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Opinion

Sonography and Neurodiagnosis (Neurosonography)

In preparation for the 1984 meeting of the American Society of Neuroradiology (ASNR), a questionnaire was mailed to all members to determine their perception of the value of sonography for neurodiagnosis, present use of neurosonography, anticipated use of neurosonography, and provisions for fellowship training in neurosonography. In the questionnaire, neurosonography was considered in four parts: echoencephalography, carotid artery, orbital, and intraoperative (cranial or spinal). An oral summary of the survey results was presented at the ASNR business meeting in June 1984. The present report analyzes the survey data more completely and expresses our belief that neurosonography should be incorporated more fully into the clinical practice and fellowship training programs in neuroradiology.

Of 813 questionnaires mailed, 179 (22%) were returned. Of the respondents, 43% were involved in neuroradiology fellowship and 57% were not. Significant differences in responses from members in fellowship and nonfellowship programs and significant differences in responses for the four types of sonographic examinations led us to analyze the data separately for each category. Tables 1–3 present the major findings of the poll.

The value of sonography in neurodiagnosis was widely appreciated (table 1). In both fellowship and nonfellowship groups, two-thirds of the members believed that sonography made an important contribution to diagnosis. In addition, most members believed that neuroradiologists should be responsible for obtaining and interpreting carotid, cerebral, and intraoperative cranial/spinal sonograms (table 2). Despite these beliefs, however, less than 25% of the respondents were actively involved in neurosonography (table 1).

While most respondents believed that neurosonography should be part of neuroradiology fellowship programs, in only a small percentage of respondents from fellowship programs was sonography included as part of their training (table 3). This discordance between desire and reality probably reflects combinations of "turf" problems, time constraints, and lack of prior training in sonography.

Types of Neurosonographic Studies

Carotid Artery

The survey indicates that most carotid sonography is currently performed in *out*patients by vascular surgeons, cardiologists, and neurologists. *In*patient carotid sonography is most often performed by sonographers or general radiologists. Neuroradiologists perform few of these studies. Leaving aside a discussion of the merits of sonography for screening patients with carotid vascular disease, we believe that when carotid sonography is performed, it should be done by or in close cooperation with a neuroradiologist. In that way, if follow-up imaging is necessary, plans for intravenous digital subtraction angiography and/or carotid arteriography could be formulated immediately and carried out expeditiously. The effectiveness of the carotid sonographic "screening" procedure could also be determined and compared with the cost-effectiveness of the more invasive but definitive diagnostic procedures.

Echoencephalography

Currently, most sonographic studies of newborn and infant brains are performed in *in*patients by sonographers and pediatric radiologists for possible hydrocephalus or intracranial hemorrhage. In many centers, sonography with older equipment has already supplanted computed tomography (CT) for initial diagnosis and serial follow-up of patients with these diseases. Advanced sonographic equipment now provides much improved resolution of fine brain structure and extends the use of sonography to many other diseases previously studied by CT and angiography. For these reasons, we believe that those radiologists most familiar with the anatomy and pathology of the central nervous system (i.e., neuroradiologists) should assume responsibility for the interpretation of the echoencephalograms.

As was shown at the business meeting in June, sonography

TABLE 1: **Value and Involvement with Neurosonography: Summary of Survey Responses by ASNR Members**

Type of Sonographic Examination	Perceived Value (%)			Present Involvement (%)			Anticipated Involvement (%)		
	Fellowship	Nonfellowship	Total	Fellowship	Nonfellowship	Total	Fellowship	Nonfellowship	Total
Carotid artery	68	81	75	14	30	24	31	48	41
Echoencephalography	77	65	70	8	32	22	26	45	37
Orbital	68	62	64	3	5	4	9	12	11
Intraoperative	91	85	88	12	22	17	35	54	46
No value perceived *or* no involvement in any type of sonography	1	5	3	75	47	59	44	22	31

TABLE 2: **Should Only Neuroradiologists Perform Neurosonographic Studies? Summary of Survey Responses by ASNR Members**

Type of Sonographic Study	% Yes Responses
Carotid artery	63
Echoencephalography	63
Orbital	34
Intraoperative	70

Note.—Responses from fellowship and nonfellowship groups were nearly equal.

TABLE 3: **Role of Sonography in Neuroradiology Fellowship Programs: Summary of Survey Responses by ASNR Members**

Type of Sonographic Study	% Yes Responses		
	Sonography Now Part of Fellowship	Sonography Should be Part of Fellowship	
		Fellowship Group	Nonfellowship Group
Carotid artery	13	66	80
Echoencephalography	17	65	72
Orbital	7	43	43
Intraoperative	17	74	90

is superior to CT in depicting some structures. In many ways, sonography more closely resembles magnetic resonance imaging (MRI) than it does CT. The lack of ionizing radiation, the ability to obtain direct sagittal and coronal images, the ability to obtain "portable" cribside images without affecting the life-support systems of critically ill patients, the improved resolution available with the newer equipment, and the fact that these sonographic examinations can be performed profitably for a fraction of the cost of CT or MRI suggest that sonography will likely become the primary imaging technique for diagnosis and follow-up of most neonatal and infant intracranial neuropathology.

Intraoperative (Cranial or Spinal)

This application of sonography is still so new that most centers have not yet defined responsibility for performing these studies. Since intraoperative localization of lesions by sonography represents only a "fine-tuning" of the traditional localization process begun preoperatively by neuroradiologists, logic and efficiency dictate that this procedure be performed by neuroradiologists who are already familiar with the patient and his preoperative workup.

Increasing use of sonography in the operating room is inevitable. The value of the technique has been proved beyond question. Despite this, many neuroradiologists appear reluctant to assume responsibility for intraoperative studies because of the long, unpredictable hours during which surgery is performed and because their direct personal involvement with the study will keep them from other work. Nonetheless, if neuroradiologists do not assume the obligation, others will, be they surgeons or sonographers. We believe it is detrimental to the specialty of neuroradiology to have a situation in which the surgeon, who needs assistance in the operating room, calls upon nonneuroradiologists for this help. Successful involvement in intraoperative sonography will require flexible planning and acceptance by all staff neuroradiologists, so that, on any given day, one of their number will have as his first priority availability to the operating room. We believe that the rapport established with the neurosurgeon, the increased understanding of neuropathology gained from seeing lesions in situ, the improved knowledge of surgical procedures and problems, and the satisfaction of participating in the therapeutic effort will repay the inconveniences.

One could ask, why not let the surgeons control and perform intraoperative sonography, thus avoiding the scheduling difficulties, after-hours examinations, and unpredictable time commitments. In answer, we believe the patient will benefit by having an impartial third party (the neuroradiologist) monitor and discuss with the surgeon the progress of the surgical procedure.

Orbital

At present, orbital sonography is performed predominantly by ophthalmologists for evaluation of intraocular pathology and, less often, for evaluating extraocular intraorbital pathology. In view of its limited appeal to neuroradiologists (tables 1–3) and its predominant application to diseases of the globe, orbital sonography will likely remain the province of the ophthalmologists. As a result, the role of neuroradiology will probably remain correlative for CT, MRI, and other radiographic studies.

Recommendations

To encourage use of sonography for neurodiagnosis, we make five recommendations:

1. Training programs in neuroradiology make arrangements to ensure that graduating fellows achieve competence in neurosonography. To this end, one staff member familiar with sonography could be assigned responsibility for performance and teaching of neurosonography.

2. Neuroradiologists not performing sonography currently should establish liaison with the physicians who do sonography at their institution with a view toward conjoint education and provision of care.

3. Where possible, neuroradiology sections should obtain separate sonographic equipment to ease the potentially difficult logistics of coordinating physician availability, machine availability, and patient need, especially for intraoperative studies. As shown at our business meeting, such equipment should pay for itself.

4. Members of the ASNR who are involved with neurosonography should submit more of their work and clinical experience for presentation at the annual scientific meeting and for publication in the *American Journal of Neuroradiology*.

5. More technical exhibits of sonographic equipment should be solicited for display at the annual meeting of the ASNR. Because there is no need to protect against ionizing radiation, these exhibits should provide fully operational equipment and appropriate phantoms to give the members hands-on experience in the technical aspects of neurosonography. Studies recorded and explained on videotape should also be available for viewing.

Summary

Sonography is a necessary part of neuroradiology. Its relative importance will increase as the sonographic images improve and the funds provided for diagnostic imaging decrease. We urge the incorporation of neurosonographic training into our neuroradiology fellowship programs and more widespread use of sonography in neurodiagnosis.

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