A Pediatric PERSPECTIVE

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Care of Neurosurgical Shunts in the Primary Care Setting

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Neurosurgical shunts are placed for a variety of reasons, but hydrocephalus is the most common one. Management of the shunt itself remains primarily a neurosurgical issue, but a number of questions concerning shunt management often arise in the primary care setting. This article addresses the most frequently asked questions encountered in daily practice.

Q: Are there routine exam features for a child who has a shunt?

A: Usually a shunt is not tender and is a benign feature of the well child exam. New pain along a shunt or swelling around the tubing can be a sign of shunt failure. As tubing ages, a number of patients report intermittent pain along the shunt, particularly across the neck and upper chest wall. This pain is typically seen during growth spurts when the distal tubing has been in place for a decade or more. Although it is often transient, persistent pain may warrant replacement of a functioning shunt. Occasionally, a distal tube may actually fracture, leading to malfunction.

Q: Is routine imaging required?

A: There are two major reasons why scheduled imaging is not always necessary. The first is a matter of "sampling": from a variety of studies, it is known that the average life of a shunt placed during childhood is approximately five years or a failure rate of about 20 percent per year. With this is mind, a randomly scheduled scan is not likely to identify shunt malfunction in an asymptomatic patient.

The second issue is that imaging is not usually sensitive enough to assess shunt function. One published study found that for 35 percent of children who had a proven shunt malfunction, there was no change in baseline imaging when either a CT scan or an MRI was done.[1] Nevertheless, children with new symptoms should be scanned, particularly if their specific pattern of malfunction symptoms is not known.

Whenever a patient who has a shunt undergoes an MRI (of any body part), providers are reminded to see if the valve is programmable, in which case it may need to be reset. Usually, the patient or family knows if the valve is programmable; otherwise, the managing neurosurgeon should be contacted (ideally, before the study is performed).

Q: Do all shunts need to be replaced at some point? Can patients outgrow the need for a shunt?

A: Most children who have shunts placed during infancy become shunt-dependent, but there is no simple test to determine if a shunt is still needed. Some shunts have lasted more than 30 years before malfunctioning, so the only advice that can be given to the patient with an older shunt is that it is either (A) working and needed or (B) non-functional and not needed. The safest position is to advise the patient that an old shunt is probably working and needed.

Q: Is there a best way to test to see if a shunt is functioning?

A: The definitive test is surgical exploration of the shunt. This option has limited practicality, but in some settings, it may become necessary. As noted above, imaging does not always help, so the diagnosis of malfunction is often based on recognizing the individual's pattern of presenting symptoms.

Although symptoms of high intracranial pressure are common in shunt malfunction, any new neurological symptom in a patient with a shunt could be a sign of shunt failure.

In other words, while headache, nausea/emesis and lethargy are important symptoms that occur as a direct result of raised intracranial pressure, early complaints might include cognitive decline, worsening of pre-existing deficits or new neurological complaints.

Q: When is headache or emesis a concern?

A: These two symptoms can be difficult to sort out, and either one of them can be a sign of shunt malfunction. As noted above, if a child has previously experienced a malfunction, the presenting symptoms tend to be consistent if a subsequent malfunction occurs.

If a child has never experienced a malfunction, the nature of the headache and/or emesis needs to be clarified. Some clues can be extracted from the history: headaches associated with increased intracranial pressure are often frontal, worse in the early morning (due to circadian variation in intracranial pressure) and are improved by standing up. Rarely, a shunt valve becomes "stuck" in the open position and over-drainage occurs. This results in the opposite symptoms, i.e., the headache is worse in the latter part of the day, and symptoms are improved by lying down.

In the context of shunt failure, emesis is a reflexive response to raised intracranial pressure, and hence the patient often feels better after emesis, presumably because of the small degree of dehydration that occurs. On the other hand, emesis with diarrhea is almost never seen in the context of shunt malfunction and is more likely due to acute illness. Occasionally, a child presents with both an acute viral illness and a coincidental shunt malfunction. Such patients may be admitted for observation, and shunt surgery will be considered, if the presenting symptoms do not resolve spontaneously and quickly.

Q: When is fever a concern in a patient who has a shunt?

A: Fever can be a sign of shunt infection, but it is important to understand that shunt infections are uncommon (less than 5 percent of shunt operations result in infection), and they tend to occur shortly after shunt surgery. When shunt infections do occur, 70 percent of them happen within one month of surgery, and at least 90 percent of infections occur within six months.[2] In practical terms, a fever occurring more than six to eight months after shunt surgery is unlikely to be a shunt infection. Before considering a shunt tap, rule out other causes of fever.

Also, it is noteworthy that shunts do not appear to become infected secondarily, unless there is direct contamination of the shunt by local spread. Hence, peritonitis or meningitis may infect a shunt, but blood-borne infections, urinary tract infections, respiratory infections and the like will not spread to the shunt.

Q: Do patients who have a shunt need subacute bacterial endocarditis (SBE) prophylaxis?

A: Dental providers often raise this issue. As noted above, it is difficult to infect a shunt from a secondary source, so it is difficult to justify the routine use of SBE prophylaxis for dental work, airway/GI/GU instrumentation, or other surgery in patients whose shunts terminate in the peritoneal or pleural cavities. An argument might be made for the use of SBE prophylaxis in the setting of a ventricular-atrial shunt, but the evidence to support this is not strong.

Q: Can shunt tubing cause abdominal pain?

A: In the absence of a distended hollow viscus, it is difficult for a shunt tube to cause abdominal pain. Obviously, recent surgery can cause discomfort, and the abdominal wall may be tender for weeks after shunt placement. A functioning shunt tube may cause pleuritic pain or referred shoulder pain if the tube is trapped under the diaphragm.

Infrequently, a patient may have abdominal pain in the setting of shunt infection. An acute shunt infection with an aggressive organism can present with clinical peritonitis, whereas subacute pain, with slow progression, is the hallmark of an infected abdominal pseudocyst. Like all shunt infections, these are best treated with intravenous antibiotics and removal of the shunt, with placement of an external ventricular drain. This usually results in resolution of the abdominal complaints.

Q: If a child with a shunt has a seizure, does the shunt need to be evaluated?

A: A study that looked at a series of children with shunts who presented to an emergency room after having had a seizure found that more than 97 percent of them did not have shunt malfunctions.

As with other children brought to the ER because of a seizure, the principle reason for seizure activity was either acute illness (often febrile) or inadequate anticonvulsant levels in a child with known epilepsy. Those children who have seizures as a symptom of shunt malfunction typically have other symptoms as well, such as seizures that occur when the child has a headache, is lethargic or is experiencing school difficulties.

Q: How does minor trauma affect a shunt?

A: Minor falls and injuries on the playground are inevitable in childhood, and children who have shunts are no exception. Children with shunts should be allowed to participate in regular sports and activities, with a few caveats. First and foremost, the child should wear head protection, if it is available for the sport or activity. Second, minor trauma is not likely to damage the shunt, but even a minor impact to the shunt can be quite painful. This is particularly true if the valve is struck, because it is the most solid part of the shunt and it sits directly on the periosteum. Pain around the valve may require management with scheduled NSAIDs. On the other hand, since the rest of the tubing is soft and relatively mobile, it is not likely to break with a blunt impact.

It also appears that children with shunts are more easily concussed than children without shunts, probably as a result of the relative lack of extra-cerebral CSF collections. This in turn means that children with shunts do not tolerate the minor degrees of brain swelling which occur with concussive injuries, because they cannot readily shift cerebrospinal fluid from the head into the spinal subarachnoid spaces. Treatment of these injuries should follow the usual practices for concussion management.

The previous questions are asked quite commonly but, as always, the provider responsible for the care of a patient who has a shunt is encouraged to contact the primary neurosurgeon if there are any other concerns regarding the shunt.

[1] *Iskander BJ, McLaughlin C, Mapstone TB, Grabb PA, Oakes WJ: Pitfalls in the diagnosis of ventricular shunt dysfunction. Radiology reports and ventricular size.* Pediatrics*: 1998 Jun; 101 (6): 1031-6.*

[2] *Campbell JW: Shunt Infections,* in *Albright AL, Pollack IF and Adelson PD (eds):* Principles and Practice of Pediatric Neurosurgery*, 2nd ed. New York: Thieme, 2008, pp. 1141-1147.*

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