

# Skin sealants: an effective option for closing cerebrospinal fluid leakage

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Cerebrospinal fluid (CSF) and surgical wound leaks are a common postoperative complication in neurosurgical or otolaryngological procedures.<sup>1</sup> Conservative treatments are usually used first for this potentially serious complication, but persistent leakage can require surgical intervention. Liquid skin sealants have been recognized for their possible usefulness in addressing persistent surgical leakage.<sup>2-4</sup> We report our experience of 6 cases of postoperative, low-volume CSF leaks that were treated successfully with such a sealant. Our goal is to increase general awareness of this safe, simple and effective treatment that can be used in conjunction with conservative management.

## Clinical presentation

Six patients were treated with the skin sealant Dermabond (Ethicon, Somerville, NJ) in an effort to stop postoperative CSF leakage. The 4 women and 2 men were 27 to 78 years of age, with a median age of 49.5. They had undergone surgical interventions that included laminectomies of the lumbar spine, and craniotomies or craniectomies either to evacuate a hematoma or to resect tumours in the cerebellum and foramen magnum (Table 1).

After patients were successfully treated, we used the sealant immediately when CSF leakage was observed; in all cases, sutures and staples were left in place. Leakages were usually low-flow, and except for bed rest and the use of

pressure dressings, only skin sealant was used to treat them. Patients can shower once the sealant has dried completely.

No further treatment was required, conservative or otherwise. No patient had a wound infection, suffered toxicity from the sealant, or required CSF diversion.

## Sample case description

A 27-year-old woman was admitted for surgery for a tethered-cord syndrome that manifested as lower-limb pain and neurogenic bladder; she also had a spinal subcutaneous lipomatous mass that had

been followed for years. At surgery, a lipomyelomeningocele was found in her lower lumbar spine, which had caused the tethered cord. This was untethered and debulked. The dura was then primarily repaired without difficulty, with no need for a dural patch; neither was there undue tension on the dural sac or its contents. It was sutured with interrupted and running stitches, and closure was reinforced with Tisseel. Postoperatively, the patient had an uneventful course without any evidence of CSF leakage, and was discharged.

On her eighth postoperative day, she

Table 1

Cases in which a postoperative leak of cerebrospinal fluid was treated with skin sealant (Dermabond) and pressure dressing only

Pt	Age, yr	Diagnosis	Procedure	Postoperative day	
				Leak observed	Sealed, dressed
1	27	Lipomyelomeningocele	L5-S2 laminectomies and dissection of left myelomeningocele	8	9*
2	78	Acute-on-chronic subdural hematoma	Parietotemporo-occipital craniotomy with evacuation of hematoma	3	6*
3	47	Right cerebellar metastasis with previous melanoma	Posterior-fossa craniectomy with resection of tumour, and duraplasty using fascia lata graft	3	3
4	49	Arnold-Chiari malformation with syringomyelia	Suboccipital craniectomy and C1 laminectomy with duraplasty of posterior fossa and cervical spine using fascia lata graft	3	3
5	50	Craniospinal meningioma of left anterolateral foramen magnum	Suboccipital craniectomy and C1 laminectomy with resection of tumour	2	2
6	54	Foramen magnum tumour with compression of C1-2	Posterior fossa craniotomy with resection of foramen magnum lesion	3	3

Pt = patient. \*Patients 1 and 2 had a delay in skin-sealant application only.

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noticed a small amount of clear straw-coloured fluid (later judged to be CSF) leaking from the incision. She was assessed to be neurologically unchanged, and a single suture was placed at the incision, stopping the leakage. The following day, she nevertheless saw leakage at the same site in the morning, and from another part of the same incision later in the evening.

The leaks were treated under sterile technique with copious administration of Dermabond and a pressure dressing. No further CSF leakage has been noted.

### Discussion

Conservative treatment of CSF leakage through a surgical incision usually involves a combination of pressure dressings, sutures, adhesive tapes, bed rest and head elevation.<sup>5</sup> Persistent leakage can require surgical intervention, involving the insertion of a lumbar drain or reoperation to close the primary CSF leak.<sup>6,7</sup> These aggressive treatments are associated with their own complications, such as meningitis<sup>8</sup> and vascular compromise from enforced prolonged bed rest.<sup>9</sup>

As a noninvasive alternative, tissue sealants and adhesives have been used to stop CSF leaks.<sup>4,8,10</sup> Most of these are adjuncts to good dural closure, with a CSF diversion in cases of hydrocephalus.

For more than 25 years, Collodion (USP, Merck & Co.) has been used to hold surgical dressings in place, and as a wound dressing for abrasions, cuts and burns. Collodion is a clear solution of pyroxylin in a mixture of 75% ether and 25% alcohol.<sup>11</sup> A viscous liquid, when applied to skin it becomes a transparent, bacteriostatic and strongly adherent film that acts as an occlusive dressing.<sup>11</sup>

Fibrin sealant is another type of adhesive that has been used in conjunction with sutures to stop or control bleeding, or provide air and fluid tightness in many surgical situations.<sup>8,12,13</sup> Its use has led to successful sealing of CSF leaks.<sup>14,15</sup> But because fibrin glue components (fibrinogen and thrombin) are extracted from pooled human plasma, their use may permit transmission of infectious diseases or induce an anaphylactic reaction.<sup>16,17</sup>

Such risks are negligible, however, for fibrin glues such as Tissucol (Immuno AG, Vienna, Austria) and Tisseel (Baxter AG, Vienna; 5-mL kit Can\$575, 2-mL kit Can\$230), as their production

includes viral deactivation by steam treatment; polymerase chain reaction is then used to check the remaining very low level of detectable viral load.<sup>18</sup> Tissucol has, in fact, received approval by the United States Food and Drug Administration; Tisseel has received a similar approval in Canada.

A cyanoacrylate tissue adhesive and pressure dressing were recently used<sup>4</sup> to stop a child's CSF leak after the removal of a ventriculo-peritoneal shunt. Cyanoacrylate adhesives, such as Histoacryl Blue (Trihawk International, Montréal, Que.) and Dermabond (Ethicon; Can\$45 per vial), have therefore expanded clinicians' options for wound closure.<sup>19</sup> These alkyl ester monomers polymerize in the presence of the hydroxyl ions in water and blood, and are able to bind the edges of the epithelial layer in a wound together.<sup>20</sup> Because shorter alkyl-chain molecules (methyl, ethyl) are more reactive, have greater toxicity and weaker tissue binding than longer alkyl-chain cyanoacrylates,<sup>19</sup> the n-butylcyanoacrylates (such as Histoacryl Blue) are less toxic than shorter-chain cyanoacrylates and maintain a stronger bond, though there may be an inflammatory response and foreign-body giant-cell reaction at the site of application.<sup>19</sup>

The 2-octylcyanoacrylates are even more stable, have greater flexibility and maintain a stronger bond.<sup>19</sup> They also degrade much more slowly than butylcyanoacrylates and are considered to be nontoxic.<sup>19</sup> There are no reports of systemic toxicity associated with the use of topical octylcyanoacrylates.<sup>21</sup> Moreover, studies have reported that cyanoacrylates have antimicrobial properties against Gram-positive organisms.<sup>19,22,23</sup> In some patients, they can form a hard barrier; when an adhesive is used in combination with sutures, suturing should be done first.

Dermabond, a recently developed 2-octylcyanoacrylate, received approval for use in the United States as a wound closure device. It can reach a maximum bonding strength in 2½ min, and is equivalent in strength to healed tissue at 7 days post-repair.<sup>20</sup> Application with a fabric-tipped plastic applicator is rapid and painless.

Use of such a liquid tissue adhesive for wound closure was ideal for our patients. The leaks were slow enough to allow the skin to dry sufficiently for

bonding, and were small enough not to necessitate the use of invasive surgical measures. By closing them primarily with Dermabond, we circumvented the various aforementioned adverse possibilities associated with the use of biological tissue sealants.<sup>24</sup>

Despite their many advantages, it has been reported that tissue sealants and adhesives should not be used in infected wounds in which the sealant can serve as the nidus for infection, and if CSF pressure is raised because of nonabsorption hydrocephalus.<sup>8</sup> Application of sealant or the use of other techniques will not suffice in such a scenario unless the CSF pressure is first normalized by a drainage-diversion technique.<sup>8</sup>

### Conclusion

There exist numerous strategies for the resolution of uncomplicated postoperative CSF leakage. Simple and effective, use of a 2-octylcyanoacrylate is a low-risk means to manage these complications. Such use warrants further exploration. Meanwhile, this type of skin sealant may be used along with regular conservative therapy as an initial treatment for low-volume postoperative CSF leaks in the absence of elevated intracranial pressure or hydrocephalus.

**Competing interests:** None declared.

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