

An Analysis of the Neurological Consultations in Seoul National University Hospital — An Analysis of 1,115 Cases —

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Abstract—We reviewed 1,115 neurologic consultations from March 1989 to February 1990 in Seoul National University Hospital, which comprised 4 percent of all admitted adult patients. The average age of the cases was 51 years. Internal medicine was the requesting service in more than half of the cases, but the rate of consultation in each service was the highest in psychiatry and thoracic surgery.

Weakness of the extremities was the most common reason for consultation. The cases diagnosed as ischemic cerebrovascular disease were 22.9 percent. It must be reemphasized to control stroke-prone factors. Determining the underlying causes of impaired consciousness posed a special diagnostic problem. Metabolic encephalopathy was its leading cause.

Iatrogenic neurologic conditions were found in 10 percent of patients. The most common antecedents were cardiac surgery and the side effects of drugs.

These findings indicate the need for improved surveillance of neurologic problems in hospitals, earlier recognition of neurologic dysfunction, research into its mechanism, and additional education about the prevention of iatrogenic misfortune.

Key Words: *Neurologic consultation, Requesting service, Neurologic disease, Iatrogenic cause*

INTRODUCTION

The neurologic systems, distributed over the entire body, play a major role in the cooperation and give-and-take of informations among organs as well as control of each organ. With an increasing the population of elderly people, neurologic problems occur more often. Neurologic consultations play an important part in a general hospital,

because impairment of the nervous system, along with infection, surgery, and toxicity from drugs, is an occasional iatrogenic condition. Furthermore, it was evident that primary physicians often failed to recognize or underestimate the occurrence of neurologic conditions associated or concurred with diseases of other organs.

This study was undertaken to elucidate the pattern of neurologic consultation in a large teaching general hospital. We analyzed cases of neurologic consultation in Seoul National University Hospital one year ago. We tried to classify the diseases taken neurologic consultations and to reveal

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their distributions in requesting services. The iatrogenic cases were searched and were discussed in view of their etiology. The problems and their solving methods in neurologic consultations of general hospital were mentioned. We also emphasized the preventive aspects of the diseases.

MATERIALS AND METHODS

From March 1989 to February 1990, 1,115 neurologic consultations in Seoul National University Hospital were surveyed. These included adults who were admitted and requested a neurologic evaluation during this study period and comprise about 90% of all cases of neurologic consultations. All patients were examined by one of the authors (J.K. Roh) who frequently accompanied one of the senior residents. Writing the consultant's papers was done by Roh or a senior resident. The other author (S.B. Hong) reviewed the consultation cases retrospectively and analyzed them statistically.

Informations recorded at the time of the initial consultations included: age, sex, requesting service, charged physician, reasons for consultation, primary underlying disease, antecedent procedures, consultant, suspected neurologic diagnosis, and recommendations. The rate of consultations were calculated by the number of neurologic consultations divided by the number of all adults patients admitted in that department. We put a lot of emphasis on finding iatrogenic causes. In addition, we tried to indicate if a major neurologic problem existed that had previously been unsuspected by the referring physicians. We also predicted the rate of follow-up consultation in each requesting service. The suspected neurologic diagnoses were compared with primary underlying diseases to assess either the concurrence with or complication of the primary diseases.

The contents of the requesting papers were evaluated by the following grading method: 1. "Good" descriptions are long and meticulous enough to see the general status, chief complaints, and suspected neurologic problems of the patient. 2. "Fair" descriptions are relatively long but lack meticulousness and extensiveness of neurologic terms. 3. "Poor" descriptions are effortless and short. The

differences of consultation rates in charged physicians with one another were estimated by Kruskal-Wallis one-way ANOVA in the cases of internal medicine service which consists of 25 charged physicians.

One of the authors (S.B. Hong) evaluated the status of the recommendations and the content of the consultant's sheets and compared them among 7 descriptors (Roh and 6 senior residents) using a Kruskal-Wallis one-way ANOVA under the following criteria: 1. A good answer is that SOAP (from initials of Subjective symptom, Objective finding, Assessment and Plan) system is satisfactory and their correlation is good. 2. A fair answer is when one step of SOAP is lacking or a problem exists in their correlation. 3. A poor answer is when more than one of the SOAP steps are missing or their correlation is bad. Finally, we listed the causes of the iatrogenic and impaired consciousness cases.

RESULTS

Neurologic consultations in this study were performed on 4 percent of all hospitalized adult patients. The male-female ratio was 1.3 to 1 (male 630, female 485), and age distribution is shown in Fig. 1. The mean age was 51 years. The fifties was the most common age bracket, accounting for 24.8% of the cases. Monthly distribution of neurologic consultations appeared bimodal, which showed two peaks in March and October, and the average number of consultations per month was 93 cases (Fig. 2).

Table 1. indicates the requesting services for all neurologic consultations in this study year. More than half of all consultations were requested from internal medicine (626 cases, 56.1%), and then neurosurgery (77 cases, 6.9%), general surgery (72 cases, 6.5%), thoracic surgery (69 cases, 6.2%), and urology (64 cases, 5.7%), in decreasing order of frequency, but the rate of neurologic consultation in each service was the highest in psychiatry and thoracic surgery (9.9% and 9.7%). Follow-up consultation rates were high in plastic surgery, rehabilitation, psychiatry, and thoracic surgery, of which those are more than 20 percent.

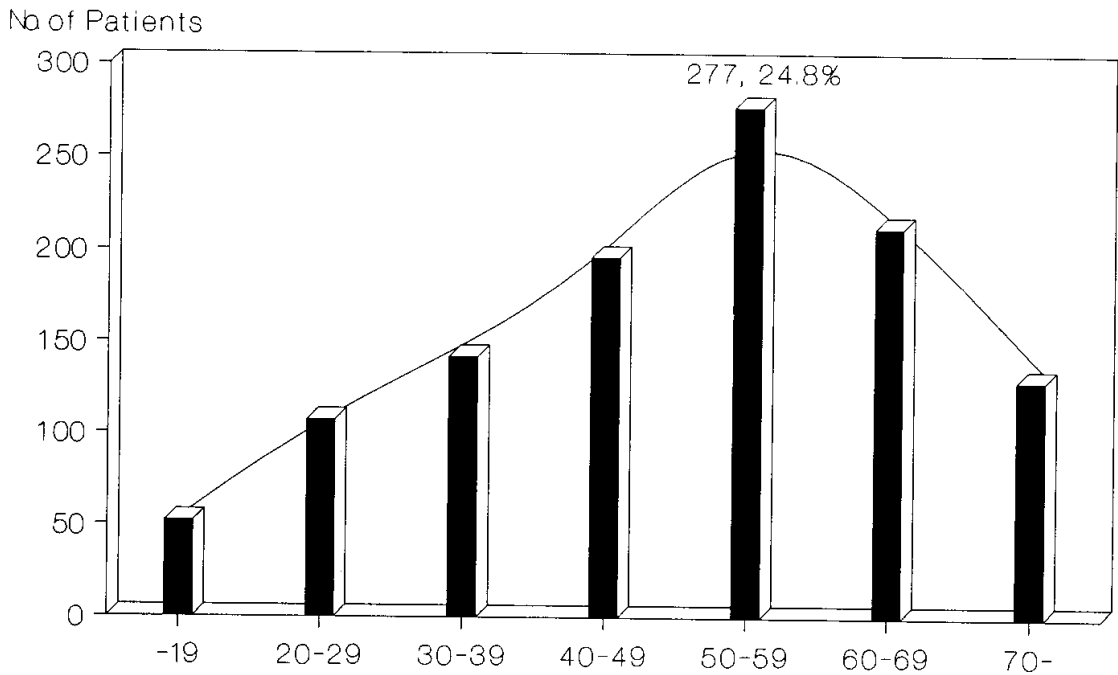


Fig. 1. Age distribution of neurologic consultations. The mean age was 51 years. The fifties accounted for 24.8 percent. In 57.9 percent of the cases, the patients were 50 or more years old.

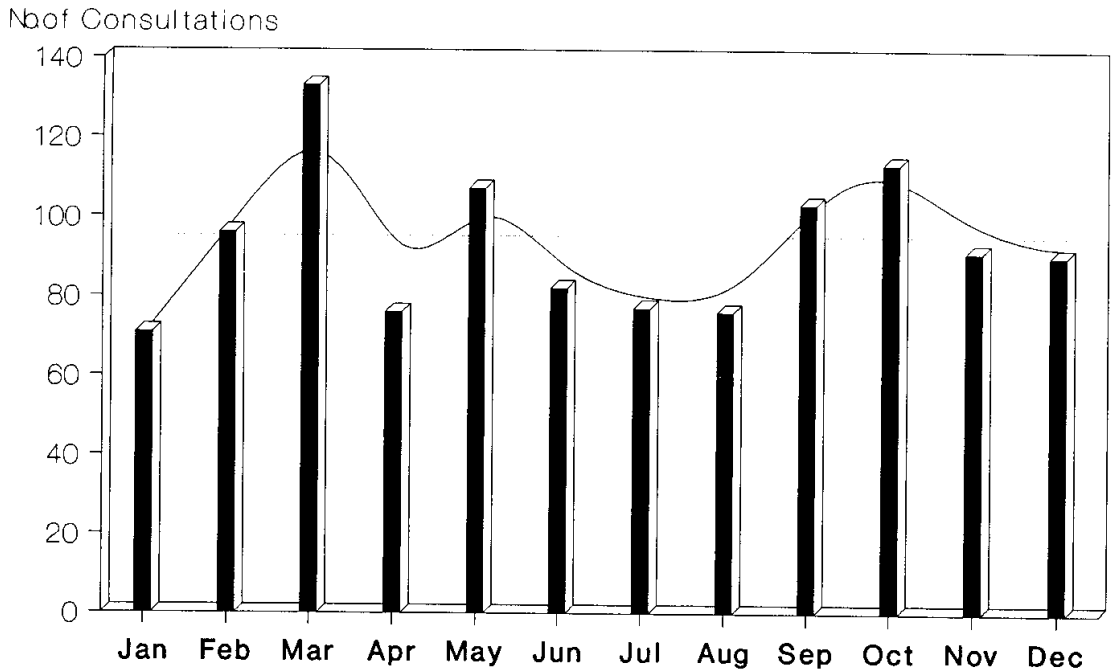


Fig. 2. Monthly distribution of neurologic consultations. The average number of consultations per month was 93 cases. And this figure shows a higher incidence in March (133 cases) and October (113 cases).

Table 1. Distribution of requesting services

Service	Number (%)	Total Patients of Each Service	Rate of Consultation (%)	Number & Rate (%) of Follow-up Consultation
Internal Medicine	626(56.1)	11,573	5.4	94(15.2)
Neurosurgery	77(6.9)	926	8.3	8(10.1)
General Surgery	72(6.5)	2,920	2.5	8(10.9)
Thoracic Surgery	69(6.2)	708	9.7	13(21.4)
Urology	64(5.7)	1,109	5.8	9(16.4)
Otorhinolaryngology	54(4.8)	1,528	3.5	3(5.9)
Orthopedic Surgery	51(4.6)	1,520	3.4	10(19.5)
Psychiatry	42(3.8)	426	9.9	9(24.2)
Obstetrics & Gynecology	22(2.0)	4,602	0.5	3(10.5)
Plastic Surgery	15(1.3)	901	1.7	2(42.9)
Ophthalmology	8(0.7)	1,375	0.6	0(0.0)
Rehabilitation Medicine	7(0.6)	104	6.7	2(40.0)
Dermatology	4(0.4)	176	2.3	0(0.0)
Therapeutic Radiology	4(0.4)	476	0.8	0(0.0)
	1,115(100.0) (total)	28,344 (total)	3.9 (mean)	12(16.7) (mean)

Table 2. Reasons for consultations

Reason for consultation	Number (%)
Motor weakness of extremity	216(19.4)
Headache	162(14.5)
Other pain or paresthesia	149(13.4)
Impaired consciousness	123(11.0)
Convulsion or syncope	120(10.8)
Dizziness or vertigo	107(9.6)
Dysarthria or speech disturbance	54(4.8)
Old cerebrovascular accident	45(4.0)
Involuntary movement	43(3.9)
Ocular Sx	28(2.5)
Hypesthesia	23(2.0)
Meningitis	10(0.9)
Behavior change	9(0.8)
Deafness or hearing disturbance	7(0.6)
Rigidity	5(0.5)
Others	60(5.4)
Total	1,115(100.0)

sultation are listed in Table 2. The most common reasons were motor weakness of the extremities (216, 19.4%), headache (162, 14.5%), other pain or paresthesia (149, 13.4%), impaired consciousness (123, 11.0%), convulsion or syncope (120, 10.8%), and dizziness or vertigo (107, 9.6%). Consultation for the diagnosis of brain death was only 3 cases.

Neurologic diagnoses are listed in Table 3. The most common one was occlusive cerebrovascular disease (255, 22.9%), and then, there were peripheral neuropathy (129, 11.6%), seizure disorder (114, 10.2%), headache (95, 8.5%), degenerative disease (63, 5.7%), metabolic encephalopathy (63, 5.7%), and so on in decreasing order of frequency.

The neurologic problems resulted from a complication of primary disease in 58.1% of the cases, and the remainder (41.9%) concurred with the underlying diseases. The antecedent diagnostic procedures or medications were done in 36.9% of the cases. The contents of the requesting papers were estimated as follows: good description 365 cases (32.8%), fair description 582 (52.2%), poor description 168 (15.1%).

Neurologic symptoms and signs requesting con-

Table 3. Distribution of neurologic diagnosis

Diagnosis	Number (%)
Occlusive cerebrovascular disease	255(22.9)
Infarction	221
Transient ischemic attack	34
Peripheral neuropathy	129(11.6)
Seizure disorder	114(10.2)
Headache	95(8.5)
Degenerative disease	63(5.7)
Metabolic encephalopathy	63(5.7)
Within normal limit	61(5.5)
Cranial nerve dysfunction	51(4.6)
Myelopathy	51(4.6)
Metastasis	47(4.2)
Intracranial hemorrhage	42(3.8)
Vertigo	42(3.8)
Infection of central nervous system	34(3.0)
Nonviral	25
Viral	9
Psychiatric disease	32(2.9)
Movement disorder	31(2.8)
Drug or chemical poisoning	22(2.0)
Tumor of central nervous system	17(1.5)
Neuromuscular junction disorder	17(1.5)
Demyelinating disorder	13(1.2)
Others	24(2.2)
Total	1,115(100.0)

Table 5. The comparison of contents of consultants' papers (7 descriptors)

Descriptor's No.	Content of consultant's paper		
	Good	Fair	Poor
1	34	50	22
2	4	10	4
3	59	56	24
4	17	52	23
5	56	116	34
6	25	48	28
7	21	34	9
	216	366	144

* Numbers indicate the number of consultations in that category.

* $p=0.95$ by Kruskal-Wallis one-way ANOVA

Table 4. Iatrogenic causes in neurologic consultation cases

Cause	Number (%)
Cardiac surgery	27(24.1)
Drug side effect	27(24.1)
Other operations	24(21.7)
Faulty surgical positioning	4
Angiography (including intervention)	8(7.2)
Other diagnostic procedures	9(8.4)
CSF tapping	4
Myelography	3
Esophagography	1
Bone marrow biopsy	1
Transfusion	4(3.6)
Radiation therapy	3(2.4)
Intramuscular injection	3(2.4)
Dialysis	1(0.9)
Spinal anesthesia	1(0.9)
Fall	1(0.9)
Rapid correction of hyponatremia	1(0.9)
Total	112(100.0)

The consultation rates according to charged physicians were estimated with one another in cases requested from internal medicine in which 25 charged physicians had been working in the same conditions for this study period. Kruskal-Wallis one-way ANOVA showed a significant difference of consultation rates among them ($p<0.05$). Unsuspected neurologic problems were found by the neurologic consultants in only 5% (66 cases) of all cases. Of these, 54 cases (82%) were judged to warrant additional diagnostic study or require specific therapy. Iatrogenic neurologic symptoms or signs occurred in 112 cases (10%) of the patients for whom neurologic consultation was required.

In the iatrogenic group, impaired consciousness or coma, convulsion or syncope, and somatic pain were common reasons for neurologic consultation. Table 4 displays the causes for original consultations. Iatrogenic complaints were attributed to surgical procedures in 51 cases (45.7%) and to drug side effects in 27 cases (24%) of the cases. 17 cases (15.2%) of the cases were caused by inva-

sive diagnostic procedures (angiography 8 cases, CSF tapping 4, myelography 4, esophagography 1, bone marrow biopsy 1).

The states of consultants' recommendations were as follows: good recommendations (satisfactory in diagnostic and therapeutic procedures) 947 cases (85.9%), fair (lack of one procedure) 122 (11.1%), and poor (lack of more than one procedure) 33 (3%). The contents of the consultants' papers showed no significant differences among the 7 descriptors ($p=0.95$, Kruskal-Wallis one-way ANOVA, in Table 5).

DISCUSSION

This study confirms not only that the burden of neurologic morbidity in general hospital is high, but also that the incidence of iatrogenic neurological disease is generally underestimated. There are several reports about psychiatric consultations of general hospital in Korea (Jeong WJ *et al.*, 1984; Cho YC *et al.*, 1984; Kang DY *et al.*, 1986; Koh KB, 1987; Kim YC, 1987; Kim SA *et al.*, 1989), but unfortunately a study of neurologic consultations in general hospitals has not been performed yet in this country. Actual comparisons with previous studies or other centers' in Korea were not possible.

Our rate of consultation is less than that of Moses (1986) in the Johns Hopkins Hospital and that of Posner (1978) in a cancer hospital, but our cases were not all neurologic consultations in our hospital. We suspect that the real rate is similar to theirs. As expected, the spectrum of neurologic diagnoses in hospital consultation is quite different from that of either an inpatient neurologic service or outpatient practice (Horwich MS, 1985). Although it has been widely predicted that much of neurologic practice will move to outpatient clinics and offices, the need for neurologic consultations for inpatients of other services will most probably continue to grow. This requires that neurologic training continue to include detailed instruction in general medicine and surgery. Likewise, medical training must reemphasize both the recognition of neurologic disease and its proper management.

In 57.9 percent of the cases, the patients were 50 or more years old. This suggests that neurologic

diseases or complications of the underlying diseases occur more often in elder people. The neurologic complication rate of primary underlying diseases was higher in the elder age bracket (age >50 years: 59.4%, age <50 years: 55.4%). The complication-concurrence ratio was higher in 50-or-more years age groups (age $\geq 50 \rightarrow 1.47:1$, age $<50 \rightarrow 1.24:1$). It is likely that the elder group is more susceptible to neurologic complications of underlying diseases.

Internal medicine accounted for more than half of the consultations, but the services of psychiatry and thoracic surgery showed the highest rate of consultation. The high rate of thoracic surgery was partially attributed to a very high proportion (41.5%) of iatrogenic cases in that department, which were mainly due to open heart surgery. Also, psychiatrists requested many neurologic consultations to exclude neurologic diseases mimicking psychosis or manifesting psychiatric symptoms.

Neurologic diagnosis indicates that occlusive cerebrovascular disease is the most common problem for neurologic consultations. Nearly all of those cases had stroke-prone factors such as hypertension, diabetes mellitus, and heart problems as underlying diseases. We were impressed that nonneurologic physicians were somewhat lacking in attention to the risk factors of cerebrovascular diseases. It must be stressed that the importance of preventive medicine is to control risk factors. Likewise, headache and paresthesia are also leading neurologic complaints. Patients need pain control. Moreover, in the view of public health, further efforts and time to elucidate the origin of pain and its mechanism are required.

Impaired consciousness or delirium poses a special diagnostic and therapeutic problem for all physicians, but particularly for neurologic consultants. The incidence of impaired consciousness in both general patients (11.0%) and those with iatrogenic disease (approaching 15.2%) indicates that elucidating their mechanism and refining diagnostic tools is of great importance. The causes are listed in Table 6. The leading one was a metabolic encephalopathy, in which hypoxic or anoxic cases were the most common (38.1%). These hypoxic conditions were largely due to iatrogenic causes, espe-

Table 6. Causes of impaired consciousness

Cause	Number (%)
Metabolic encephalopathy	39(33.6)
Cerebral infarction	21(18.1)
Seizures (or postictal state)	7(6.0)
Dementia (senile or Alzheimer)	7(6.0)
Meningoencephalitis	7(6.0)
Metastasis to CNS	5(4.3)
Intracranial hemorrhage	4(3.4)
CNS systemic lupus erythematosus	3(2.6)
Psychiatric disease	2(1.7)
Paraneoplastic syndrome	2(1.7)
No single cause identified	19(16.4)
Total	116(100.0)

cially cardiac surgery. A thoracic surgeon should realize the necessity of more cautious operative procedures and preventive measures.

More importantly, bedside neurologic assessment could not reliably distinguish those patients with impaired consciousness due to a primary neurologic disorder from those who had systemic abnormalities with secondary metabolic encephalopathy. It is clear that the appearance of a new major neurologic sign (such as hemiplegia, oculomotor palsy, hemianopia) usually indicates the presence of a new serious intracranial pathology; however, new minor neurologic signs or seizures do not reliably predict new intracranial pathology, since they occur equally often in those with and without demonstrable primary neurologic abnormality. Failure to distinguish primary from secondary encephalopathy precludes the ability both to provide proper therapy and to determine prognosis. Further work to improve the diagnostic precision of bedside techniques is needed.

Drug side effects or intoxication is also a prime cause (24.0%) of iatrogenic cases. This proportion is much greater than that (1.0%) of the Johns Hopkins Hospital. Although there are differences between the two hospitals in defining drug intoxication, inappropriate drug therapy and drug abuse must be avoided, and more strict dose adjustment is important.

The neurologic consultation rate of each charged physician showed significant differences among one another. This indicates that medical education and training must underscore both a general knowledge of neurologic disease and its recognition and proper management.

The detection rate (5.9%) of unsuspected neurologic problems in our hospital was lower than that of Moses (1986, 20%). The manpower of our hospital, especially the number of faculties in the department of neurology, is less than one-fourth of general hospitals of similar size in the U.S. The neurology staff cannot afford enough time to evaluate the whole neurologic system of patients. Solving this problem is not promising in the near future. But we should expend a great effort to overcome this practical difficulty and find a way out.

Systemic cancer with or without chemotherapy comprised 17.1 percent of cases, as a underlying disease. Their neurologic problems were understood much less. In these patients, neurologic consultation is especially important for recognition of occult infection, direct effects of mass lesions, the occurrence of peripheral neuropathy, other paraneoplastic syndromes, and, especially, the particular requirements for managing these conditions (Posner, 1978).

Brain death is a particularly awkward issue for both neurologists and other physicians. Consultation for diagnosis of brain death was only 3 cases. In Korea, organ donation is not actively performed, and the concept of brain death is still strange to general population. In Moses' study, consultations for brain death is 12 percent of the total cases, and their details are listed in Table 7. Their study demonstrated that referring physicians correctly identified the presence of brain death in fewer than half of the cases, nearly always making the error in the positive direction—a premature and erroneous pronouncement of brain death. This disparity has major implications for the role of neurologist as a consultant for declaring brain death. The tense emotional situation that frequently surrounds a patient in a coma, especially when it resulted from a diagnostic or therapeutic misfortune, often makes pronouncement of brain death a vexed question. In the U.S., the criteria for brain death have

Table 7. Consultations for brain death (12 percent of total consultations)

	Percent
Diagnosis suspected by referring physician	71
Diagnosis confirmed by neurologist	43
Aid sought in judging prognosis of coma	29
Underlying conditions	
Primary neurologic event	57
Cardiac arrest	21
Anesthesia accident	6
Sepsis, hypotension, anoxia or other systemic process	16

* This table is cited from Moses's report (1986).

been widely publicized in medical and neurologic circles; the concept of brain death has become a law in several states, is widely discussed in general publications, and is now understood by many people. We believe that neurologists have a specific role in assuring that the criteria are met. When organ donation is planned, the need for neurologic consultation is especially important, as a neurologist can both provide the diagnosis of brain death and screen for the presence of neurologic conditions that would preclude donation, e.g., dementia, infections, and degenerative neurologic diseases. The role of neurologists in judging the prognosis of serious neurologic injury, even when brain death has not occurred, is also important. Neurologists should provide specific guidance about probable eventual neurologic outcome, which can now be based on realistic estimates obtained from multicenter studies of nontraumatic (Levy *et al.*, 1981) and traumatic (Jennette *et al.*, 1979) coma.

This study has several implications for neurologists and other physicians. Referring physicians should strive to ask specific questions to neurologists (and other specialists), and neurologists must hone their skills in imparting usable information in an unambiguous fashion to the primary service. Surveillance for the presence of iatrogenic neurologic disease should be improved so that steps can be taken to diminish injury from medical interven-

tions. Impaired consciousness is a special problem; both the mechanisms of this condition and specific causes need additional study. As absence of neurology specialty or lack of its staff number, neurologists have not clearly communicated the criteria for brain death to other medical practitioners nor adequately supervised their application. Although these findings were from a single hospital and were collected by only a small group of physicians, relatively many cases and a study in the largest teaching hospital in Korea lead us to suggest that our experience is representative. But, further studies in other centers and in the coming years is required.

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= 국 문 초 록 =

서울대학교병원 신경과 자문예에 대한 임상적 고찰

- 1,115예 -

서울대학교 의과대학 신경과학교실

노재규 · 홍승봉

신경계는 우리 신체의 모든 부위에 걸쳐, 분포되어 있으면서 개개 장기의 활동 및 서로 다른 장기 사이의 협조와 연락에 커다란 역할을 하고 있다. 이에 신경과 전문의는 기타 상기의 질환에 동반되거나, 합병되는 신경학적 이상 현상에 주의를 환기시켜야 할 것이며, 성심껏 자문에 응해야 하겠다. 저자는 최근 고령 인구의 증가에 따라 기타 질환의 신경과적 합병증에 대한 자문이 나날이 많아져, 지난 일년간(1989.3~1990.2)의 자문예 중 고찰이 가능하였던 1,115예를 종합 및 분석하여 아래와 같은 결과를 얻었다.

1. 총 증예수는 1,115예로써 전체 성인 입원환자 (신경과 제외) 28,344 중 4%이며, 성별은 남자 630예, 여자 485예(M:F = 1.3:1)였다.
2. 연령분포는 50대가 277예(24.8%)로 가장 많았고, 평균 나이는 51세였다.
3. 월별분포는 월평균 93예로 비교적 고른 분포를 보이나, 3월과 9, 10월에 많아 이점점(bimodal) 분포양상을 띄었다.
4. 자문예들의 과별분포는 전체적으로 내과(626예), 신경외과(77예), 일반외과(72예), 흉부외과(69예), 비뇨기과(64예), 이비인후과(54예) 등이 순이었으나, 각 과별 전체 입원환자수에 대한 자문율은 정신과와 흉부외과가 각각 10%로 가장 높았다.
5. 자문이유를 보면 Motor Weakness가 216예(19.4%)로 가장 많았고, 다음으로 두통(162예), Paresthesia or pain(149예), 의식장애(123예) 등의 순이었다.
6. 일차질병(primary disease)에서 유래되었다고 볼 수 있었던 경우가 467예로 41.9%였고, 411예(36.9%)에서 자문전 검사 또는 투약이 있었다.
7. 신경과적 진단시의 질병분포는 폐쇄성 뇌혈관질환이 255예(22.9%)로 가장 많았고, 다음으로 말초신경장애 129예(11.6%), 경련성 질환 114예(10.2%), 두통 95예(8.5%), 퇴행성 질환 63예(5.7%), 대사성 뇌병증 63예(5.7%) 등의 순이었다.
8. 마지막으로, 의인성(iatrogenic) 예에 대하여 조사하였는데, 원인으로 개심술(open heart surgery)이 27예(24.1%), 약물의 부작용 27예(24.1%)로 가장 많았고, 다음으로 기타 수술이 24예, 혈관조영술 8예, 기타 진단적시술 9예, 수혈 4예, 방사선 치료 3예, 근육주사 3예 등의 순이었다.