

The Use Fibrin Sealant after Spinal Intradural Tumor Surgery: Is It Necessary?

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Objective: A fibrin sealant is commonly applied after closure of an incidental or intended durotomy to reduce the complications associated with the leakage of cerebrospinal fluid. Routine usage might not be essential after closure of an intended durotomy, which has clear cut-margins. We investigated the efficacy of fibrin sealants for primary intradural spinal cord tumor surgery.

Methods: A retrospective review was performed for 231 consecutive surgically treated patients with primary intradural spinal cord tumors without extradural extension. Fibrin sealants were not used for 47 patients (group I: age, 51.57±16.75 years) and were applied to 184 patients (group II: age, 48.8±14.7 years). The surgical procedures were identical except for the use of a fibrin sealant after closure of the durotomy. The primary outcome was the occurrence of complications (wound problems, hematoma collection, infection, and neurological deterioration). The covariates were age, sex, body mass index, operation time, pre-/postoperative ambulation, number of laminectomies, and type of tumor.

Results: Schwannoma was the most common pathology (n=134), followed by meningioma (n=35) and ependymoma (n=31). Complications occurred in 13 patients (3 in group I and 10 in group II, p=0.73). The postoperative ambulation status (p<0.01; odds ratio, 28.8; 95% confidence interval, 6.9–120.0) and operation time (p=0.04; cutoff, 229 minutes; sensitivity, 62%; specificity, 72%) were significant factors, whereas the use of a fibrin glue was not (p=0.47).

Conclusion: The use of a fibrin sealant might not be essential to reduce complications after surgery for primary spinal intradural tumor.

Key Words: Fibrin tissue adhesive • Spine • Surgical wound infection • Cerebrospinal fluid • Spinal cord neoplasms

INTRODUCTION

The goal of dural repair includes the containment of neural tissue and restoration of the cerebrospinal fluid (CSF) space around the spinal cord^{8,19,21}. A watertight dural closure allows early ambulation of the patients and reduces complications associated with the leakage of CSF^{3,11,24}. The rate of CSF leak after intradural procedures is reported to be approximately 11%–16%^{8,19,21}. And persistent leakage of CSF leads to postoperative complications such as wound dehiscence, infec-

tion and pseudomeningocele formation^{9,19,21}. To supplement the dural closure, a fibrin sealant is frequently used after spinal intradural tumor surgery, and the efficacy of fibrin sealant application has been demonstrated in the literature^{1,3,5,13,18,24,26}. Although the supplementation of a fibrin sealant after closure of an incidental or intended durotomy is supported in the literature^{1-3,18,26}, routine usage might not be a requirement after an intended durotomy⁶. The dura is incised in the midline with a scalpel for intradural tumors. Consequently, intended durotomies have clear cut-margins, and closure of the dura appears to be easier than in torn-out incidental durotomies. If a watertight dural closure could be achieved by suturing, a supplemental fibrin sealant might not be essential. We investigated whether closure without the use of a fibrin sealant was associated with the occurrence of complications after primary intradural spinal cord tumor surgery.

MATERIALS AND METHODS

A retrospective review was performed for 231 consecutive surgically treated patients with primary intradural spinal cord

• Received: November 28, 2015 • Revised: January 3, 2016
• Accepted: January 11, 2016

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tumors without extradural extension from February 2008 to December 2013. The study was approved by Institutional Review Board of Seoul National University Hospital Biomedical Research Institute (H-0910-014-296). Fibrin sealants were not used for 47 patients (group I: male:female=25:22; age, 51.57 ± 16.75 years) and were used for 184 patients (group II: male:female=83:101; age, 48.8 ± 14.7 years) after dural closure. The use of fibrin sealant was at the discretion of the surgeons, and there was no specific indication. We reviewed the medical records including the operation/progression/nursing records and magnetic resonance imaging to identify the patients who experienced complications during postoperative 3 months. The complications included wound problems (leakage of CSF, bulging, and/or dehiscence), hematoma collection, surgical site infection and postoperative neurological deterioration.

1. Surgical Method and Perioperative Care

The surgical procedures and postoperative management were similar in both groups, except for the use of a fibrin sealant⁹⁾. A prophylactic antibiotic with first generation cephalosporin was administered once to each patient, beginning 1 hour before the incision, and was continued for 24 hours postoperatively. All the operations were performed with a conventional midline approach and a laminotomy in a prone position. The dura was opened at the midline or slightly off the midline with a scalpel, according to the location of the tumor, without violation of the arachnoid membrane, if possible. After reflection of the incised dura, the arachnoid membrane was separately incised with a fine scalpel and tacked-up to the reflected dura. After tumor removal and meticulous hemostasis, the arachnoid membrane was closed by 8-0 nylon suture, and the dural closure was performed using 4-0 silk or 6-0 nylon suture with interrupt sutures or continuous locked sutures³⁾. In meningioma cases, the tumor origin of the dura was not resected; it was coagulated⁹⁾. The artificial dura was used to cover contracted dura, if necessary⁹⁾. The dural sac was filled with normal saline until it was expanded as much as the preoperative state, and the last suture was tied. The fibrin glue (Tisseel, Baxter, IL, USA or Greenplast, Green Cross Corp., Seoul, Korea) was applied to cover the whole closed dura. The lamina was replaced with a mini-plate or a trans-laminar screw¹⁵⁾. The muscle, fascia, and skin were closed in an ordinary layer-by-layer fashion. In particular, the fascia was meticulously and tightly closed with 1-0 Vicryl. Closed-suction drainage was not routinely inserted; however, it was inserted if there was a large amount of bleeding from muscle or epidural space²⁰⁾. All the patients in both groups were encouraged to ambulate from the day of the operation. The closed-suction drainage bag was removed the next day; it was removed earlier, if CSF were suspected to be draining through the drain tube. The surgical wound was closely inspected every day, beginning from the second postoperative day.

2. Statistical Analysis

The primary outcome was the occurrence of complications; wound problems (leakage of CSF, bulging, and/or dehiscence), hematoma collection, surgical site infection, and postoperative neurological deterioration. The following factors were considered as covariates; sex, age, the body mass index, number of laminectomy levels, pre-/postoperative ambulation status, laminoplasty or laminectomy, tumor location (intradural or extradural), operation time, estimated intraoperative blood loss, and insertion of a closed suction drain. The secondary outcomes were the length of the hospital stay, highest body temperature on postoperative days 1 and 2, and the total amount of closed suction drainage.

Univariate analyses were performed with Student t-test or chi-square test for the continuous or noncontinuous parameters, respectively. The factors with a p-value <0.2 were set into the logistic regression analysis. IBM SPSS Statistics ver. 22.0 (IBM Co., Armonk, NY, USA) was used for statistical analysis and a two-tailed p-value of less than 0.05 was regarded as significant.

RESULTS

The baseline characteristics were not different between the groups (Table 1). The extent of surgery (level of laminectomy) and the frequency of using artificial dura were not different between the groups ($p=0.13$ and $p=0.24$, respectively). Complications occurred in 3 patients (6.4%) in group I and 10 patients (5.4%) in group II, and the incidence was not different between the groups ($p=0.7$) (Table 2). In detail, a wound problem occurred in 2 patients (4.3%), and neurological deterioration occurred in 1 patient (2.1%) in group I and 5 patients (2.7%) in group II, respectively. A revision operation was necessary because of the collection of CSF in 1 patient in group I and 2 patients in group II. Leakage of CSF through the surgical wound was controlled with a simple suture in 1 patient in group I and 3 patients in group II. Postoperative meningitis occurred in 1 patient of group II and was controlled with antibiotics.

Complications were associated with the operation time, postoperative ambulation status and laminoplasty by the univariate analysis (Table 3). The operation time was 287 ± 113 minutes for the patients with a complication and 207 ± 82 minutes for patients without a complication ($p=0.03$). Complications occurred in 9 of 209 patients (4.3%) with laminoplasty and 4 of 22 patients (18%) without replacement of the lamina ($p=0.03$). The postoperative ambulatory patients showed complications in 5 of 212 patients (2.3%), whereas the postoperative nonambulatory patients showed complications in 8 of 19 patients (42.1%) ($p<0.01$). The multivariate analysis showed that the postoperative ambulatory status ($p<0.01$) and

Table 1. Characteristics of groups

Characteristic	Group I (n=47)	Group II (n=184)	p-value
Sex			
Male:female	25:22	83:101	0.32
Age (yr)	51.6±16.8	48.8±14.7	0.26
Height (cm)	162.1±8.9	163.1±9.7	0.51
Weight (kg)	63.6±9.5	62.9±11.9	0.69
Body mass index (kg/m ²)	24.2±3.2	23.5±3.0	0.15
Levels of laminectomy	2.0±1.0	2.3±1.1	0.13
Use of artificial dura	1	12	0.24
Operation time (min)	193.7±82.7	215.5±86.6	0.12
Preoperative ambulation, yes	45	170	0.54
Postoperative ambulation, yes	45	167	0.38
Estimated intraoperative blood loss (mL)	437.1±459.4	449.0±408.7	0.87
Laminoplasty	39	170	0.09
Closed suction drain	14	38	0.18
Location of tumor			
Intramedullary:extramedullary	5:42	30:154	0.33
Schwannoma	29	105	
Meningioma	5	30	
Ependymoma	4	26	
Cavernous malformation	5	7	
Neurofibroma	1	3	
Hemangioblastoma	1	4	
Subependymoma	0	2	
Astrocytoma	1	3	
Oligodendroglioma	0	1	
Others	1	3	

Values are presented as number or mean±standard deviation. Group I, without fibrin sealant; group II, with fibrin sealant.

Table 2. Primary outcomes

Variable	Group I (n=47)	Group II (n=184)	p-value
Complication	3 (6.4)	10 (5.4)	0.73
Neurological complication	1 (2.1)	5 (2.7)	0.82
Wound problems*	2 (4.3)	5 (2.7)	0.58
Revision operations	1 (2.1)	2 (1.1)	0.57

Values are presented as number (%).

Group I, without fibrin sealant; group II, with fibrin sealant.

*Bulging, cerebrospinal fluid leak, and infection.

operation time (p=0.04) were significant factors, whereas the use of a fibrin glue was not a prognostic factor (p=0.47) (Table 3). The nonambulatory patients showed a 28.8 times higher complication rate (odds ratio [OR], 28.8; 95% confidence interval [CI], 6.9–120.0). To determine the optimal cutoff value of the operation time, a receiver-operating char-

acteristic curve was created (Fig. 1). The area under the curve was 0.72 (95% CI, 0.56–0.87). The cutoff segmental angle was 229 minutes (sensitivity, 62%; specificity, 72%). Lamina replacement appeared to show lower the complication rate (OR, 0.2; 95% CI, 0.04–1.04).

The secondary outcomes (the length of hospital stay, body temperature at postoperative days 1 and 2, and total amount of closed suction drainage) were not different between the groups (Table 4).

DISCUSSION

This study investigated whether the use of fibrin glue was associated with postoperative complications. The occurrence of complications was not dependent on the use of fibrin glue (6.4% vs. 5.4%, p=0.7). The use of fibrin glue was not associated with the hospital stay period, body temperature or amount of drainage. The determining factors for the occur-

rence of complications were the postoperative ambulation ability and operation time.

1. The Use of a Fibrin Sealant

Among the patients who underwent spinal intradural surgeries, CSF leakage from the wound is not rare^{8,10,16,21}. A persistent leakage of CSF might cause postoperative complications such as wound dehiscence, surgical site infection and pseudomeningocele formation^{10,19,21}. To reduce such problems, supplementation of a fibrin sealant on the closed dura has been introduced¹⁸. Fibrin sealants contain inactivated human fibrinogen and thrombin and mimic the last step of the coagulation cascade^{6,17}. In addition to its potent hemostatic properties, a fibrin sealant acts as adhesive agent by a forming fibrin cross-linking polymer^{6,17}. Many authors recommend the routine usage of a fibrin sealant to reinforce the durotomy site, and they have reported that the patients treated with the a fibrin sealant had a significantly higher rate of watertight closure than that of the controls^{3,24} as well as decreased postoperative drainage output and length of hospital stay^{13,26}.

The use of a fibrin sealant is not always beneficial. Jankowitz et al.⁶ retrospectively reviewed 4,835 patients with lumbar surgery and found that the rate of CSF leakage was not re-

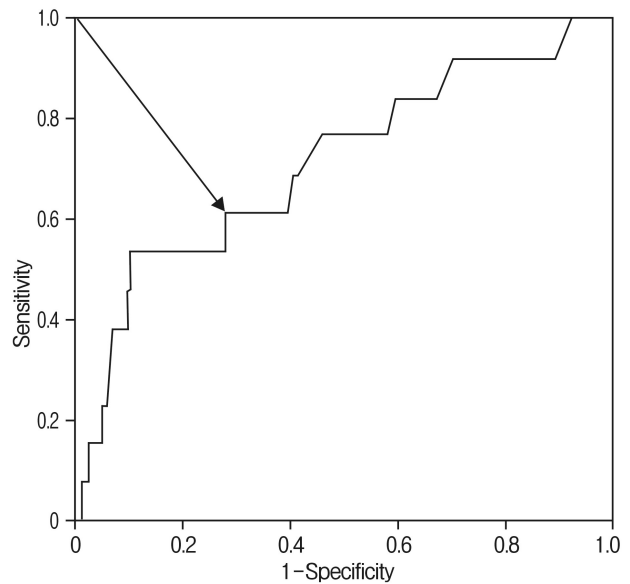


Fig. 1. The receiver operating characteristic curve (ROC). To determine the optimal cutoff value of the operation time, a ROC curve was created. The area under the curve was 0.72 (95% confidence interval, 0.56–0.87). The cutoff was 229 minutes (sensitivity, 62%; specificity, 72%).

Table 3. Risk factors for the occurrence of complications

Variable	Univariate	Multivariate	Adjusted OR (95% CI)
The use of fibrin glue	0.73	0.47	1.9 (0.3–10.0)
Age	0.54	-	-
Sex	0.78	-	-
Body mass index	0.90	-	-
Operation time	0.03	0.04	1.01 (1.0–1.1)
Preoperative ambulation	1.00	-	-
Postoperative ambulation (reference, yes)	<0.01	<0.01	28.8 (6.9–120.0)
Number of laminectomy	0.11	-	-
Type of tumor (IDEM/IM)	1.00	-	-
Laminoplasty	0.03	0.06	0.2 (0.04–1.04)
Drain	0.50	-	-

OR, odds ratio; CI, confidence interval; IDEM/IM, intradural extramedullary/intramedullary.

Table 4. Secondary outcomes

Variable	Group I (n=47)	Group II (n=184)	p-value
Hospital stay (day)	8.5±7.6	9.7±11.1	0.48
Highest body temperature (°C)			
Postoperative day 1	37.7±0.5	37.8±0.5	0.44
Postoperative day 2	37.5±0.6	37.5±0.6	0.66
Amount of drain (mL)*	323.6±286.8 (n=14)	303.9±196.7 (n=38)	0.82

Group I, without fibrin sealant; group II, with fibrin sealant.

*Closed suction drain was inserted for 14 patients in group I and 38 patients in group II.

duced by the use of a fibrin sealant. In addition, fibrin sealant was not differentiable from a pseudomeningocele in postoperative magnetic resonance imaging, potentially causing a lengthening of the hospital stay, an invasive CSF diversion procedure or a reoperation^{12,14,23}. Fibrin sealant usage might not be a routine recommendation because of those issues and the cost^{3,6}.

Previous studies did not classify the use of a fibrin sealant according to the completeness of the dural closure^{3,4,6,7,13,24,25}. Frequently, the incidental durotomy margin is uneven, and a watertight dural closure could not be completed with only suture. In such cases, a dural sealant was helpful^{10,13,22,26}. The opened dura had clear margins after an intended durotomy, and a watertight dural closure with only suture was possible in most cases^{3,6}. The use of a fibrin glue might not be a necessary procedure for patients with primary spinal intradural tumor surgery.

2. Limitations of This Study

There was a critical limitation in this study. The study design was a retrospective analysis, and the use of a fibrin sealant was not randomized. Although the baseline characteristics in the study groups were similar, a selection bias was inevitable. Three surgeons performed the surgeries, and the indications for applying a fibrin sealant might not be identical. This study showed that the use of a fibrin sealant might not be essential once a watertight dural closure and tight layer-by-layer wound closure are achieved. Dural closure without the use of a fibrin sealant might be faultless after spinal surgery for intradural tumor. We hope this information will be helpful for surgeons.

CONCLUSION

The occurrence of postoperative complications was not associated with the use of a fibrin sealant after surgery for a primary intradural spinal cord tumor. The usage of a fibrin sealant after a watertight dural closure might be at the discretion of surgeons.

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

ACKNOWLEDGMENTS

This work was supported by the Seoul National University Hospital Research Fund (grant number: 0420153090 [2015-0987]).

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