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Intraoperative Spinal Sonography: Adjunct to Metrizamide CT in the Assessment and Surgical Decompression of Posttraumatic Spinal Cord Cysts

Robert M. Quencer[1]
Berta M. M. Morse[1]
Barth A. Green[2]
Frank J. Eismont[3]
Patricia Brost[1]

Ten patients with prior spinal cord trauma were examined preoperatively by metrizamide computed tomography (CT) and were studied subsequently by intraoperative spinal sonography. On comparing intraoperative sonography with metrizamide CT, it was found that metrizamide CT tends to overestimate the size and number of posttraumatic cysts, that areas of myelomalacia on metrizamide CT correspond to areas of abnormal echogenicity on intraoperative sonography, and that intracyst septations are seen only on intraoperative sonography. By monitoring the position of the shunting catheter during surgery, intraoperative sonography can assure its proper intramedullary placement and demonstrate the successful decompression of the cyst. If no cyst is found with intraoperative sonography, further surgery is obviated. Intraoperative sonography is recommended for all cases where decompression of cord cysts is planned.

With heightened clinical awareness of cysts of the spinal cord developing after trauma and the relative simplicity with which these cysts can be detected with metrizamide computed tomography (CT), it is likely that there will be an increasing number of operations to decompress these cysts. During surgery, we used real-time sonography to examine the spinal cords and spinal contents of 10 patients diagnosed by metrizamide CT or subsequently found by intraoperative spinal sonography to have posttraumatic spinal cord cysts. This report compares intraoperative spinal sonography (IOSS) with preoperative metrizamide CT and reveals some of the limitations of metrizamide CT in delineating precisely the morphologic abnormalities of the injured spinal cord. The usefulness of IOSS during decompression of these cysts commends its wider use.

Subjects and Methods

We studied the clinical features and preoperative metrizamide CT and IOSS findings of 10 spinal-cord-injured patients, all of whom were evaluated and had surgery during an 11 month period at the University of Miami/Jackson Memorial Medical Center and its Regional Spinal Cord Injury Center. The clinical information, including each patient's pre- and postoperative evaluation, is summarized in table 1.

In our 10 patients, the interval from original injury to presentation was 6 months to 16 years (average, 4.4 years). Seven patients had cervical injuries, two had thoracic injuries, and one (case 3) suffered no fracture or subluxation of the thoracic spine, but the mechanism of his injury and his subsequent neurologic deficit was such that we believe that the original injury was a thoracic cord contusion. Note was also made of the patient's age at injury, the original neurologic findings, and surgery (if any) at the time of injury. Increasing pain was the most common complaint at admission, while increasing weakness and spasticity were also frequent symptoms. Only in the two patients with gunshot wounds to the spine (cases 9 and 10) was progressive dysesthesia a presenting symptom.

Nine patients were studied preoperatively with metrizamide CT on a GE 8800 scanner. One patient (case 2) was studied with metrizamide CT at an outside hospital on a lower-resolution early-generation CT scanner. Delayed CT scans were obtained as closely as possible to 4 hr after metrizamide myelography. Consecutive 5 mm axial sections were

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[1] Department of Radiology (R 130), University of Miami School of Medicine, Jackson Memorial Medical Center, P.O. Box 016960, Miami, FL 33101. Address reprint requests to R. M. Quencer.

[2] Department of Neurological Surgery, University of Miami School of Medicine, Jackson Memorial Medical Center, Miami, FL 33101.

[3] Department of Orthopedic Surgery, University of Miami School of Medicine, Jackson Memorial Medical Center, Miami, FL 33101.

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TABLE 1: **Clinical Evaluation of Patients Undergoing Intraoperative Spinal Sonography**

Type of Injury: Case No. (age)	Location	Neurologic Findings	Initial Surgery	Years until Presentation	Presenting Symptoms	Months Follow-up after Surgery	Clinical Improvement? Comments
Fracture/subluxation:							
1 (23)	C4–C5	Complete quadriplegia	Posterior fusion C2–C6	3	Increasing neck pain and spasticity; respiratory distress on sitting	10	Yes. Cyst not shunted; only untethering of cord and myelotomy performed
2 (20)	C5–C6	Complete quadriplegia	None	6	Right arm pain and motor and sensory loss	4	No. Transient improvement only*
4 (27)	C4–C5	Complete quadriplegia	Anterior and posterior fusion	1	Increasing spasticity; hyperhidrosis	4	Yes. Minimal loss of posterior column function postoperatively
6 (20)	C5–C6	Complete quadriplegia	None	2	Increasing neck pain and spasticity; hyperhidrosis	9	Yes
7 (30)	C6–C7	Complete quadriplegia	Anterior fusion	1½	Increasing pain and sensory deficit in C8 distribution	2	Yes. Cyst not shunted†
8 (14)	C4–C5	Complete quadriplegia	Anterior fusion	10	Increasing spasticity and shoulder weakness; hyperhidrosis	1	No. No cysts seen with IOSS
No fracture/subluxation (presumed cord contusion):							
3 (50)	...	Incomplete paraplegia	None	16	Progressive weakness in both legs	5	Yes
Fracture:							
5 (29)	C7	Complete quadriplegia	C6–C7 laminectomy	1½	Increasing weakness in arms and legs	7	Yes. No cyst seen with IOSS†
Gunshot wound:							
9 (32)	T6	Complete paraplegia	None	2	Increasing back pain and spasticity in legs; dysesthesia	6	Yes
10 (29)	T5	Complete paraplegia	None	½	Increasing back pain and sensory loss in legs; dysesthesia	7	Yes

Note.—IOSS = intraoperative spinal sonography.

* A new type of narrow-diameter shunt catheter was used that probably obstructed after surgery, accounting for the transient improvement followed by return of original symptoms. Shunt revision with a wider catheter was planned.

† Clinical improvement was believed to be secondary to anterior decompression and fusion.

obtained through the areas of clinical interest. These images were studied for the presence of collections of metrizamide within the spinal cord. Intramedullary contrast collections that were dense and well defined were diagnosed as cysts. Intramedullary contrast collections that were poorly defined were diagnosed as myelomalacia because we believed that these collections represented metrizamide that had penetrated diffusely into the extracellular spaces of the spinal cord [1, 2], rather than having entered significant-sized cystic spaces [3]. When the diagnosis of a cord cyst was made, the number of cysts, their positions within the spinal cord, and the size of each cyst was determined.

Intraoperative sonography was performed with a 7.5 MHz transducer using the ATL Neurosector Scanner (Advanced Technology Labs., Bellevue, WA). In eight cases, IOSS was performed after a laminectomy, and viewing was obtained from the posterior surface of the dura and spinal cord. In two cases (cases 5 and 7), C7 corpectomy (removal of C7 vertebral body) was performed, and viewing was obtained from the anterior surface of the dura and spinal cord. After either the laminectomy or corpectomy, the operative field was filled with sterile saline to provide a water bath about 4 cm deep for through-transmission of the sound waves. Early in our use of IOSS, we wrapped the transducer in a sterile microscope drape;

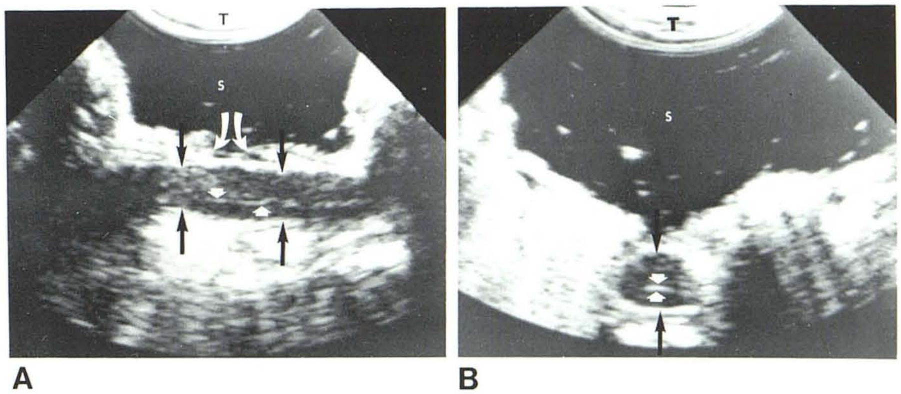
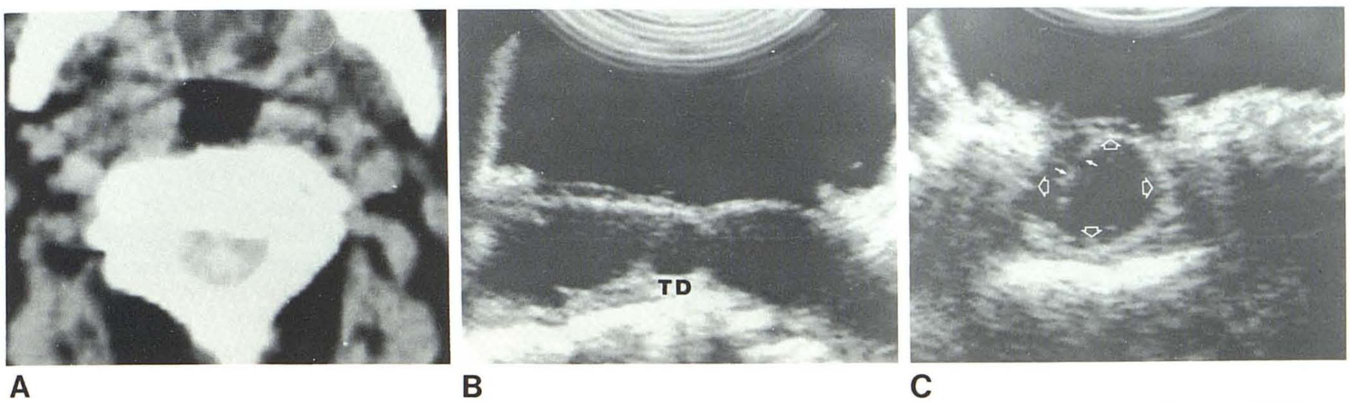


Fig. 1.—Normal spinal cord. Sagittal (**A**) and transverse (**B**) IOSS at C6–C7 from posterior aspect after laminectomy for intradural meningioma. Normal spinal cord (*black arrows*) has relatively uniform echogenicity and size. Linear echogenicity within cord is central canal (*short arrows*), which we have been unable to visualize in severely injured cords. Dura has been opened (*curved arrows*). Most high reflectivity dorsal and ventral to cord is Gelfoam, and consequently cord surface, normally seen as dense structure (cf. fig. 4C), is not seen well. The 7.5 MHz transducer (T) sits in sterile saline bath (S), which provides for acoustic through-transmission. In this and following sagittal IOSSs, cephalad is to reader's left; on transverse IOSS, right side of cord is on reader's right.



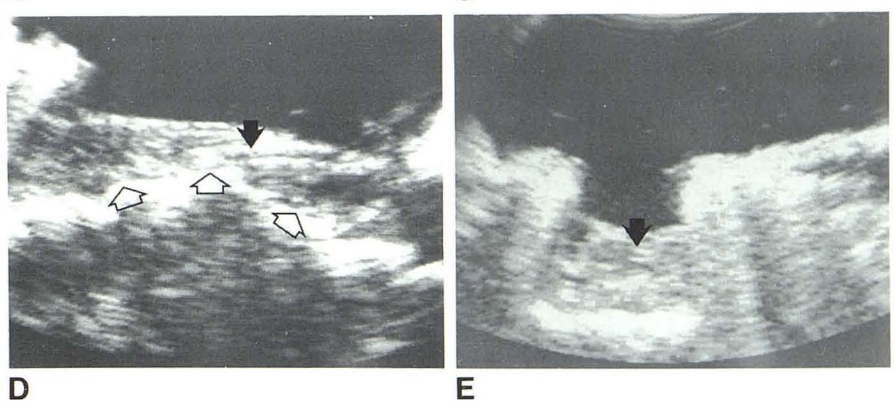


Fig. 2.—Case 2. Large posttraumatic spinal cord cyst. **A**, Metrizamide CT. Abnormal collection of metrizamide within center of spinal cord at C5 level was believed to represent cord cyst, the lower end of which extended inferiorly to T5. **B**, Initial sagittal IOSS at C4–C6 levels shows wide, dumbbell-shaped cyst with narrowing of cyst at C5, level of prior fracture/subluxation. Thickened dura (TD) was adherent to cord. **C**, Transverse IOSS. Outer borders of cyst (*open arrows*). Septations within cyst (*closed arrows*) divide cyst into larger right side and smaller left side components. Echogenicity of surrounding spinal cord could not be determined accurately because it was so thin. **D** and **E**, IOSS after catheter placement shows catheter (*closed arrows*) within cord and completely collapsed cyst. Posterior edges of vertebral bodies (*open arrows*) are seen well, as is marked kyphos of spine.

however, now we use a sterile scan head sheath of latex, which is available from ATL. A sterile gel is used to couple the transducer to the latex sheath. Longitudinal and transverse scans were obtained at two stages during the operation.

The first stage, "initial IOSS," occurred before surgically entering the dura. At this stage, information was obtained concerning the morphology of both the cyst and the spinal cord. As was done with metrizamide CT, we determined the number of cysts present, their position within the cord, and their size. Cysts were seen as well defined anechoic structures with no internal echoes. Intracyst septations, when present, were seen as thin echogenic structures within the anechoic areas. Spinal cord size at the level of the cyst was measured so that it could be compared with the resulting size of the cord after the cyst had been shunted. The presence or absence of adhesions surrounding the spinal cord at the level of the cyst was determined. Using the echogenicity of a normal spinal cord (fig. 1) as a reference, we determined if there were an abnormal echo pattern in each case.

The second stage, "monitored surgery by IOSS," occurred after the anatomic features of the cyst and spinal cord had been identified by the initial sonography. Sonography was used in four cases (cases 3, 4, 6, and 9) to show the place on the dorsal surface of the spinal cord where a myelotomy should be performed to reach the cyst most directly. In case 2, it was not necessary to indicate a place on the surface of the cord for the myelotomy because the cyst was so large (figs. 2B and 2C) that, after removal of the thickened dura, the cyst could be seen by the naked eye directly below the pial surface. After passing the shunting catheter through the dorsal part of the spinal cord, IOSS was used in five cases of cord cysts to confirm the proper position within the cyst. Intraoperative sonography also confirmed

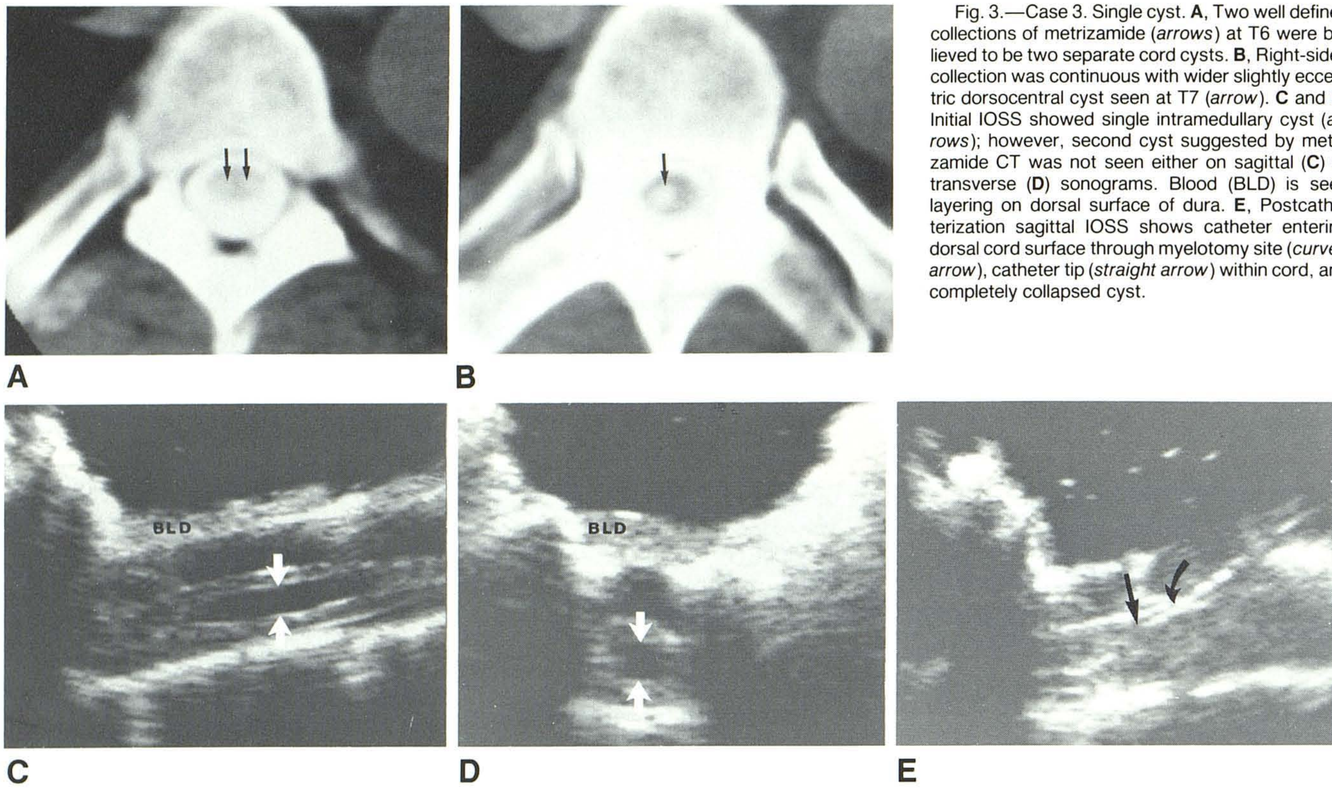
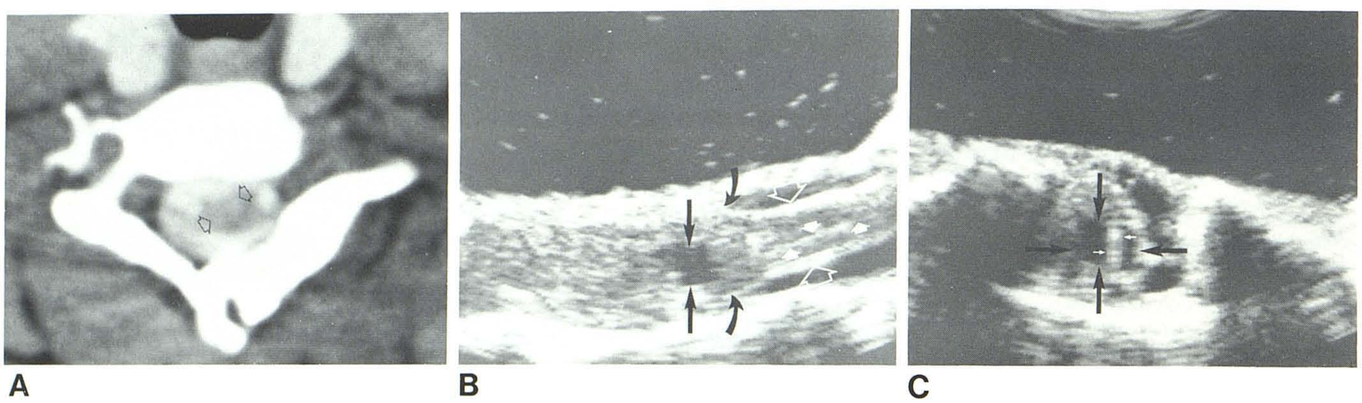


Fig. 3.—Case 3. Single cyst. **A**, Two well defined collections of metrizamide (*arrows*) at T6 were believed to be two separate cord cysts. **B**, Right-sided collection was continuous with wider slightly eccentric dorsocentral cyst seen at T7 (*arrow*). **C** and **D**, Initial IOSS showed single intramedullary cyst (*arrows*); however, second cyst suggested by metrizamide CT was not seen either on sagittal (**C**) or transverse (**D**) sonograms. Blood (BLD) is seen layering on dorsal surface of dura. **E**, Postcatheterization sagittal IOSS shows catheter entering dorsal cord surface through myelotomy site (*curved arrow*), catheter tip (*straight arrow*) within cord, and completely collapsed cyst.



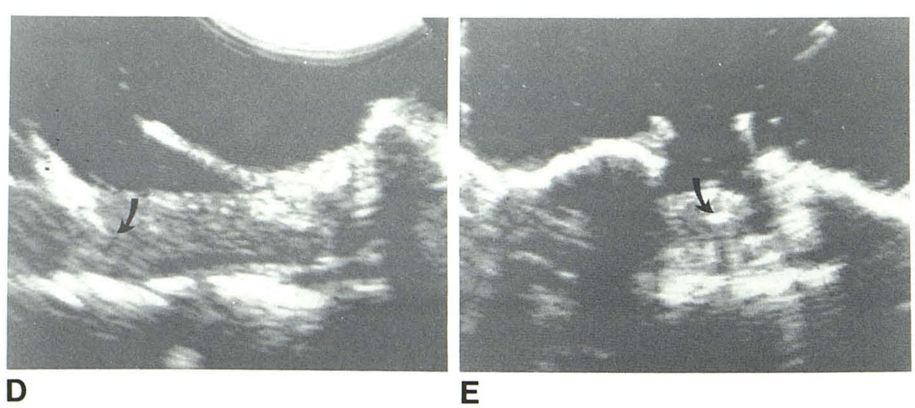


Fig. 4.—Case 4. Septated cyst. **A**, C6 level. Intramedullary collection of contrast material (*arrows*). Because we were unsure whether cyst was present, percutaneous spinal cord puncture was performed, which suggested intramedullary cyst. **B** and **C**, Initial IOSS showed central cyst (*straight black arrows*) with eccentric septation (*white arrows*, **C**). On sagittal IOSS (**B**) cord is adherent to thickened dura (*curved arrows*). Craniad to cyst in **B** there is abnormal echogenicity of cord, normal reflectivity of central canal has been lost, and normal highly reflective dorsal and ventral surfaces of cord are not seen; caudad to cyst cord appears normal with intact central canal (*closed white arrows*, **B**) and normal highly reflective surface of ventral and dorsal aspects of cord (*open arrows*). At surgery, intracyst septation in **C** was broken to create single cavity, and catheter was passed into cyst. **D** and **E**, Postcatheterization IOSS shows catheter (*curved arrows*) within cord and completely decompressed cyst.

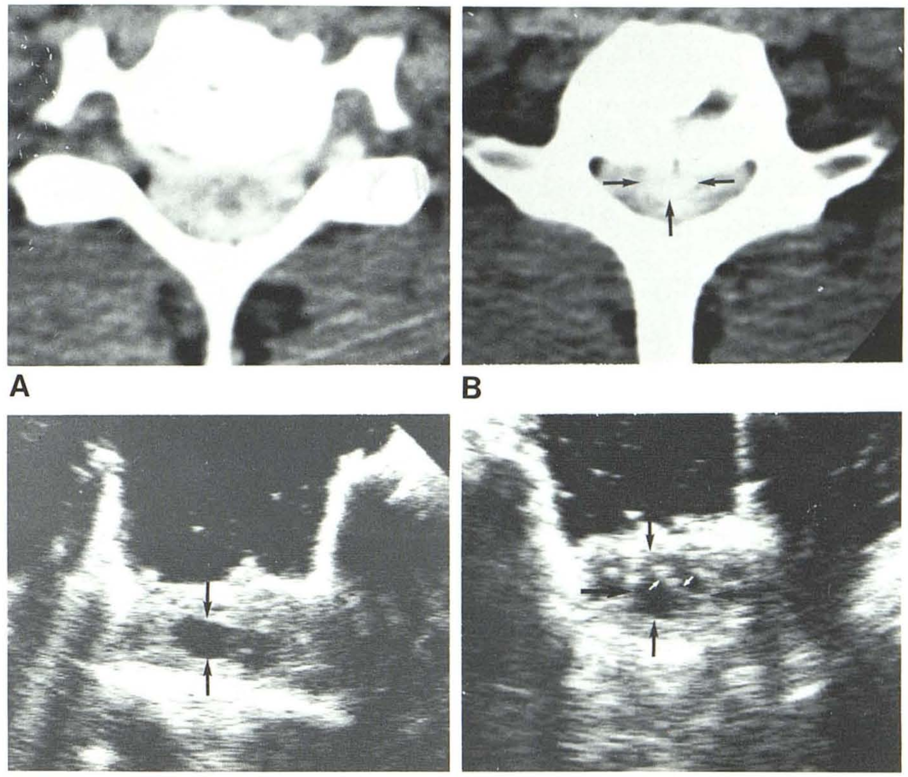


Fig. 5.—Case 7. Single cyst, anterior approach. **A**, At C5 level. Diffuse increased density in periphery of cord was interpreted as myelomalacia. Central part of cord appears less affected. **B**, At C7 level, with narrowing of canal by displaced bony fragments, contrast appears denser and better defined (*arrows*), compatible with cord cyst. To decompress spinal canal, a C7 corpectomy was done, and anterior IOSS (**C** and **D**) was performed. A cyst (*black arrows*) was septated (*white arrows*) into larger right and smaller left cavities. Abnormal echogenicity of cord above and below cyst and loss of normal reflectivity of central canal was noted. These findings correlated with poorly defined areas of increased contrast within cord seen on **A**. It was considered undesirable to pass catheter through ventral part of cord to reach cyst. Therefore, only anterior decompression and interbody fusion were performed.

the proper catheter position in one case (case 10) of a shunted posttraumatic subarachnoid cyst. In each case of shunted cyst, note was made of whether the catheter had successfully collapsed the cyst and whether the cord diminished in size after cyst decompression. In four cases (cases 1, 5, 7, and 8), intramedullary cyst shunt surgery was not performed.

In all cases except case 8, surgery occurred within 5 days after metrizamide CT. In case 8, surgery was performed 6 weeks after metrizamide CT. The surgical procedure for shunting the cyst was the same as we have described previously [4]. The surgical procedure used in the case of a shunted subarachnoid cyst (case 10) consisted of passing the catheter from the cyst to the subarachnoid space caudad to the cyst. In two cases (cases 5 and 7), only a C7 corpectomy and fusion were performed.

Observations

Preoperative Metrizamide CT Assessment

In six cases the diagnosis of a single cyst was made, in two cases the diagnosis of two separate cysts was made, and in one case no cyst was seen. In one case (case 10), a posttraumatic subarachnoid cyst was identified. In addition, areas of "myelomalacia" (e.g., fig. 5A) within the cord were diagnosed in nine cases. In case 2 we could not tell if, in addition to a cord cyst, myelomalacia was present because a lower-resolution scanner had been used. We were also unsure in one case (case 4) whether the area of increased density (figs. 4A and 4B) was a cyst or myelomalacia because of streaking from a posterior wire fusion. Percutaneous spinal cord puncture was performed in case 4 to resolve that question, and on this basis the diagnosis of a cord cyst was suggested.

As expected, the cysts were present at the site of original injury. The areas of abnormal contrast collection that we diagnosed as cysts were present in the dorsocentral (figs. 3B and 6A) parts of the cord. The cysts varied in length from 5 to 260 mm. When the size of the cord could be determined (eight of 10 cases) we found no instances of an enlarged spinal cord.

Intraoperative Spinal Sonography

Initial IOSS. In seven cases a single intramedullary cyst was found, in one case two cysts were found, and in two cases no cyst was seen. In only three cases did the number of cysts that we thought were present on metrizamide CT correspond to the number found on intraoperative sonography. Specifically, metrizamide CT overestimated the number of cysts in four cases and underestimated the number in two cases. The cysts were within the central and dorsal parts of the cord, and they varied in length from 3 mm to a cyst that extended beyond the field of view (greater than 78 mm). In comparing the estimated sizes of the cysts found with metrizamide CT versus the sizes found with IOSS, the cysts appeared longer on metrizamide CT than on sonography in three cases (cases 1, 3, and 9) and nearly equal in two cases (cases 6 and 7). In the other five cases, a comparison could not be made, either

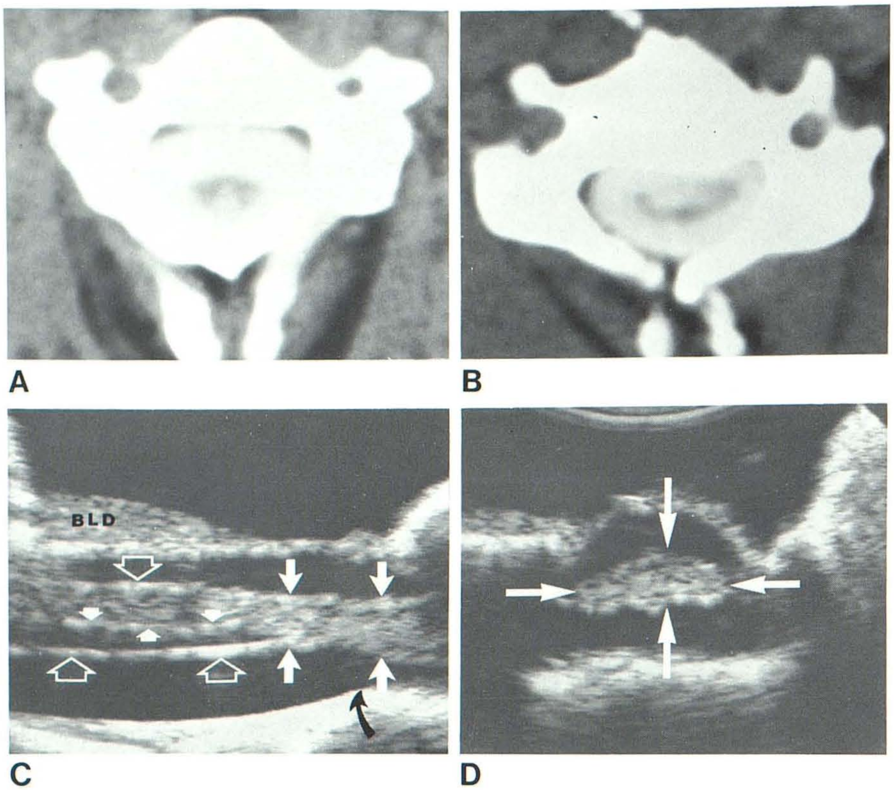


Fig. 6.—Case 8. Pseudocyst by metrizamide CT. Metrizamide CT at C4 (**A**) and C5 (**B**) levels show well defined and dense collection of contrast within spinal cord, which we believed was a single cyst. **C** and **D**, IOSS after C3–C5 laminectomy showed no intramedullary cyst, dural thickening, or adhesions to spinal cord. There was abnormal echogenicity of cord (*long white arrows*) and loss of normal reflectivity of central canal. Craniad to abnormal echogenicity, normal cord has intact central canal (*short closed arrows*) and normal highly reflective surface (*open arrows*). Blood (BLD) is along dura dorsally. Abnormal echogenicity is at level where there was greatest narrowing of canal by bony subluxation (*curved arrow*). Because no cyst was identified on IOSS, no further surgery was performed.

because of cysts extending beyond the sonographic field (case 2), artifacts obscuring the metrizamide CT features (case 4), no cysts being found with intraoperative sonography (cases 5 and 8), or no cysts being found with metrizamide CT (case 10). Septations were identified within three cord cysts (fig. 4D) and one arachnoid cyst (fig. 7D). Adhesions of the spinal cord to thickened dura at the site of injury were seen in seven cases. There was abnormal spinal cord echogenicity in nine cases. Only in case 2 was there an insufficient amount of cord tissue around the cyst (fig. 2C) to make a determination of its echogenicity. In all cases of abnormal echogenicity there was an associated loss of the normal reflectivity of both the central canal and the dorsal and ventral cord surfaces.

Monitored surgery by IOSS. In five cases, intraoperative sonography was used to confirm the proper position of the shunting catheter within a cord cyst, and, in one case (fig. 7E), sonography confirmed the catheter's position within an arachnoid cyst. The recognition of intracyst septations on initial sonography was important because during surgery the septations were intentionally broken to create a larger single cavity that was shunted more easily (case 4). Likewise, the demonstration of two separate cysts separated by a small amount of abnormal cord tissue persuaded the surgeon to remove the abnormal tissue in order to create a single larger cavity (case 6). Cyst collapse was demonstrated by intraoperative sonography in every case after catheter placement, which further attested to the proper position of the shunt within the cyst (fig. 4E). In case 9, both the cord cyst and arachnoid cyst collapsed after placement of the shunt in the cord cyst. This indicated to us the probability that a fistulous connection between the two cysts existed as a result of the gunshot wound to that area. A significant diminution of the spinal cord after cyst decompression was seen in the two cases (cases 2 and 4) where the cord cysts were the widest. No significant decrease in cord size after shunting was seen in case 3, 6, or 9.

Postoperative Clinical Evaluation

Of the eight patients with intramedullary or subarachnoid cysts, six underwent surgery aimed at directly decompressing those cysts via an indwelling shunting catheter. There was clinical improvement in five of those six patients. In the one patient (case 2) who showed no clinical improvement, a new type of catheter was used, and it was believed that the catheter probably obstructed in the early postoperative period. Despite the fact that no shunting procedure was performed in case 1, there was clinical improvement, which was believed to be the result of lysis of adhesions around the cord and a dorsal myelotomy, which may have helped to drain the small intramedullary cyst. Both cases 5 and 7 improved after anterior cervical decompression and interbody fusion. One patient (case 8) in whom no cyst was seen with intraoperative sonography showed no improvement after a cervical laminectomy. In these 10 patients, the length of time from surgery to our most recent evaluation was 1–10 months. Close clinical

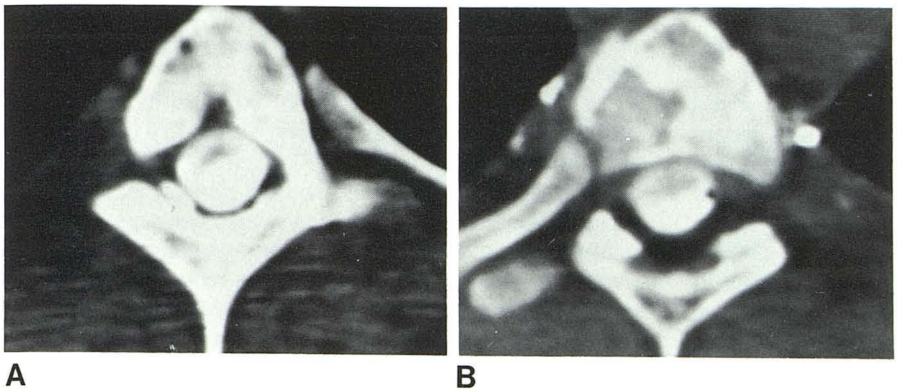


Fig. 7.—Case 10. Arachnoid cyst after gunshot wound at T5. **A** and **B**, Dorsal extramedullary collection of contrast representing subarachnoid cyst deforms spinal cord and pushes it anteriorly. No separate dense collection of contrast within cord was seen, but poorly defined increased intramedullary density best appreciated in **B** was consistent with myelomalacia. **C**, Sagittal IOSS. Arachnoid cyst (*arrows*) compresses dorsal part of spinal cord; on more cephalad scans (not shown) a small unsuspected intramedullary cyst was identified. **D**, Transverse IOSS through level of maximum cord compression (x) shows arachnoid cyst (*black arrows*) within which septations were seen (*white arrows*). **E**, After placement of catheter (*arrows*) arachnoid cyst partly collapsed and mass effect on adjacent spinal cord lessened.

follow-up of our patient population will allow us to determine the long-term results of these surgical procedures.

Discussion

The use of intraoperative sonography for detection, characterization, and needle biopsy of intracranial lesions has been the subject of a number of recent reports [5–8]. However, the use of sonography during spinal surgery has received virtually no attention. The only works on this subject have been a presentation on the techniques and usefulness of IOSS [9] and a brief communication on the intraoperative evaluation of intradural extramedullary masses [10]. We believe this is the first description of intramedullary masses evaluated at surgery with IOSS.

Outside the operating room, the spinal contents have defied sonographic imaging because of the sound impedance of the surrounding bone. Only with a wide laminectomy in a postoperative patient [11] or in a dysraphic spine [12, 13] have the spinal contents been adequately imaged with sonography. Since a real-time sonographic unit became available to us 10 months ago, we have been able to evaluate its usefulness in spinal surgery and to compare the information thus obtained with the more conventional radiologic imaging techniques, particularly metrizamide CT. The large number of previously spine-injured patients who have been clinically and radiologically evaluated at our Regional Spinal Cord Injury Center has given us the opportunity to determine the roles of IOSS and metrizamide CT in the assessment and operative treatment of spinal cord cysts.

The 10 patients described here had original injuries and neurologic symptoms similar to the group of 16 patients that we reported with posttraumatic spinal cord cysts [4]. We find it distressing that two patients (cases 5 and 8) had symptoms that we believed indicated a cord cyst but were shown subsequently by intraoperative sonography to have no cyst. Case 3 was also unusual since there was no spinal fracture or subluxation but rather a severe flexion-extension injury of the lower thoracic spine. The resulting cord contusion caused an initial incomplete paraplegia. In our group of patients, pain was the dominant symptom, and it was usually seen in conjunction with other complaints, the most common of which were increasing spasticity and weakness. It is noteworthy that dysesthesia was present only in those patients with bullet fragments in the spine.

In comparing metrizamide CT with IOSS, we found that cysts were present in the dorsocentral parts of the cord. We attributed this finding to the fact that the dorsal gray matter is the most richly vascular area within the cord [14] and, therefore, most susceptible to the formation of a hematomyelia. It is also an area where cysts can most easily expand because of the presence of a loose connective tissue stroma [15, 16]. In the nine cases where spinal cord size could be measured with high-resolution metrizamide CT, there was no evidence of cord enlargement. This reemphasizes the fact that non-water-soluble myelographic contrast agents will not, in most cases, be able to detect intramedullary cysts, since cord enlargement is an unusual occurrence in these types of cysts. Using a water-soluble agent, such as metrizamide, with delayed CT is the only reliable way to make the diagnosis.

An important feature of this study was the comparison between metrizamide CT and IOSS relative to the numbers and sizes of cysts. Even though on metrizamide CT we believed that areas of poorly defined intramedullary contrast probably represented myelomalacic cord tissue and not a cyst, there were cases where we diagnosed well defined areas of intramedullary contrast as cysts that turned out to be only zones of abnormal echogenicity on sonography (e.g., fig. 6). Although these zones were not explored, we are confident they do not represent cysts. Thus, metrizamide CT resulted in overestimation of the size of each cyst in three cases and overestimation of the number of cysts in four cases. In only two cases (cases 6 and 10) were there more cysts on intraoperative sonography than there appeared to be on metrizamide CT. It is clear that not all areas of intramedullary contrast represent cysts, even if they are well defined. Because of this, symptoms compatible with an expanding intramedullary cyst should be present before a decision to operate is made [4].

The abnormal spinal cord echogenicity seen in nine of our patients probably relates to the varying amounts of scar tissue and multiple vacuoles or microcysts that have been described in previously traumatized spinal cords [17]. We believe that this deranged morphology produces many acoustic interfaces, absence of the normal reflectivity of the central canal, and loss of the relatively high reflectivity of spinal cord surfaces. Because we have no proof at this time that abnormal penetration of metrizamide into an injured cord and abnormal echogenicity are related to such histologic changes described above, we are currently performing animal studies to examine this point.

Intracyst septations could be seen with IOSS only. When these septations occur in intramedullary cysts they are probably fibrous or glial scars [17], and when they occur in subarachnoid cysts they are probably fibrous scars. Recognition of these septations is important because the catheter may drain only some of the locules unless the septations are broken. In case 4 the intracyst septations were broken to create a larger single cyst that could then be shunted more efficiently. The value of IOSS was demonstrated even further when we discovered a subarachnoid cyst when only a spinal cord cyst was suspected by metrizamide CT (case 9) and discovered a spinal cord cyst when only a subarachnoid cyst was suspected by metrizamide CT (case 10).

After initial IOSS, the ensuing surgery was monitored by sonography, allowing us to determine the optimal place on the surface of the cord for myelotomy so we could reach the cyst with minimal cord dissection. In five cases of cord cyst and in one case of arachnoid cyst, intraoperative sonography confirmed the catheter's final position within the cyst. In every case, proper placement of the shunt resulted in collapse of the cord cyst (five cases) and/or the arachnoid cyst (two cases). Diminution in cord size after shunting of the cord cyst occurred in the two cases where the cysts were largest (cases 2 and 4). Of equal importance was the absence of a cord cyst on intraoperative sonography when one was suspected on metrizamide CT (cases 5 and 8). This obviated myelotomy and cord dissection to locate the cyst.

Postoperative evaluations of our 10 patients have ranged from 1 to 10 months after surgery. Of the five patients who had cord cyst shunt surgery, four (cases 3, 4, 6, and 9) had improvement in all of their presenting symptoms. The failure of cyst surgery in one patient (case 2) is believed to be from obstruction of the narrower catheter, and shunt revision with a wider catheter is planned. It is interesting to note that in three patients (cases 1, 5, and 7) who had no shunts there was clinical improvement. In cases 5 and 7 this was probably because of the anterior spinal decompression and interbody fusion. In case 1, the reasons for improvement are less clear but are probably related to lysis of adhesions with the subsequently improved cerebrospinal-fluid dynamics, along with a small myelotomy, which may have served to decompress the small cyst. The one patient (case 10) with a shunted arachnoid cyst improved postoperatively. The only surgical complication was a minimal loss of posterior column function in case 4. These surgical results are comparable to the results of the 12 shunted patients we reported previously [4], of which 11 had clinical improvement. We believe the potential benefits of reversing the effects of a gradually enlarging cord cyst outweigh the risks of surgery.

In conclusion, our experience with IOSS shows it is valuable in the surgical management of posttraumatic spinal cord cysts. It gives a more accurate indication of the number, size, and location of the cysts than does metrizamide CT. As a result, a precisely positioned myelotomy can be performed. Intracyst septations may be detected. These septations can be broken to create a single larger cyst, making it more amenable to shunting. No cyst may be found with intraoperative sonography, even though a well defined collection of contrast material consistent with a cord cyst may have been seen on metrizamide CT. This may save the patient from unnecessary spinal cord dissection. The proper positioning of the shunting catheter within the cyst and the subsequent collapse of the cyst can be assured before surgical closing. On the basis of our experience, we recommend that IOSS become an integral part of every surgical procedure undertaken to decompress posttraumatic spinal cord cysts.

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