristics of patients with SD were evaluated using univariate analyses, chi-squared tests, or Fischer's exact tests to compare categorical parameters between groups, and t-tests for comparisons of continuous variables.

This study was approved by the institutional review board of Incheon St. Mary's Hospital, The Catholic University of Korea (IRB No. OC14RIS10079).

RESULTS

Characteristics of patients and of the departments requesting consultations

A total of 2,770 in-patient referrals were made to the dermatology department during the study period. Considering the total number of in-patients during this time, a dermatology consultation was made for 2.8% of patients. The department of IM had the largest number of referrals (*n*=978, 35.3%), followed by the department of NS (*n*=463, 16.7%). During the 3-year period, the ratio of consultations to NS in-patients runs from 4.7% to 6.4%. The mean percentage of NS patients who required a dermatology consult was 5.4%, which is far higher than the ratio of total consultations to total in-patients, 2.8% (Table 3). The mean admission duration of NS patients was 12.7 days, which was the third longest duration. With respect to it, the number of NS patients requiring dermatology consultation ranked seventh.

Table 1. Demographic characteristics

Characteristic	n (%)
Sex	
Male	240 (51.8)
Female	223 (48.2)
Age distribution (yr)	
< 20	9 (1.9)
20 ~ 39	37 (8.0)
40 ~ 59	185 (40.0)
60 ~ 79	202 (43.6)
> 80	30 (6.5)
Neurosurgical condition	
Cerebral vascular and hemorrhagic disorders	244 (52.6)
Intracranial hemorrhagic disorders	111 (23.8)
Cerebral infarction or transient ischemic attack	92 (19.9)
Cerebral aneurysm	29 (6.3)
Others	12 (2.6)
Spinal diseases	117 (25.3)
Herniated nucleus pulposus	47 (10.2)
Spine fracture	38 (8.2)
Others	32 (6.9)
Tumor	56 (12.1)
Infectious disease	23 (5.0)
Others*	23 (5.0)
Total	463 (100.0)

*Seizure, facial palsy, hydrocephalus, Parkinson's disease, headache, wound dehiscence, back pain, coccyx cyst, peripheral neuropathy.

Table 2. Dermatologic conditions diagnosed in neurosurgery in-patients

Diagnosis	n (%)	Comments
Dermatitis	204 (36.5)	
Eczematous dermatitis (not contact dermatitis or seborrheic dermatitis)	100 (17.9)	Includes xerotic eczema (21), lichen simplex chronicus (10), nummular eczema (7), atopic dermatitis (3), hand eczema (15), prurigo simplex (21), and unspecified eczema (23)
Contact dermatitis	63 (11.3)	
Seborrheic dermatitis	41 (7.3)	
Infectious skin disorders	151 (27.0)	
Mycoses	88 (15.8)	Included superficial fungal infection (84), yeast infection (4)
Viral disease	50 (8.9)	Included herpes simplex (22), herpes zoster (21), wart (3), chickenpox (2), and viral exanthem (2)
Bacterial disease	7 (1.2)	Included abscess (2), carbuncle (2) and cellulitis (3)
Syphilis and rickettsioses	6 (1.1)	
Drug eruption	66 (11.8)	
Urticaria	34 (6.1)	
Folliculo-sebaceous/eccrine diseases	21 (3.8)	Included acne and folliculitis (20), miliaria (1)
Cutaneous vascular diseases	19 (3.4)	
Papulosquamous diseases	10 (1.8)	Included psoriasis (5), pityriasis lichenoides chronica (2), palmoplantar pustulosis (3)
Nevus and neoplasm	10 (1.8)	
Hair disorders	5 (0.9)	Included telogen effluvium (1), alopecia areata (4)
Connective tissue diseases	2 (0.4)	Scleroderma
Subcutaneous fat diseases	1 (0.2)	Erythema nodosum
Pigment anomalies	1 (0.2)	Vitiligo
Vesiculocutaneous disease	1 (0.2)	Pemphigus vulgaris
Nail disorders	0 (0)	
Mucous disorders	0 (0)	
Miscellaneous*	33 (5.9)	
Total	558 (100.0)	

*Abrasion, friction blister, corn and callus, pediculosis, insect bite, chronic ulcer, petechiae.

Table 3. In-patient services consulting dermatology

Requesting service	Consultations	Total inpatients during the study period	Percentage of inpatients who are referred to dermatology*
Internal medicine	978 (35.3)	27,883 (28.2)	3.5
Neurosurgery	463 (16.7)	8,619 (8.7)	5.4
General surgery	394 (14.2)	21,057 (21.3)	1.9
Orthopedics	260 (9.4)	6,515 (6.6)	4.0
Pediatrics	149 (5.4)	11,531 (11.7)	1.3
Psychiatry	127 (4.6)	601 (0.6)	21.1
Rehabilitation medicine	100 (3.6)	806 (0.8)	12.4
Otolaryngology	75 (2.7)	4,073 (4.1)	1.8
Gynecology and obstetrics	74 (2.6)	7,891 (8.0)	0.9
Cardiothoracic surgery	43 (1.6)	1,605 (1.7)	2.7
Neurology	38 (1.4)	1,591 (1.6)	2.4
Urology	36 (1.3)	2,894 (2.9)	1.2
Plastic surgery	17 (0.6)	769 (0.8)	2.2
Family medicine	11 (0.4)	417 (0.4)	2.6
Ophthalmology	5 (0.2)	2,601 (2.6)	0.2
Total	2,770 (100.0)	98,853 (100.0)	2.8

Values are presented as number (%). *(Total consults/total in-patients)×100.

There were slightly more male ($n=240$, 51.8%) than female ($n=223$, 48.2%) patients (Table 1). The patients ranged in age from 6 to 98 years, with an average age of 58.67 ± 15.43 years (median=60). The most frequent patient age group encountered was the 6th decade of life. For 386 (83.4%) patients, the presenting problem was improved after a single encounter, while 1 patient required 5 visits. Although there was no appreciable seasonal trend, the greatest number of consultations was placed during the summer, from June to August ($n=125$, 27%).

Reason for admission

Our patient population was a heterogeneous group with various underlying neurosurgical disorders (Table 1). Cerebral vascular and hemorrhagic disorders accounted for over half of the hospital admissions ($n=244$, 52.6%) followed by spinal disease ($n=117$, 25.3%). The most common underlying neurologic disease was intracranial hemorrhage (ICH) ($n=111$, 23.8%).

Dermatologic conditions

A total of 558 dermatologic conditions were diagnosed in 463 patients (Table 2). There were cases with multiple dermatologic conditions, with 77 (16.6%) patients having two dermatologic diseases and 8 (1.9%) patients having three diseases. The most common diagnosis type was dermatitis ($n=204$, 36.5%), followed by skin infection ($n=151$, 27.0%), and drug eruption (DE) ($n=66$, 11.8%). Among the eczema types, contact dermatitis (CD) was the

most common ($n=63$, 11.3%). This was followed by SD ($n=41$, 7.3%). Dermatomycosis was the most common infection of the skin in our study ($n=88$, 15.8%). The majority of referrals identified as viral infections ($n=50$, 8.9%) were herpes simplex (22 patients) and herpes zoster (21 patients).

Characteristics of patients with seborrheic dermatitis

Thirty (73.2%) of the 41 patients diagnosed with SD were male, and 11 (26.8%) were female ($p=0.004$). The most common underlying neurologic condition within this category was ICH ($n=15$, 36.6%). Overall, SD was diagnosed in 13.5% of ICH patients, as compared with 7.4% of patients without ICH ($p=0.048$, odds ratio [OR]=1.96) (Table 4).

In the group of ICH patients diagnosed with SD, there were also more male ($n=10$, 66.7%) than female ($n=5$, 33.3%) patients, 7 (46.7%) of whom had hypertension. Eight (53.3%) patients were referred in winter or early spring, from November to March.

Characteristics of patients with dermatomycosis

Superficial fungal infections with a dermatophyte accounted for 95.5% of cases in mycoses category ($n=84$). Tinea pedis was the most frequently diagnosed skin infection, accounting for the third largest proportion of specific dermatologic diagnoses ($n=44$, 9.5%). None of the associations between this and spinal diseases ($p=0.116$) including subcategories, herniated nucleus pulposus

Table 4. Characteristics of patients with seborrheic dermatitis

Variable	Value	<i>p</i> -value	OR (95% CI)
Sex (n, %)		0.004	2.75 (1.34 ~ 5.64)
Male	30 (73.2)		
Female	11 (26.8)		
Age (yr)		0.717	
Mean \pm SD	57.8 \pm 16.7		
Median	61		
Range	7 ~ 81		
Neurosurgical conditions (n, %)			
Intracranial hemorrhage	15 (36.6)	0.048	1.96 (1.00 ~ 3.85)
Cerebral infarction	6 (14.6)	0.379	0.67 (0.27 ~ 1.64)
Other cerebral vascular disorders	4 (9.8)	0.774	1.13 (0.38 ~ 2.96)
Tumor	4 (9.8)	0.804	0.77 (0.26 ~ 2.24)
Spinal fracture	4 (9.8)	0.763	1.23 (0.42 ~ 3.63)
Herniated nucleus pulposus	2 (4.9)	0.412	0.43 (0.10 ~ 1.84)
Other spinal diseases	2 (4.9)	1.000	0.67 (0.15 ~ 2.91)
Infectious disease	3 (7.3)	0.445	1.59 (0.45 ~ 5.53)
Others	1 (2.3)	0.710	0.46 (0.06 ~ 3.46)
Total patients	41 (100.0)		

OR: odds ratio, 95% CI: 95% confidence interval, SD: standard deviation.

($p=0.110$), spinal fracture ($p=0.344$), and other neurologic conditions related to spinal problems ($p=0.067$) were found to be statistically significant. Yeast infection, *Candidiasis*, pityriasis versicolor, and *Malassezia* folliculitis, were diagnosed in 4 cases. No deep fungal skin infections were diagnosed during the study period.

Characteristics of patients with drug eruptions

Ten cases (15.2%) of the 66 consultations for DE were due to contrast media-related reactions. The prevalence of DE was not significantly higher in patients with aneurysms ($p=0.050$). DE was significantly associated with neurologic infectious disease ($p=0.009$, OR=3.51). The most common form was morbilliform DE ($n=36$, 54.5%).

DISCUSSION

In recent years, the field of dermatology has evolved into a predominantly out-patient practice, with increasing emphasis on cosmetics and surgical procedures¹⁴. While the number of patients admitted to dermatology services is decreasing, the need for dermatologists as consultants in the hospital setting is increasing¹⁵.

Although the type and number of referrals from other services varies according to factors such as the healthcare system and the proportion of beds allocated to each department, previous studies have reported a lower proportion of referrals from the department of NS compared with our study results, accounting for 1.9%¹⁴, 3.0%⁴ and 11.9%² of all referrals. Interestingly, one study found that NS patients were the most frequently referred⁵. Several other reports have shown that neurology patients also require frequent dermatology consults^{4,16}. This high number of consultations from NS and/or neurology patients likely reflects the fact that these patients are often bed-ridden⁴ and thus have a greater need for dermatologic care³.

Eczema and cutaneous infections were the two most common dermatologic disorders referred for management, accounting for over half of all consultations. This is consistent with previous findings^{5,8-10,14}.

The two most common individual 'dermatitis' diagnoses encountered in this study were CD and SD. A previous report suggested that sweating caused by inappropriate hospital room temperature, detergents used to clean bed clothes, and soaps are factors that can cause CD⁴. In addition, antiseptics in general, and specifically those used in surgical washing preparations, occlusive dressings for surgical wounds, confinement to the hospital bed for patients with delirium, athetotic movements or seizures, and use of catheters tend to contribute to dermatologic issues, particularly among NS in-patients.

In our study, SD had various underlying neurosurgical diseases, from cerebral vascular disorders, tumors, to spinal disease. Although the pathogenesis of SD remains unknown, the frequent presentation of SD with Parkinsonism and other neurologic disorders such as epilepsy, cerebrovascular infarcts, quadriplegia, and other facial nerve palsies has attracted considerable attention with respect to neurologic theory of the etiopathogenesis of SD¹⁷.

Reed et al.¹⁸ previously reported a high incidence of SD after spinal cord injury due to altered sebaceous secretion, dermatophytosis, and changes in sweat secretion. Similarly, Wilson and Walshe¹⁹ identified SD in 65% of recently injured quadriplegic patients. The accumulation of sebum and scales on inadequately scrubbed skin resulting from a prolonged period of immobilization were suggested as the possible cause of SD. In addition, the histopathologic findings of less differentiated sebaceous glands and thickened germinated layers in affected area of ipsilateral SD occurred after syringomyelia also suggest that a neuro-cutaneous mechanism may involve the sebaceous and immune pathways²⁰.

But, among the neurosurgical disorders, ICH only has been significantly associated with SD ($p=0.048$). Proceeding from these findings and quadriplegic state seen in ICH patients, it seems reasonable to assume that SD is linked to abnormal neurologic condition of ICH, just in overall perspective. However, there are no studies to date which directly address the specific relationship between ICH and SD.

Additional factors including seasonal fluctuations, age, sex, facial trauma, and drugs, can affect statistical significance of association between ICH and SD as potential confounders¹⁷. Actually, our study showed that there were more referrals in SD patients with ICH during winter and early spring compared with SD patients with other neurosurgical conditions (ICH patients: 53.3%, cerebral infarction patients: 33.3%, the remainder: 0%). This point may explain the discrepancy of relation between individual neurosurgical conditions and SD, and inconsistency in previous finding. One of the remarkable features is that patients with ICH and SD had a high prevalence of hypertension (46.7%). Aside from its association with ICH^{21,22}, this feature was consistent with the previous study showing a positive association between SD and hypertension²³. So, a clear understanding of the association between ICH and SD requires further researches assessing the possible interplay of these confounders.

Infectious skin disorders were one of the 3 most common dermatologic diagnoses encountered in this study. Contributing factors for skin infection in neurosurgical in-patients are an altered skin barrier due to decreased sweat

production²⁴, increased sebum excretion²⁵, and immunologic changes including a decrease in immune function via alterations in natural-killer cells, T-cells, and interleukin receptor levels²⁶⁻²⁸. In contrast to a previous report that suggested an increased rate of fungal infections below the level of spinal cord injury¹², we did not identify a significant correlation between spinal disease and fungal skin infections. This discrepancy is possibly due to transfer of these patients to the rehabilitation medicine unit.

DE was the third most frequent reason for consultation, which is consistent with that reported in previous studies^{1,2,4,9,10}. Notably, 10 patients (15.2%) developed DE after exposure to contrast media, of which the most common adverse reaction was skin eruption²⁹, for computerized tomography or angiography. However, none of the individual neurosurgical conditions were significantly associated with DE except for cerebral aneurysm ($p=0.05$). There was a greater likelihood of an infectious neurosurgical condition ($p=0.009$) in patients diagnosed with DE. The findings are natural as the major putative drugs implicated in cases of DE among dermatology referrals were antibiotics (50%) and antiepileptics (13%)¹⁴.

The wide spectrum of dermatologic conditions seen in in-patient multidisciplinary hospitals can pose diagnostic and therapeutic challenges to non-dermatologists in patient care. Falanga et al.³⁰ reported a mean diagnostic accuracy for dermatologic diagnoses made by non-dermatologists to be 48%. In our study, 86.4% of referred in-patients were managed with a single consultation, and this result is in agreement with previously reported data ranging from 71.8%⁴ to 85.7%¹⁶. This suggests that clinical diagnosis with appropriate treatment by a dermatologist is a crucial step in resolving the dermatologic problem.

Our results enhance understanding of in-patient neurosurgical dermatology consultations and may be helpful in developing educational materials and management guidelines. But this study has some potential limitations. Limitation of the study is its retrospective design, with all the attendant limitations of a retrospective study. And we reviewed the electronic medical records only, so its reliance also is potential limitations. The paucity of histological information also limited the interpretation of our data which was not adequately recorded and incomplete. When evaluating the statistical result of this study, we also should bear in mind a point. It is the vagueness of a control group because this study was conducted in in-patients only. Comparing the dermatological findings in our NS patients and the general population may make up for this weak point in case of need. And larger prospective studies may help to shed light on useful clinical features that may determine the relationship between underlying NS disorders

and dermatologic conditions such as ICH and SD.

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