

Dorsal Brain Stem Lipomas: Case Report

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INTRACRANIAL LIPOMAS ARE uncommon and rarely symptomatic lesions accounting for 0.06 to 0.46% of intracranial lesions. The management of symptomatic dorsal brain stem lipomas was once limited to cerebrospinal fluid diversion, but with recent advances in microsurgery, they now may be directly treated. We report three patients with dorsal brain stem lipomas, two of which involved the quadrigeminal cistern and one of which was in the cisterna magna region. Antenatal documentation by ultrasound examination in one patient represents the first reported in utero diagnosis of quadrigeminal cistern lipoma. Computed tomographic and magnetic resonance imaging scans were diagnostic. The surgical experience in two symptomatic patients is discussed. Microsurgical decompression was performed in each without neurological deficit, and clinical symptoms postoperatively subsided. No patient required a permanent cerebrospinal fluid shunt. The management of symptomatic dorsal brain stem lipomas is discussed, and an algorithm is proposed. (Neurosurgery 38:1031-1035, 1996)

Key words: Brain stem, Cisterna magna, Intracranial lipoma, Magnetic resonance imaging, Quadrigeminal cistern, Ultrasound

Intracranial lipomas (ICLs) are uncommon benign lesions of the central nervous system. Their diagnosis was once limited to incidental necropsy findings or infrequent incidental radiographic diagnosis. Recent advances in neuroimaging have made antemortem diagnosis possible in many patients. At post mortem, Vonderache and Niemer (27) found four cases of ICL among 5500 autopsies (0.08%), whereas Budka (2) reported nine cases among 1956 selected neuropathological autopsies (0.46%). The clinical incidence detected by computed tomographic (CT) scans was almost identical. Faerber and Wolpert (5) reported five cases diagnosed by CT scan among 6125 patients (0.08%). In a large series, Kazner et al. (12) reported 11 ICLs (0.06%) among 17,500 patients studied by CT scan, an incidence among 3,200 patients with intracranial tumors of 0.34%. Maiuri et al. (16), in 1988, re-

viewed 203 cases from the literature and found that ICLs were most commonly found in the corpus callosum (64%). The quadrigeminal or ambient cisterns (13%) and the infundibular-chiasmatic region (13%) were the second most common sites of occurrence, and the cerebellopontine angle (0.06%) and the sylvian fissure (0.03%) were the third and fourth most common, respectively (16). Among lipomas in these locations, however, cerebellopontine angle lipomas were the most symptomatic (80%) and callosal and sylvian fissure lipomas (50% each) and quadrigeminal or ambient cistern lipomas (20%) were the next most symptomatic. Infundibular-chiasmatic lesions were usually asymptomatic. Whether symptoms were related to the lipoma per se or to the coexisting congenital malformations is not clear (16). Dorsal brain stem lipomas (DBSLs) are the second most common ICLs (13-26%)

after callosal lipomas and usually are not associated with congenital malformations (25, 26, 29).

Lipomas are rarely seen in the medulla, the pons, the choroid plexus, or the brain convexities (2, 3, 10, 12, 16, 19). ICLs are known to adhere to adjacent neural tissue and often encase the surrounding cranial nerves and blood vessels, making complete excision almost impossible without permanent brain damage (3, 7, 10, 16, 17, 20).

We report the cases of three children with DBSLs. An asymptomatic female child was diagnosed in utero as having quadrigeminal cistern lipoma (QCL) and is still receiving conservative follow-up. Two children with symptomatic lipomas of the quadrigeminal cistern and the cisterna magna, respectively, underwent microsurgical decompression. Their presenting symptoms resolved, and the hydrocephalus present in one has arrested.

CASE REPORTS

Patient 1

A 15-year-old female child presented with a long history of bifrontal headaches, occurring since the age of 7 years. Her headaches, initially interpreted as migraine, were well controlled with mild analgesics for many years, but during the start of puberty, they increased in frequency and intensity and became associated with nausea, vomiting, and double vision. The results of physical and neurological examinations were normal. As an outpatient, she underwent a CT scan, which revealed a 15 × 20-mm hypodense lesion in the quadrigeminal cistern that did not enhance after contrast injection and a mild triventricular dilatation suggestive of obstructive hydrocephalus. Magnetic resonance (MR) images (Fig. 1A) revealed a 15 × 15 × 20-mm homogeneous lesion in the left quadrigeminal plate compressing the left colliculi without definite aqueductal obstruction. The lesion was hyperintense on T1-weighted images and hypointense on T2-weighted images. There was no enhancement with gadolinium-diethylene

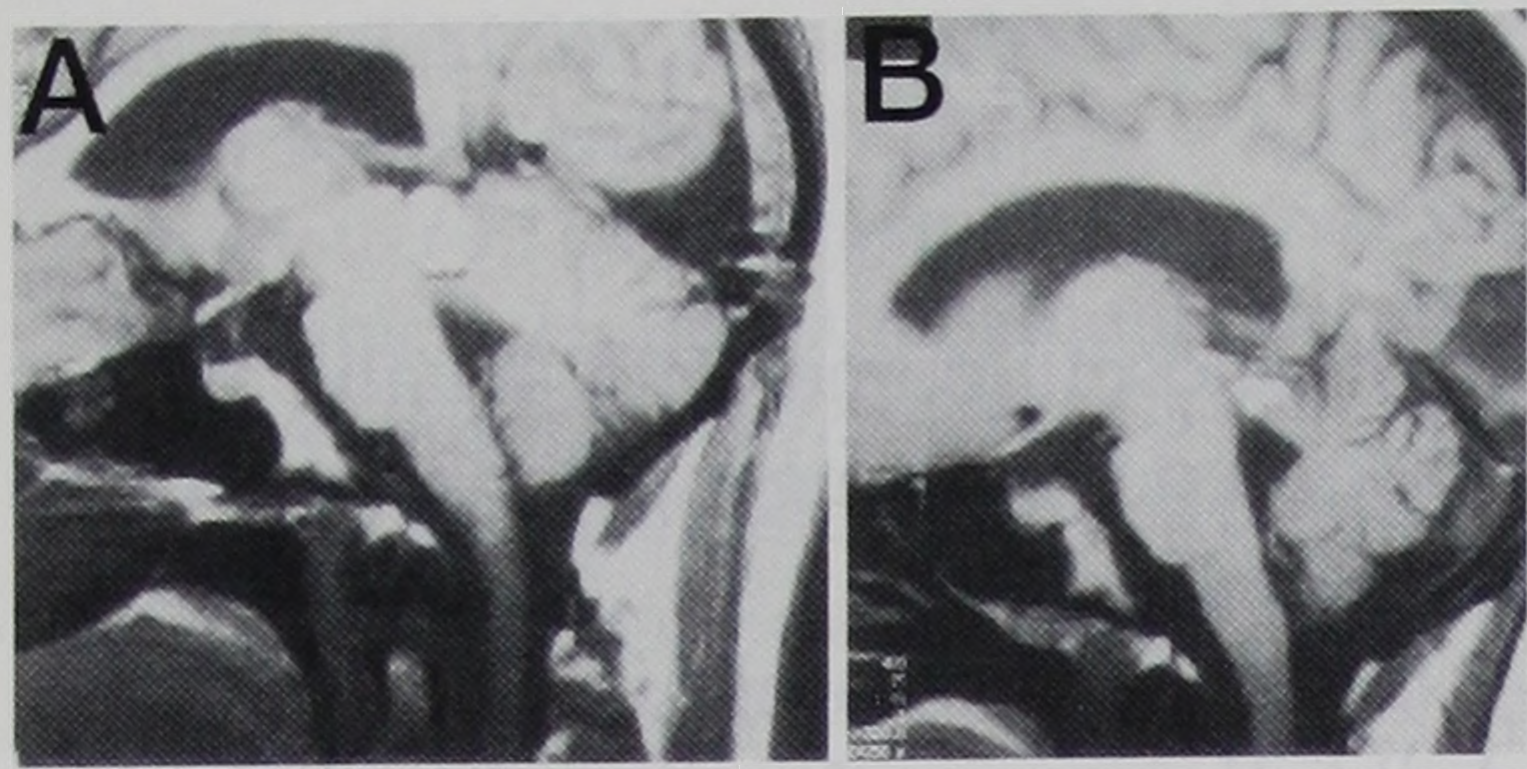


FIGURE 1. Patient 1. A, sagittal MR T1-weighted image demonstrating a 15 × 20-mm QCL compressing the collicular plate and the cerebral aqueduct. The third ventricle is enlarged. B, postoperative sagittal MR T1-weighted image showing an unchanged lipoma remnant after subtotal excision over 5 years of follow-up.

triamine penta-acetic acid administration. Brain stem auditory evoked responses (BAERs) were slightly prolonged, mainly on the left side. Somatosensory evoked potentials (SSEPs) were within normal limits. In January 1990, through a left occipital transtentorial approach, a yellow encapsulated lesion, which proved to be adherent to the superior colliculus, was subtotally excised. The lipoma was not adherent to the left trochlear nerve or the superior cerebellar arteries. Complete excision was then considered to be impossible without irreversible neurological injury. No shunt was required. A right homonymous hemianopsia was detected during the early postoperative period. A postoperative CT scan at 2 weeks showed residual lipoma but no progression of the hydrocephalus. Histological examination confirmed the radiological and surgical diagnosis of lipoma. The patient was discharged on the 15th postoperative day with normal BAERs. Her visual field defect completely recovered after 4 weeks, and she has since remained neurologically intact. MR imaging (Fig. 1B) showed no change in the size of the residual lipoma or in the ventricular size over a 5-year period.

Patient 2

A 14-year-old female patient presented with a history of progressive occipital headache, unsteadiness, nausea and vomiting, and blurred vision, which had continued for several weeks. Physical examination revealed a soft, nontender midcervical mass. Neurological examination revealed mild truncal

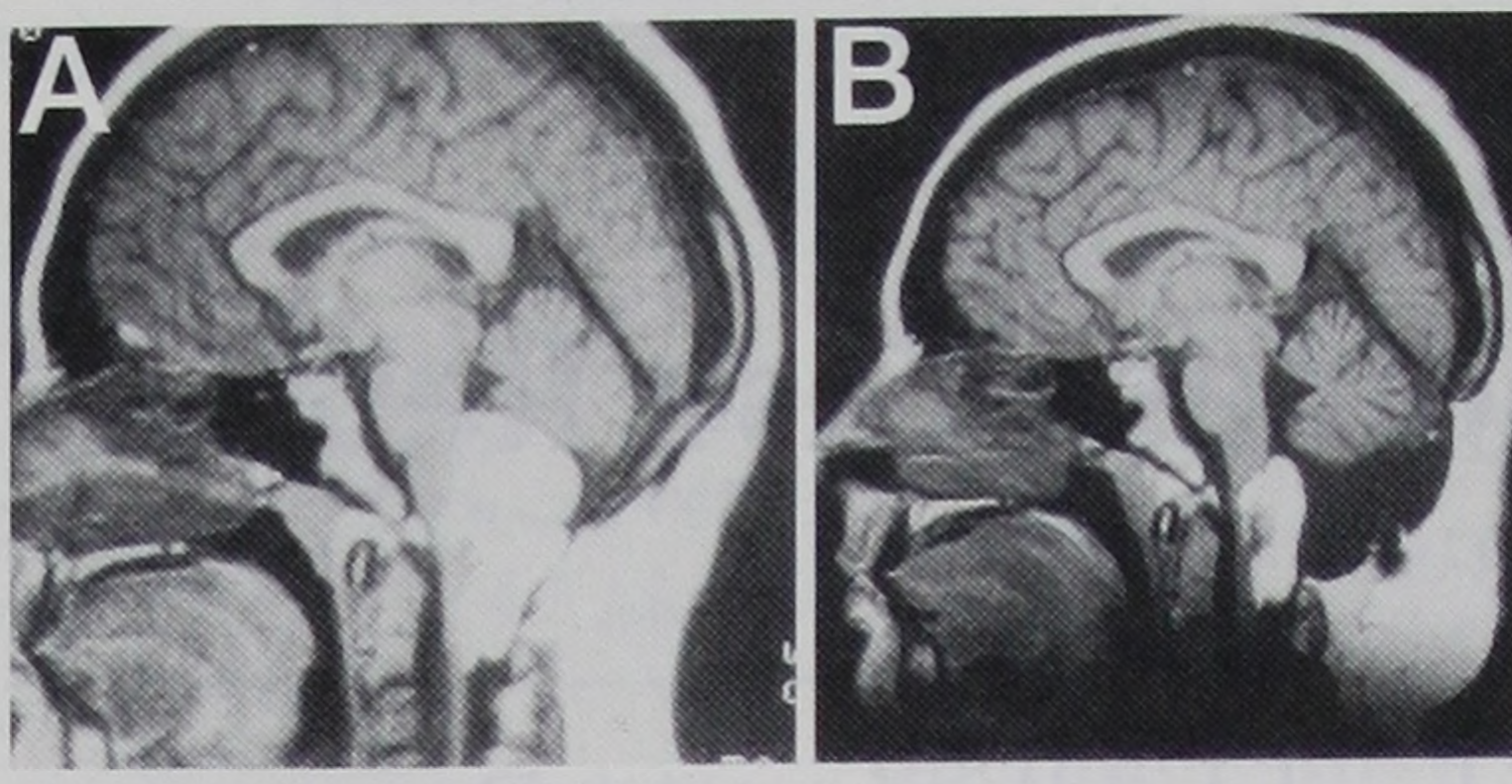


FIGURE 2. Patient 2. A, sagittal MR T1-weighted image revealing a 65 × 45-mm cisterna magna lipoma encasing and compressing the inferior pons and medulla with extension through the foramen magnum. B, postoperative sagittal MR T1-weighted image demonstrating residual lipoma after microsurgical decompression. The lipoma has not changed over 5 years of follow-up.

ataxia and downbeating nystagmus. A CT scan showed a large extra-axial lesion in the cisterna magna region, which appeared to be hypodense and did not enhance after contrast administration. There was no associated hydrocephalus. The subcutaneous mass measured 35 × 30 mm and appeared to be of the same radiological density as the intracranial lesion. A spina bifida of the C1 vertebra was seen on bone windows. Sagittal T1-weighted MR images (Fig. 2A) showed a 65 × 45 × 40-mm homogeneous high signal intensity lesion extending from the fourth ventricle to the level of the C1 vertebra, compressing the medulla and anteriorly displacing the cervicomedullary junction. This lesion was hypointense on T2-weighted images. There was no anatomic relationship between the subcutaneous and the intracranial lesions. BAERs and SSEPs were significantly bilaterally delayed. Surgical resection was performed in July 1990 through a midline suboccipital craniectomy with C1 laminectomy and initially consisted of partial excision of the subcutaneous lipoma. The dura was slightly tense and, once opened, revealed a large yellow capsulated tumor enveloped by arachnoid membrane containing prominent blood vessels. Subtotal microsurgical resection was performed with the use of an ultrasonic aspirator with concurrent shrinkage using bipolar coagulation. The tumor encased the left lower cranial nerves (IXth, Xth, and XIth cranial nerves) and the posterior inferior cerebellar arteries,

which were left intact without injury. A portion of the tumor tightly adherent to the floor of the fourth ventricle was left undisturbed. Because this mass was tenaciously adherent to the medulla oblongata and lower cranial nerves, radical excision was considered to be hazardous. Subsequent watertight dural closure required a cadaveric dural graft. The postoperative course of the patient was uneventful, and she was discharged on the 8th postoperative day after remarkable improvement of her preoperative neurological symptoms. Histological examination confirmed the diagnosis of lipoma. Postoperative SSEPs and BAERs became normal. Serial MR imaging (Fig. 2B) showed a stable lipoma remnant during 5 years of symptom-free follow-up.

Patient 3

During routine prenatal ultrasound at 36 weeks gestation, a dorsal brain stem mass was identified in an otherwise normal fetus (Fig. 3, A and B). The pregnancy continued to term without incident, and at birth, this female baby was normal. Cranial ultrasound on the 2nd day of life demonstrated a quadrigeminal cistern mass suggestive of lipoma (Fig. 3, C and D). Her head circumference was 37 cm (75th percentile for age). The anterior fontanel was soft and sunken in erect position. She was neurologically intact. A CT scan showed a hypodense nonenhancing 10 × 12-mm lesion in the quadrigeminal cistern. MR imaging (Fig. 3, E and F) showed a 14 × 10 × 10-mm lesion (hyperintense T1- and hypointense T2-weighted images), which filled the quadrigeminal cistern at the left superior colliculus and produced mild focal compression of the midbrain without obstruction of cerebrospinal fluid pathways, consistent with lipoma. SSEPs and BAERs were normal. During clinical follow-up and annual MR imaging (Fig. 3, E and F) over 3 years, this child remained neurologically intact and her lipoma remained asymptomatic despite a definite increase in size.

DISCUSSION

ICLs are benign lesions, neither hamartomas nor true neoplasms; rather,

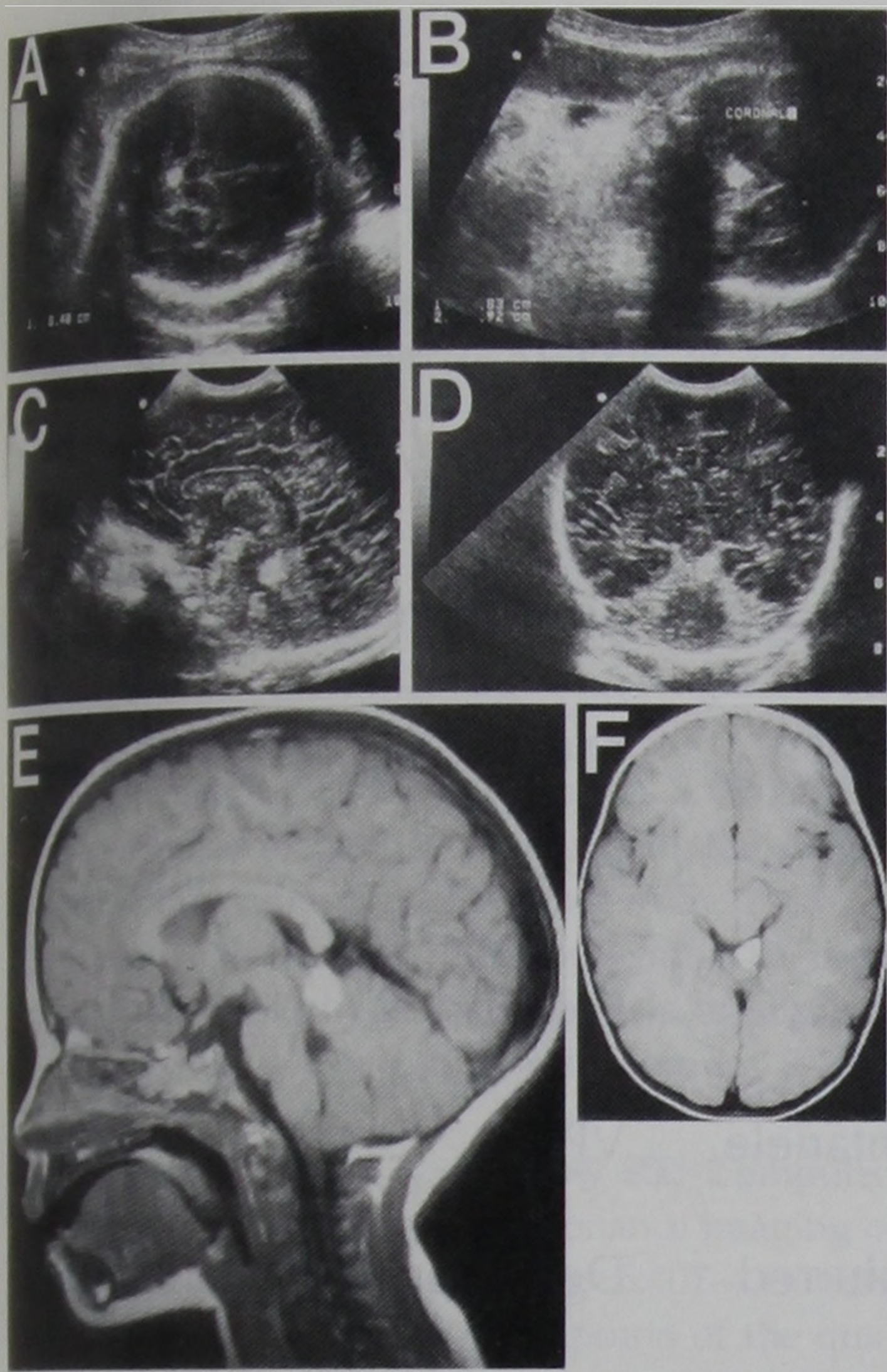


FIGURE 3. Patient 3. Transabdominal axial (A) and coronal (B) sonographic images of the fetal head, demonstrating an 8-mm dorsal brain stem hyperechoic mass. Sagittal (C) and axial (D) neonatal ultrasound images confirm a hyperechoic 8 × 10-mm mass near the tentorial incisura suggestive of DBSL. Sagittal (E) and axial (F) MR T1-weighted images obtained at age 3 years, demonstrating a 12 × 14-mm QCL; a comparison with postnatal MR images demonstrates that the mass has enlarged.

they are congenital malformations and tend to arise near the midline (2, 12, 16, 17, 25). Numerous pathogenic theories have been described, including the following: 1) hypertrophy of preexisting meningeal fatty tissue; 2) origin from within the brain substance, lipomatous glioma; 3) transformation or metaplasia of meningeal connective tissue; 4) fatty degeneration of proliferated glia; 5) mesodermal inclusion within the lips of the closing neural tube (dysraphism theory); and 6) derivation from the embryological "meninx primitiva," a mesenchymal derivative of neural crest (25). The final theory has invalidated previous pathogenic theories, suggesting an abnormal, persistent focus of meninx primitiva differentiation into adipose tissue and maturation into a lipoma. It simply explains the cisternal location of ICLs, the intralésional location on blood vessels and cranial nerves, and the ab-

sence of other mesodermal derivatives, such as muscle and cartilage. However, it does not fully explain the common association of congenital malformations with callosal lipomas. The natural history of these lesions is unknown, but they may enlarge with time. In the posterior fossa, they occur either in the dorsal midline, ventral to the brain stem, or in the cerebellopontine angle.

DBSLs include those residing in the quadrigeminal or ambient cisterns, in the superior vermis and superior medullary velum, and in the cisterna magna over the medulla oblongata. Ventral brain stem lipomas and those arising in the upper cervical spinal cord extending to the posterior fossa (18, 25, 28) are not included here. Among numerous ICLs, more than 60 lesions arose in the dorsal brain stem (1-3, 5-17, 19-27, 29, 30). Only three lipomas were found in the cisterna magna, including one autopsy finding, one incidental CT scan finding, and one, which produced neck pain and truncal ataxia, treated successfully with subtotal resection (2, 3, 16). The remaining lesions were predominantly located in the quadrigeminal region. The diagnosis was established by necropsy in 21 patients and after neuroimaging in the rest. In contrast to supratentorial lipomas, many reported DBSLs were symptomatic, either because of direct brain stem and cerebellar compression or distortion of the cerebral aqueduct (3, 6, 7, 9, 11, 12, 16, 17, 21, 24, 26). DBSLs producing direct brain stem or cerebellar compression clinically present as focal mass lesions with ocular apraxia, diplopia, hemianesthesia, ataxia, and/or headache (3, 12, 16, 21, 26). Lipomas disturbing the flow of cerebrospinal fluid through the cerebral aqueduct produce symptoms of increased intracranial pressure secondary to obstructive hydrocephalus (1, 6, 7, 9, 11, 12, 17). Occasionally, DBSLs present coincident to seizure disorders, dementia, and mental retardation, suggesting they may be epiphenomena of a coexisting congenital malformation (9, 13, 16, 25, 26).

The CT and MR imaging scan characteristics of DBSLs are pathognomonic and allow a confident diagnosis without biopsy confirmation. On CT scans, lipomas are hypodense sharply demarcated

lesions with attenuation values of -50 to -100 Hounsfield units, lack contrast enhancement, and may have occasional rim calcifications (6, 12, 15). On MR imaging, ICLs shorten T1 and T2 relaxation times, thus yielding hyperintense homogeneous signal in T1-weighted images and hypointense signal in T2-weighted images (6, 25, 26). Attention to precise neuroimaging criteria allows differentiation of ICLs from other mass lesions. Dermoid and epidermoid cysts have higher attenuation values and are less homogeneous. Teratomas are heterogeneous lesions that may enhance with contrast. Myelolipomas and angioliipomas typically show intense enhancement after contrast administration. ICLs, histologically, are well-circumscribed masses surrounded by a thin fibrous capsule and, classically, are composed of mature adipose cells separated by thin, delicate fibrous septa (3).

The antenatal diagnoses of a QCL (Patient 3), a pontine lipoma (29), and three lipomas of the corpus callosum (4, 19) strongly support the concept that ICLs are congenital lesions. Controversy regarding the natural history of ICLs persists, including whether, at what rate, and in which patients they grow. The relatively high incidence of symptomatic neural compression in DBSLs, especially in adolescents and adults, suggests that some lipomas indeed grow. Additional evidence from our patients supports this hypothesis. Progressive symptoms over a long interval, as in our first adolescent patient, or the acute development of significant symptoms and signs in a previously asymptomatic patient, as in our second adolescent patient, indirectly suggest that ICLs do grow. Furthermore, the documentation of neurophysiological abnormalities and the prompt resolution of both the clinical and neurophysiological abnormalities in each of our patients after decompression argue that these DBSLs had indeed become pathological. Our young patient (Patient 3) has shown definite lipoma growth but, as yet, has developed no clinical symptoms. Unfortunately, no ICLs previously reported in the literature have been shown to increase in size or produce progressive symptoms after diagnosis or treat-

TABLE 1. Surgical Experience with Dorsal Brain Stem Lipomas^a

Series (Ref. No.)	Age/Sex	Location	Size (mm)	Symptoms/Signs	Surgery	Outcome
Kazner et al., 1980 (12)	36 yr/F	Quadrigeminal cistern	17 × 11	Headache	Excision	Improved
Friedman et al., 1986 (6)	63 yr/M	Superior medullary velum	Medium	Hydrocephalus	VPS	Improved
Maiuri et al., 1987 (16)	62 yr/M	Ambient cistern	Large	Headache, diplopia, hydrocephalus	Biopsy, VPS	Improved
Cho et al., 1991 (3)	73 yr/M	Cisterna magna	50 × 40 × 30	Nuchal soreness, truncal ataxia	Decompression	Improved
Nikadio et al., 1993 (21)	65 yr/M	Quadrigeminal cistern	33 × 30 × 30	Abducens nerve palsy	Excision	Improved
Hayashi et al., 1983 (9)	3 d/M	Quadrigeminal cistern	Small	Hydrocephalus	VPS	Improved
Summers et al., 1987 (24)	10 mo/F	Superior vermis	40 × 30 × 25	Ocular motor apraxia	Excision	Unchanged
Kawamata et al., 1995 (11)	1 d/M	Quadrigeminal cistern	12 × 10 × 9	Tense anterior fontanelle, hydrocephalus	VPS	Improved
This study, Patient 1	15 yr/F	Quadrigeminal cistern	15 × 15 × 20	N/V, headache, blurred vision	Decompression	Improved
This study, Patient 2	14 yr/F	Cisterna magna	65 × 45 × 40	Occipital headache, N/V, ataxia, nystagmus	Decompression	Improved

^a N/V, nausea and vomiting; VPS, ventriculoperitoneal shunt.

ment. An estimate of the true natural history of ICLs may be deduced from further observation of our young patient and others like her or, perhaps, from new reports detailing the long-term outcomes of previously reported patients.

Surgical treatment of DBSLs has been reported in 10 patients, including the two patients described herein (see Table 1). The two cisterna magna lipomas had identical clinical presentations, and each was subtotally removed through midline suboccipital approaches with good outcome. QCLs in four patients who each presented with symptoms related to obstructive hydrocephalus were treated by insertion of ventriculoperitoneal shunts. Direct surgical treatment of QCLs was performed in four patients (three total removals and one subtotal removal). The presenting neurological symptoms improved or resolved in all except one who remained unchanged. We, like Kawamata et al. (11), think that the size of symptomatic QCLs is not a limiting factor in treatment planning. In experienced hands, with microsurgical laser-assisted techniques and a Cavitron ultrasonic aspirator, direct surgical treatment of DBSLs is

safe and symptomatic improvement is the likely outcome. We found SSEPs and BAERs helpful in pre- and post-operative assessment. Intraoperative BAER (18) and SSEP monitoring may be of benefit. The goal of surgery should be adequate decompression, because these lesions are tenaciously adherent to underlying neural tissue, cranial nerves, and surrounding vessels. Radical excision offers little additional benefit but may greatly increase the risk of brain injury. Neuroendoscopic third ventriculostomy may be a reasonable alternative to the ventriculoperitoneal shunt in those patients whose symptoms and signs solely relate to obstructive hydrocephalus. The presence of focal signs or deficits related to brain stem compression indicate that simple cerebrospinal fluid diversion will prove to be inadequate treatment for symptomatic DBSLs. Patients presenting focal signs or evidence of significant brain stem compression should be candidates for microsurgical decompression. In conclusion, we propose an algorithm for the management of DBSLs (Fig. 4), incorporating the principles discussed above.

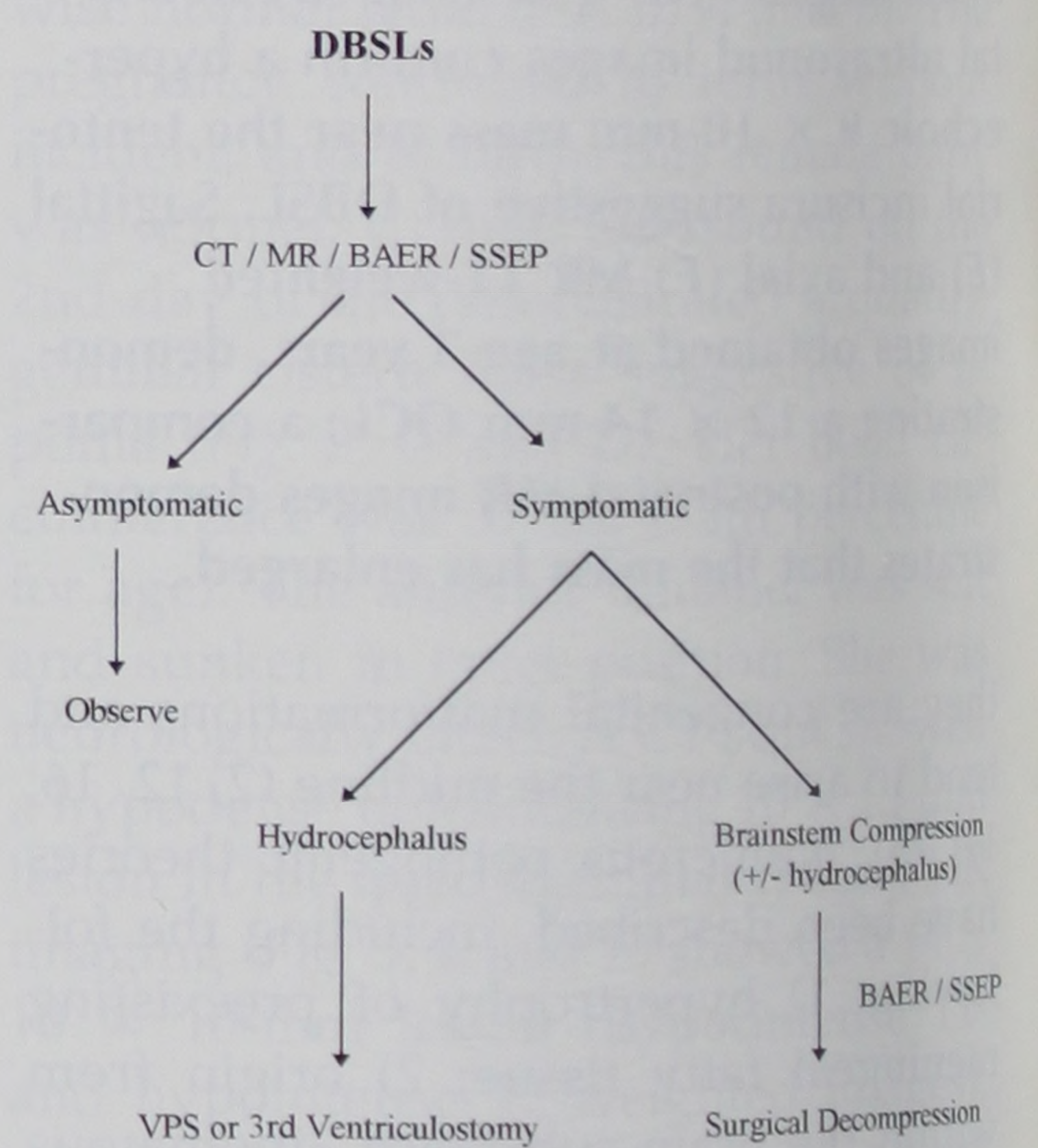


FIGURE 4. Management algorithm of DBSLs.

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COMMENTS

This is a thoughtful review of a very rare pathological entity in three patients, two of whom seem to have been symptomatic. In my experience, this is rarely the case and the majority of these masses are essentially hamartomas with no true clinical significance. Nevertheless, the authors present a very complete review of the literature and two very well-illustrated cases in which the patients seem to have benefited from surgical excision.

Luis Schut

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The authors report three patients with posterior fossa lipomatous masses. I wonder whether the outcome of the first patient might have been the same, irrespective of operative intervention. The second patient seemed to have a most unusual case of a lipomatous mal-

formation associated with a closed neural tube defect analogous to what is usually seen in the lumbosacral region. Operative intervention was indicated and successful in this patient. In the third patient, the mass was noted as an incidental finding on fetal ultrasonography. This patient has received follow-up for 3 years without any noticeable change in the size of the mass except for proportional growth with the brain. The authors appropriately have not operated on this patient, as the mass is not obstructing cerebrospinal fluid flow and has not produced a neurological deficit.

The majority of intracranial lipomatous masses similar to the ones described by the authors are incidental findings on imaging studies and do not require operative intervention. Follow-up would consist of magnetic resonance studies at progressively increasing intervals. The need for doing any additional studies, such as computed tomography, brain stem auditory evoked responses, and somatosensory evoked potentials, can be questioned.

J. Gordon McComb

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Tectal lipomas can be completely asymptomatic or they can give rise to hydrocephalus, as in Patient 1. I think that the preferred method of treatment is a third ventriculostomy or a diversionary shunt rather than an attempt to remove the lipoma.

Patients with lipomas at the craniocervical junction can present with significant neurological deficits. I have had three patients with these, all of whom presented with significant weakness of their extremities because of compression of cervical cord. Some of these intramedullary lipomas at the craniocervical junction will have subcutaneous masses, whereas others will have no cutaneous signs whatsoever. These particular lipomas require surgical debulking, because they do produce significant deficits.

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