The burden of inpatient neurologic disease in two Ethiopian hospitals

J.H. Bower, MD; J. Asmera, MD; M. Zebenigus, MD; P. Sandroni, MD, PhD; S.M. Bower, RN; and G. Zenebe, MD

Abstract—*Objectives:* To define the burden of inpatient neurologic disease seen in Ethiopian teaching hospitals. *Methods:* We reviewed records of all medical inpatients admitted over a 6-month period to two teaching hospitals, one with and one without neurologists. *Results:* Neurologic cases made up 18.0% and 24.7% of all medical admissions. The mortality rates were 21.8% and 34.7%. Noninfectious diseases were 36.7% and 31.7% of neurologic cases, but unknown etiologies made up 42.2% and 29.0% of all cases. Of total cases, only 42.9% and 24.1% had at least a high level of diagnostic certainty. *Conclusions:* Patients with neurologic disease make up a substantial minority of medical inpatients in Ethiopia. Noninfectious neurologic disease is at least as common as infectious neurologic disease. Reaching a well-defined final diagnosis occurs in only a minority of cases. Areas for improving the mortality rate include improving the barriers to diagnostic certainty and increasing treatment options for Ethiopian patients.

NEUROLOGY 2007;68:338–342

The overall burden of neurologic disease is increasing in the developing world.[1] In fact, most disorders of the nervous system occur in developing countries.[2] The 2003 Institute of Medicine report made recommendations to improve the health services for neurologic disease in patients in the developing world.[3] One of these was to "link national centers for training in and research on brain disorders with institutions in high income countries." However, most neurologists in developed countries are unfamiliar with the burden of neurologic disease in developing countries. This may be preventing cooperation between neurologists in the two settings.

The number of neurologists serving in the countries of Africa is small.[4] For this reason, it may be more practical for neurologists in these countries to serve as teachers of primary care practitioners rather than as deliverers of primary care neurology themselves.[4-7] The development of local neurology training programs in these countries, by increasing the number of neurology teachers, could potentially make major strides in the care of patients with neurologic disease.[4] Assisting in the development of training programs would be an area where neurologists from developed countries could greatly help their colleagues in the developing world.

With limited resources for physician training, however, this raises important questions. How does the burden of neurologic disease compare to other medical illnesses in morbidity and mortality? With the high prevalence of HIV (as well as tuberculosis and malaria), would resources be better used training infectious disease specialists than neurologists? On a practical level, is neurology too esoteric a specialty to divert these precious resources?

Ethiopia is a nation of approximately 71 million people served by seven practicing neurologists. This is a typical situation in many of the nations in Africa.[4] In hopes of training internists who can then teach neurology at the eight medical schools in the country, the neurologists in Ethiopia have recently initiated a residency program. We performed this study to understand the burden of disease presenting to Ethiopian neurologists. We also wished to address the concerns about resource allocation for physician training.

Methods. We reviewed medical records of all patients admitted for a primary neurologic illness to two referral hospitals in Ethio-

Editorial, see page 322
See also pages 326 and 384

From the Departments of Neurology (J.H.B., P.S.) and Emergency Medicine (S.M.B.), Mayo Clinic College of Medicine; Rochester, MN; the Department of Neurology (M.Z., G.Z.), Addis Ababa University School of Medicine, Addis Ababa, Ethiopia; and the Department of Internal Medicine (J.A.), Gondar College of Medicine and Health Sciences, Gondar, Ethiopia.

Disclosure: The authors report no conflicts of interest.

Received July 14, 2006. Accepted in final form November 6, 2006.

Address correspondence and reprint requests to Dr. James H. Bower, Department of Neurology, Mayo Clinic College of Medicine, 200 First Street SW, Rochester, MN 55905; e-mail: bower.james@mayo.edu

pia for the 6-month period March 10, 2005, to September 10, 2005 (the Gregorian calendar equivalent of the last 6 months of the Ethiopian calendar year 1997).

The Tikur Anbessa Hospital of the Addis Ababa University School of Medicine serves as a tertiary care hospital for the entire country and is one of two postgraduate teaching hospitals for internal medicine in Ethiopia. It is located in the capital city of Addis Ababa and is staffed by one neurologist. Common laboratory studies available include complete blood count; routine chemistries; sedimentation rate; thyroid studies; toxoplasmosis titers; prothrombin and partial thromboplastin times; HIV, hepatitis, typhoid, typhus, and syphilis serologies; phenobarbital, phenytoin, and carbamazepine serum levels; blood, urine, and stool cultures; and CSF studies for cells, glucose, protein, Gram stain, India ink, acid-fast bacilli stain, syphilis serology, and bacterial cultures. Common ancillary testing available includes CT; nerve conduction studies; chest, skull, and spine radiography; EKG; and echocardiography. MRI, EEG, and needle EMG are not available. All medical patients are admitted to a general medical service, but if the primary reason for admission is neurologic, they are staffed by the neurology attending physicians. A log is kept for all inpatients staffed by the neurology attendings. We requested the medical records for all patients seen by the neurology service during the study period as recorded in the log.

The Gondar College of Medicine and Health Sciences is a hospital in north-central Ethiopia that serves as the referral hospital for an area of approximately four million people, of whom approximately 15% live in urban areas and 85% live in rural areas. It trains 70 to 90 medical students per year, but currently has no postgraduate training in internal medicine. There are no neurologists on staff. Common laboratory studies available are similar to those in Addis Ababa except electrolytes, thyroid studies, toxoplasmosis titers, hepatitis serologies, drug levels, and prothrombin and partial thromboplastin times are not available. In addition, CSF studies are only available for cells, Gram stain, acid-fast bacilli stain, India ink, and bacterial cultures. CSF glucose, protein, and syphilis serology are not available. EKG, echocardiography, and chest/skull/spine radiography are available, but there are no nerve conduction studies or CT. All medical patients are admitted to one of three medical services, which are staffed by one of eight general internists. A complete log of admitted patients with admitting diagnoses is maintained by the nursing staff. We reviewed these logs and requested the medical records for all patients who had a possible neurologic diagnosis as the primary reason for admission during the study period.

There were 877 medical admissions to the Tikur Anbessa Hospital during the study period, of which 161 were staffed by the neurology service. Eleven (6.8%) of these records could not be located but had enough information in the log from which we could determine that they were definitely neurologic. We excluded three cases for being non-neurologic, leaving 158 (80 men, 78 women; 18.0% of medical admissions) definite neurologic cases, for which we had complete medical records on 147.

There were 676 medical admissions to the Gondar College of

Table 1 *Categories and definitions*

Presumed etiology
Infectious, noninfectious, both or unknown as determined by the treating physicians
HIV relationship
Definite: Clinically related, and positive HIV serology or low CD4 count
Probable: Clinically related but no laboratory confirmation performed
Probably unrelated: Clinically possible but unlikely
Definitely unrelated: Clinically unrelated, or negative laboratory confirmation
Unknown
Level of certainty of diagnosis
Known: Clinical findings sufficient for diagnosis, or testing was diagnostic
High: Clinical findings very suggestive of diagnosis, and further testing deemed unnecessary
Moderate: Clinical findings suggestive of diagnosis, and either further testing was needed but not performed, or treatment was given presumptively
Minimal: Diagnosis was unknown or part of differential diagnosis only
Use of available testing
All cases of either minimal or moderate diagnostic certainty were assessed for whether available testing was performed but inconclusive, or whether available testing was not performed.
Hypothetical use of unavailable testing
All cases of either minimal or moderate diagnostic certainty were also assessed for whether testing unavailable at the site would "definitely" have been necessary to make the diagnosis. Examples include CSF for oligoclonal bands or PCR testing; tissue biopsy; myelogram; angiogram, MRI or EEG. Differences in practice patterns alone between developed and developing nations were not sufficient to receive the "definite" categorization.
Hypothetical use of unavailable treatment
All cases were assessed for whether other treatment would have been hypothetically given if it had been available at the site. Once again, differences in practice patterns were not considered. Attempts were made to remain restrictive, under the following definitions:
Definite: Necessary treatment was unavailable (e.g. intravenous immunoglobulin, anti-neoplastic agents, dialysis, sophisticated intensive care unit treatments)
Probable: Appropriate treatment was given but death occurred, and a wider variety of medications in the same class (e.g. antibiotics) are available elsewhere
Possible: Appropriate treatment was given and poor outcome achieved, but patient survived
Unlikely: Good outcome was achieved with treatment given

Table 2 *Patient demographics, etiologies, and death rates*

	Addis Ababa*	Gondar§
Median age, y (range)	35 (13–74)	35 (15–80)
Infectious cases	32 (14–55)	28 (15–70)
Noninfectious cases	41 (15–74)	56 (16–80)
Etiology, no. (%)		
Infectious	28 (19.0)	64 (38.3)
Noninfectious	54 (36.7)	53 (31.7)
Both	3 (2.0)	0 (0)
Unknown	62 (42.2)	50 (29.9)
HIV relationship, no. (%)		
HIV-related†	49 (33.3)	51 (30.5)
Not HIV-related‡	76 (51.7)	86 (51.5)
Unknown	22 (15.0)	30 (18.0)
Deaths, no. (%)	32/147 (21.8)	58/167 (34.7)

* The total number of cases in Addis Ababa, where this information was available, was 147.
† Includes probable and definite.
‡ Includes probably and definitely unrelated.
§ The total number of cases in Gondar, where this information was available, was 167.

Medicine and Health Sciences during the study period, of which 187 were admission diagnoses suspicious for a primary neurologic disease. Twenty-six (13.9%) records could not be located, but the nursing log had enough information for us to determine that they were definitely neurologic. Twenty patients were excluded for being non-neurologic, leaving 167 (86 men, 81 women; 24.7% of medical admissions) definite neurologic cases, for which we had complete medical records on 141.

All pertinent medical records were abstracted (by J.H.B., J.A., M.Z., P.S., or S.M.B.) for the following information: history, examination, laboratory and ancillary test results, hospital course, treatment, outcome, and final diagnosis. The cases were categorized further using the definitions given in table 1.

Results. Table 2 lists the presumed etiologies and death rates. At both sites, a substantial minority had an unknown etiology (42.3% for Addis Ababa and 29.9% for Gondar).

Table 3 lists the neurologic burden in each hospital by neurologic syndrome. At both sites, the mortality rate was highest in those with delirium/coma.

Table 4 *Presumed specific etiologies*

	Infectious agents treated*	Noninfectious etiologies†
Addis Ababa	Bacterial: 34	Vascular: 32
	Tuberculosis: 27	Neoplastic: 5
	Toxoplasmosis: 24	Inflammatory/autoimmune: 6
	Cryptococcus: 18	Epileptic: 5
	Viral: 3	Toxic/metabolic: 4
	Malaria: 2	Other: 2
Gondar	Bacterial: 47	Vascular: 27
	Tuberculosis: 28	Toxic/metabolic: 12
	Malaria: 20	Degenerative: 2
	Toxoplasmosis: 21	Epileptic: 2
	Cryptococcus: 4	Inflammatory/autoimmune: 1

* There were 66 total patients (Addis Ababa) and 84 patients (Gondar) given treatment for infectious agents. Many patients were treated for multiple agents.
† There were 54 (Addis Ababa) and 44 (Gondar) patients for whom information was available.

Table 4 lists the presumed specific etiologies. In Addis Ababa, a total of 66 patients were treated for 108 presumptive infectious agents. Of these, only 24/108 (22.2%) were considered to be of high or known diagnostic level of certainty. In Gondar, a total of 84 patients were treated for 120 presumptive infectious agents. Of these, only 22/120 (18.3%) were considered to be of high or known diagnostic level of certainty.

In only a minority of overall cases was the diagnostic certainty high or known (42.9% for Addis Ababa and 24.1% for Gondar). Unavailable testing was deemed as necessary in a large proportion of cases (48.3% in Addis Ababa and 61.7% in Gondar). Although many patients did not receive definitive treatment (21.1% in Addis Ababa and 9.2% in Gondar), for those whose diagnostic certainty was high or known, only three of 63 in Addis Ababa and none of 34 in Gondar received no treatment.

Discussion. We found that the proportion of patients with primary neurologic disease admitted to referral hospitals in Ethiopia is a substantial minor-

Table 3 *Neurologic syndromes with outcomes*

	Addis Ababa*		Gondar†	
	Total, no. (%)	Deaths, no. (%)	Total, no. (%)	Deaths, no. (%)
Meningitis/meningoencephalitis	29 (19.7)	9/29 (31.0)	29 (20.1)	7/29 (24.1)
Delirium/coma	25 (17.0)	12/25 (48)	43 (30.5)	22/43 (51.2)
Hemiparesis	51 (34.7)	7/51 (13.7)	40 (28.4)	10/40 (25)
Para-/tri-/quadraparesis	25 (17.0)	3/25 (12)	19 (13.5)	5/19 (26.3)
Seizure	9 (6.1)	1/9 (11.1)	1 (0.7)	0 (0)
Other	8 (5.4)‡	0 (0)	9 (6.4)§	4/9 (44.4)

* The total number of cases in Addis Ababa was 147.
† The total number of cases in Gondar, where this information was available, was 141.
‡ Other cases in Addis Ababa included posterior fossa syndromes (five), tetanus (one), pain (one), visual changes (one).
§ Other cases in Gondar included tetanus (five cases), ataxia (two cases), pain (one case), diabetic neuropathy (one case).

ity of all medical patients. The mortality rate among these patients is high. Neurology is not an esoteric medical specialty in Ethiopia.

Contrary to what many in developed nations may believe, we found that noninfectious neurologic disease is at least as, if not more, common than infectious neurologic disease. This is consistent with previous reports that noncommunicable neurodegenerative diseases will increase in the developing world,[1,2,5,8] and that the death rates from noncommunicable diseases are higher in the developing world than in market economies.[1,9] Similarly, although HIV infection contributes a great part to neurologic morbidity and mortality, the majority of neurologic disease in hospitalized patients is not HIV related. In terms of resource allocation, the high burden of neurologic disease will require specialists capable of differentiating between all possible insults to the nervous system. High-quality neurology training is essential.

Although our initial intent was to report the neurologic burden by diagnosis, it became clear that this was going to be difficult. The overall presumed etiology was unknown in a high percentage of cases (42.2% for Addis Ababa and 29.9% for Gondar). Furthermore, the final diagnosis was considered of high or known level of certainty in only a minority of cases (42.9% for Addis Ababa and 24.1% for Gondar). With the final diagnosis being unclear in a large proportion of cases, we believe that it is more accurate to report the burden of neurologic disease in terms of presenting neurologic syndromes as defined by the history and examination, something obtainable in 100% of patients. Defining the burden by syndrome can help future investigators determine needed diagnostic tools and improve management strategies.

We looked for barriers in making a definite diagnosis. Available testing was not used in a sizable minority of patients (34.0% in Addis Ababa and 22.7% in Gondar). Although the retrospective study prevented us from systematically recording the explanation for this, we found many records in which reasons were listed. Medical explanations included lack of a lumbar puncture because of concerns about a space-occupying lesion, other medical comorbidities taking precedence in the patient's care, or rapid death before evaluation could occur. Patients sometimes refused evaluation. Reasons listed included privacy concerns about HIV testing, uncooperative for lumbar puncture, refusal of evaluation because of probable lack of effective treatment, evaluation being too expensive, or patient leaving the hospital against medical advice. Technical or availability problems with CT were also present.

Unavailability of necessary testing was also found to be a significant barrier in making a diagnosis. Of all patients, 48.3% in Addis Ababa and 61.7% in Gondar definitely required testing not available at their site. The definition of "definitely" was purposely kept restrictive. It is the authors' impression that had differences in practice patterns been considered, the need for unavailable testing would have approached 100%.

Because the Tikur Anbessa Hospital is the only teaching hospital in Ethiopia with neurologists, we studied another teaching hospital to confirm that there was no referral bias for neurologic cases in Addis Ababa. The Gondar College of Medicine is very representative of the other six medical schools in Ethiopia. We found that the percentage of neurologic cases was actually higher in Gondar, although the type of patient by syndrome was very similar. Other differences were noted. The diagnostic certainty was higher in Addis Ababa than Gondar. This probably reflects the presence of neurologists, internal medicine residents, and more available testing in Addis Ababa. Due to this, the Gondar physicians must treat more patients presumptively. We are unable to conclude from this retrospective study whether this diagnostic uncertainty explains the higher mortality rate in Gondar. However, we believe it does emphasize the need for trained neurologists in all the medical schools of Ethiopia. The need for sophisticated neurologic knowledge is higher in locations without sophisticated neurologic testing.

The ultimate goal of neurologic training is to reduce morbidity and mortality of neurologic disease. It is beyond the scope of this study to explain the mortality rate so as make scientific suggestions for improvement. The patient mix, the diseases themselves, and the stages of the diseases on presentation all contribute to the high mortality rate. However, a few of our findings suggest areas where improvements are needed.

The difficulty in formulating a concise diagnosis impairs the ability to treat appropriately. We found several potential barriers in making a diagnosis. Both the lack of using available testing consistently and the unavailability of necessary testing prevent the physician from reaching a diagnosis. Solving this problem will be complex. It will require intervention on many levels: social, public health, local government (e.g., increasing health care spending), and international (both in helping to improve the local health care infrastructure as well as reducing overall poverty).

Inadequate treatment certainly contributes to a higher mortality rate. We found that some patients did not receive definitive treatment (supportive care only). Once again, the retrospective design of our study did not allow us to document the reasons for this, but in many records, the reasons were recorded. There was documentation that patients declined treatment, could not afford treatment, or signed out against medical advice. There was no neurosurgical availability in some cases. Some patients were referred to other hospitals for treatment. We had the impression, however, that the most frequent explanation was a lack of clear diagnosis. The fact that only 22.2% (Addis Ababa) and 18.3% (Gondar) of infectious agents were treated with a high or known level of certainty helps support this impression. In

addition, unavailable medication is certainly playing a role. We determined that in approximately one fourth of cases, unavailable treatment would have definitely or probably been given.

The most obvious limitation of this study is the hospital-based design. The neurologic disease seen in teaching hospitals does not necessarily represent the prevalence of neurologic disease in the community. It does, however, represent the disease seen by the neurologists in the country and at its medical schools.

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