INTRODUCTION
A 49-year-old male presented to hospital with 2 weeks of orthostatic headaches and diplopia without any history of blunt trauma. On arrival, the patient's examination was significant for the right-sided abducens palsy without other neurological deficits. Workup included magnetic resonance imaging (MRI) brain with and without contrast demonstrated diffuse meningeal enhancement. Lumbar puncture was performed and opening pressure was noted to be 4 cm H₂O. Intracranial hypotension was suspected and the patient underwent CT myelogram [Figure 1],
which demonstrated ventral extravasation of contrast at the level of calcified disc at T3-4 space. Clinical and radiographic findings drew the conclusion that patient's symptoms resulted from spontaneous intracranial hypotension from a durotomy caused by this thoracic disc. Three months postoperatively, he had complete resolution of his abducens palsy and resolving MRI findings [Figure 2].

CASE DESCRIPTION

This is the first reported use of hybrid biplane operating room for intraoperative localization with DSM for treatment of SIH and also the first to describe the “snowman” pledget technique. The patient was positioned prone for a standard thoracic laminectomy. After exposure, DSM was completed to verify the site of spinal cerebrospinal fluid (CSF) leak (T3-4 disc space) [Figure 3]. Once laminectomy was completed a pseudomembrane, not to be confused with dura, overlying thecal sac was identified [Figure 4]. Although unreported, identification of pseudomembranes at the site of spinal CSF leak is a consistent finding in our experience. With a microdissector, this pseudomembrane was opened and resected from dura along laminectomy defect with expectation to encounter CSF. Before starting intradural work, a partial pediculectomy of the left fourth thoracic pedicle, across from the operative surgeon, was completed.

A left paramedian durotomy along laminectomy defect was completed without compromising arachnoid. Once

Figure 1: Sequence of CT myelogram demonstrating ventral extravasation of contrast indicating dural defect of ventral dural originating near calcified thoracic disc of T3-T4.

Figure 2: Comparison of MRI findings of spontaneous intracranial hypotension preoperatively (left) and postoperatively (right). Cerebellar ectopia, elevated pontomamillary distance, and pituitary hyperemia all noted to trend toward resolution (a). Diffuse meningeal enhancement resolved postoperatively (b). Venous congestion noted by bulging circular superior sagittal sinus and transverse sinuses noted to decrease on postoperative imaging (c and d).
dura was opened, the neuromonitoring technician was requested to monitor motor evoked potentials every 2 min – with any change, the surgeon would immediately stop and respond. The dura was tented posterolaterally with suture and the dentate ligaments were released. The pediculectomy, laterality of durotomy, and release of dentate ligaments are key steps dural retraction and presentation of ventral dural tear without manipulation of the cord [Figure 4].

A paraspinal muscle graft was harvested to serve as a pledget. The graft was introduced intradurally and carefully pushed to the epidural space – providing a “snowman” effect. Care was taken to ensure no mass effect from pledget was exerted on the intradurally by visualization and neuromonitoring. Small amounts of dural sealant agent were then used on both intradural and epidural compartments to stabilize and reinforce seal around the pledget [Figure 5]. Incision durotomy and surgical wound were then closed in standard fashion [Figure 6].

The authors have proposed a grading scale to aid in the work up and management of intracranial hypotension [Table 1].

| Presenting symptom               | Grade 1          | Grade 2                      | Grade 3                        |
|----------------------------------|------------------|-----------------------------|--------------------------------|
| Positional headache              |                  | Cranial nerve complaint, spasticity, or hyperreflexia | Focal weakness, new-onset seizure, stroke-like symptoms |

**Figure 4:** Exposure and durotomy of thoracic spinal cord at level of cerebrospinal fluid leak. Partial pediculectomy of T4 completed so that there will be room to retract and work on ventral dural defect without manipulation of spinal cord. Also note pseudomembrane around thecal sac which may be mistaken as dura (a). Spinal cord exposed with hemostasis and adequate exposure laterally for dural retraction (b). Longitudinal posterior durotomy made with number 11 blade spanning along laminectomy (c). Dentate ligaments severed (not shown) and dura is tacked with silk for retraction (d).

**Figure 5:** Application of “snowman” muscle pledget technique. The ventral dural defect is appreciated with retraction of dura without manipulation of spinal cord (a). Muscle pledget is inserted into dural defect (b) and adjusted to a low intradural profile so that there is no mass effect on the spinal cord (c). Extradural and minimal intradural application of dural sealant is used to complete seal (d).

**Figure 6:** Posterior durotomy closed with primary intention. Valsalva ensures that there is a watertight closure.
CONCLUSION

In this case, we localized a ventral dural defect with the assistance of intraoperative DSM then repaired the defect with the “snowman” pledget technique. This is the first report to illustrate this technique.

Declaration of patient consent

Institutional Review Board (IRB) permission obtained for the study.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

How to cite this article: Arshad M, Odell T, Fiani B, Hadi H, Johnson E, Li C, et al. Intraoperative localization and “snowman” muscle pledget repair for ventral dural defect in a case of spontaneous intracranial hypotension. Surg Neurol Int 2022;13:39.