Comparison of Non-continuous Versus Continuous Drain Use Following Thoracolumbar Spine Surgery

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Purpose: *To evaluate the efficacy and safety of non-continuous drain use following posterior instrumented fusion in thoracolumbar spinal injury.*
Methods: *Retrospective identification of patients with thoracolumbar spinal injury operated posterior instrumented fusion during the period 2013-2016 into 2 groups. Group I (non-continuous drain use): received 2-hour temporary drain clamping and group II (continuous drain use): no clamping. The groups were evaluated the amount of drain content in 8th, 16th, 24th, 48th, and 72nd hour. The entire period of drain use, the hemoglobin level change, post-operative Packed Red Cell (PRC) transfusion, Visual Analogue Scale (VAS), and wound complications between two groups were also compared.*
Results: *A total of 56 patients were included; their age was 51.50 years and 36 years on average in non-continuous drain group and continuous drain group retrospectively. 53.6% and 75% were male in non-continuous drain group and continuous drain group retrospectively. The drain content in 8-hour postoperative period and hemoglobin level change were significantly lower in the non-continuous drain group than the continuous group whereas the post-operative PRC transfusion, VAS, hospital length stay, total drain content, total drain use time and wound complications were not different between two groups.*
Conclusion: *The use of non-continuous drain following posterior instrumented fusion in thoracolumbar spinal injury can reduce patients' post-operative hemoglobin level difference. However, there was no statistically significant difference in term of postoperative blood transfusion, VAS, total drain content, entire period of drain use, the length of hospital stay as well as wound complications.*

Keywords: *Drain, spine surgery, fusion, bleeding*
Abbreviations: *PRC Packed Red Cell, VAS Visual Analog Scale, NSAIDs non-steroidal antiinflammatory drugs*

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Introduction

More than 160,000 spinal injuries occur per year in North America which also has high rates of morbidity and mortality. Spinal fractures are usually the result of high-energy trauma. Conventional open posterior approach associated with morbidity because of approach-related muscle injury and higher blood loss[(1)].The blood lost following spinal surgery may require replacement by homologous blood transfusion; however, such transfusions are associated with a risk of microbial infection, viral transmission, fluid overload, and high cost[(2)]. The methods to reduce perioperative blood loss and rate of blood transfusion have been recently invented, such as using tranexamic acid, intra-operative hypotensive blood pressure and cell saver use.

For knee arthroplasty, there was a meta-analysis indicating that clamping drainage can achieve less hemoglobin loss and postoperative visible blood loss with no increment of postoperative complications[(3)]. Commonly, a spine surgeon will apply a drain after lumbar spine procedure to drain hematoma from potential space. The epidural hematoma has a reported incidence of 0.2% to 2.9% surgical corrections[(2,4-5)]. Drain use may also decrease wound dehiscence or infection.
To our knowledge, most spine surgeons use different drain types[(6)], very few studies compared the continuous drain and non-continuous drain use for the lumbar spine procedures.

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Materials and Methods

After approval by our Institutional Ethics Committee, we retrospectively reviewed the medical

records of patients who has thoracolumbar spinal injury without neurological deficits and underwent posterior instrumented fusion during the period 2013-2016. The exclusion criteria were patients with (1) coagulopathy, (2) bleeding tendency (abnormal coagulation test, history of taking NSAIDs or aspirin 1 week before surgery), (3) dural injury and (4) any spinal infection. The fifty-six patients included were assigned into 2 groups. Group I, 2 hour-drain clamp group where the drain was clamped for 2 hours after closing the wound and group II, no drain clamping. Patient backgrounds were not notably different among groups. (Table 1)

Visual analog scale (VAS), operative time, intraoperative blood loss, volume of PRC transfusion during surgery and postoperatively, drain content on the postoperative 8th, 16th, 24th, 48th and 72nd hours, the duration of drain use, hospital stay and complications e.g. wound infection or epidural hematoma were compared between groups. A *p*-value of less than 0.05 was statistically significant by the Fisher's exact test, chi-square test, Mann-Whitney U test, and two-sample t-test methods.

Table 1 Baseline characteristics.

Variable	Non-continuous drain group (n=28)	Continuous drain group (n=28)	*p*-value
Age (years)	51.5 (35.5-58)	36 (20.3-53.5)	0.012[a)]
Age group			1.00[b)]
< 65 years	26 (92.9)	27 (96.4)	
≥ 65 years	2 (7.1)	1 (3.6)	
Body weight (kg)	60.3 ± 9.7	61.4 ± 11.5	0.69[c)]
Height (cm)	164.1 ± 6.2	164.3 ± 8.1	0.91[c)]
BMI (kg/m^2)	22.3 ± 3.2	22.6 ± 2.9	0.76[c)]
Male sex	15 (53.6)	21 (75)	0.94[d)]

Values are presented as median (interquartile range), number (%) or mean ± standard deviation.
BMI, body mass index; [a)] Result of Mann-Whitney U test; [b)] Result of Fisher's exact test; [c)] Result of two-sample t-test; [d)] Result of chi-square test.

Results

Blood loss

The drain content was significantly lower in the non-continuous group in the first 8th hour (*p*=0.044) compared to the continuous group. However, after that the drain content at the 16th, 24th, 48th, and 72nd hours and total drain content were not shown statistically differences between two groups. Moreover, the hemoglobin change was shown statistically differences in the non-continuous group at 48 hours postoperatively. There were no statistically significant difference of the need of postoperative PRC transfusion between non-continuous and continuous groups. We found that the total drain content was more than 300 mL at the 24th hour and total drain content of ≥ 300 mL were correlated with post-operative PRC transfusion. (Table 3). Furthermore, non-continuous drain use was removed faster in patients (3 vs 3.3 days) but was not statistically significant.

Clinical Outcomes & Complications

VAS at arrival, 24th hours, 48th hours and discharge day were not different between the two groups. The length of hospital stay was shorter in non-continuous group (16 days) compared with 16.5 days in the continuous group. For complications (e.g., wound infection or epidural hematoma), there was no wound complication nor epidural hematoma in this study. (Table 2)

Table 2 Perioperative clinical results.

Variable	Non-continuous drain group (n=28)	Continuous drain group (n=28)	*p*-value
PRC transfusion			
Pre-operative PRC transfusion	5 (17.9)	1 (3.6)	0.19[a)]
Intra-operative PRC transfusion	7 (25)	10 (35.7)	0.38[b)]
Postoperative PRC transfusion	11 (39.3)	15 (53.6)	0.28[b)]
VAS			
VAS before operation	5 (4-6)	4 (3-5)	0.10[c)]
VAS at 24 hours after operation	7 (7-8)	7 (5.25-9)	0.47[c)]
VAS at 48 hours after operation	6 (5-7)	5.5 (5-7.8)	0.61[c)]
VAS on discharge day	5 (5-7)	6 (3-6)	0.45[c)]

Variable	Non-continuous drain group (n=28)	Continuous drain group (n=28)	*p*-value
Intraoperative blood loss (mL)	200 (177.5-300)	300 (200-387.5)	0.08[c)]
Operative time (min)	88 (75.8-100)	95 (90-110)	0.07[c)]
Postoperative hospitalization (day)	8 (7-12.8)	10 (6-17.8)	0.42[c)]
Length of stay in the hospital (day)	16 (12.3-20.8)	16.5 (12-29.3)	0.44[c)]
Duration of drain retained (day)	3 (2.5-3.9)	3.3 (2.1-4.3)	0.95[c)]
Drain content (mL)			
1st 8 hour drain content	150 (100-245)	220 (130-277.5)	0.044[c)]
2nd 8 hour drain content	80 (50-127.5)	60 (30-115)	0.09[c)]
3rd 8 hour drain content	50 (42.5-80)	40 (22.5-77.5)	0.1[c)]
Total drain content at 24 hours	345 (232.5-407.5)	330 (212.5-485)	0.74[c)]

Values are presented as number (%), median (interquartile range) or mean ± standard deviation.
PRC, packed red cells; VAS, visual analog scales. [a)] Result of Fisher's exact test; [b)] Result of chi-square test [c)] Result of Mann-Whitney U test; [d)] Result of two sample t-test.

Table 3 The comparison of the categorized affecting factors and postoperative PRC transfusion.

Variable	Post-op PRC transfusion	Relative risk (95% CI)	χ^2 or F (*p*-value)
Intervention group		0.73 (0.41 to 1.30)	-0.143 (0.28[a)])
Non-continuous drain group (n=28)	11 (39.3)		
Continuous drain group (n=28)	15 (57.7)		
Age group		0.43 (0.32 to 0.59)	-0.256 (0.09[b)])
< 65 year (n=53)	23 (43.4)		
≥ 65 year (n=3)	3 (100)		
Intraoperative blood loss		0.74 (0.42 to 1.31)	-0.138 (0.30[a)])
< 300 mL (n=30)	12 (40)		
≥ 300 mL (n=26)	14 (53.8)		
1st 24 hour drain content		0.49 (0.25 to 0.98)	-0.300 (0.02[a)])
< 300 mL (n=24)	7 (29.2)		
≥ 300 mL (n=32)	19 (59.4)		
Total drain content		0.18 (0.03 to 1.20)	-0.341 (0.01[b)])
< 300 mL (n=10)	1 (10)		
≥ 300 mL (n=46)	25 (54.3)		

Values are presented as number (%), PRC, packed red cells.
[a)] Result of chi-square test; [b)] Result of Fisher's exact test.

Table 4 The hemoglobin before and after operation according to temporary drain clamping.

Variable	t (*p*-value)							
	Pre-op at day before operation	Post-op 2 hours	Post-op 24 hours	Post-op 48 hours	Pre-op change	Immediate post-op change	1st day post-op change	2nd day post-op change
Hemoglobin (g/dL)								
Group I	11.9 ± 1.5	11.6 ± 1.5	10.7 ± 1.5	10.9 ± 1.2	-0.995 (ns = 0.33)[c)]	1.756 (ns = 0.09)[c)]	5.153 (0.00)[b),c)]	1.578 (ns = 0.13)[c)]
Group II	12 ± 1	11 ± 1.4	11 ± 1.1	10.1 ± 1.1	1.578 (ns = 0.13)[c)]	3.793 (ns = 0.00) [b),c)]	1.884 (0.07)[c)]	3.748 (ns = 0.00) [b),c)]
p-value btw. group	ns = 0.75[a)]	ns = 0.17[a)]	ns = 0.56[a)]	0.04[a)]				

[a)] Result of two sample t-test; [b)] Result of chi-square test [c)] Result of Mann-Whitney U test;
Group I: non-continuous drain use, Group II: continuous drain use
btw.: Between ns: not significant

Discussion

Thoracolumbar spine trauma represents the most common area fractured in the spine[(7)]. In a large series of 3,142 patients with traumatic spinal fractures, Wang *et al*., 2012, reported that 54.9% of the patients had fractures in the thoracolumbar spine. Early surgery is recommended for unstable fracture[(8)]. In this study, the long segment fusion (three levels above and below fracture site) was used to stabilize the fracture. Blood loss and postoperative blood transfusion result in a risk of

hypovolemic, and blood transfusion complications. The purpose of this study was to evaluate the effectiveness and safety of non-continuous drain use in the terms of the reducing blood loss (total drain content, PRC transfusion need) wound complication and clinical outcome compared with continuous drain use following posterior instrumented fusion in thoracolumbar spinal injury.

For lumbar spine surgery, drain use after procedure vary among spine surgeons[6]. Recently, Waly et al. systematically reviewed the using of closed suction drains in patients who had undergone lumbar spine surgery and concluded that spine surgeons should not rely on routine closed suction drains but low and insufficient evidence were included[9].

Even though some studies reported increased postoperative anemia and blood transfusion in continue drain use compared to non-use, those studies were performed on the decompression procedure[1]. Our study was evaluated in posterior instrumented fusion in thoracolumbar spinal injury without decompression. The decompression usually causes more soft tissue or epidural vessel bleeding. The decompression and fusion procedure have more resected bone, the ongoing blood loss following procedure was higher than fusion alone. The results show that the non-continuous drain use has statistically significant reduce drain content at 8th hour (***p***-value = 0.044) and also shows a statistically significant difference of the hemoglobin before pre-operative and 48-hour post-operative (*p*-value = 0.04). The pre-operative PRC transfusion was 17.9% in non-continuous drain use group compared with 3.6% in continuous drain use group. These findings may result in the differences between pre- and postoperative because the hemoglobin value requires time for equilibration[10]. The exact pre-operative hemoglobin should be measured at 24 hours after PRC transfusion. The 2 hours clamping has decreased content at 8 hours by high pressure at the outflow of the drain line, however, this may not help to stop the ongoing bleeding after the releasing of the clamp. The post-operative blood transfusion was not shown to be statistically significant between both groups.

For wound healing, Andrew et al. study[11] has shown that drain use was not correlated with poor wound healing. There was no wound complication in this study. The incidence of the epidural hematoma was low[2,4-5,12] therefore no epidural hematoma found in this study. Similar to Brown study[12], compared the closed wound suction drain versus no drain in extensive lumbar spine surgery patients and reported no infection, epidural hematoma or neurologic deficits in either group as well as the Kanayama et al. study which reported the risk of wound infection and hematomas in single-level lumbar decompression surgery was not influenced by use of a drain[14].

The discontinue of the drain in this study (day 3-3.3) was similar to other studies which nearly all colleagues discontinue drains by day 4[6]. Prolong surgical drain retention demonstrated association with deep surgical site infection[15,16]. In the non-continuous drain group, there was evidence of shorter drain use but with no significance.

Poorman et al. reported a significantly longer length of hospital stay and increased blood loss in patients' who had undergone one-two level cervical spine fusion using a drain. The more blood loss in drain use group prolong the drain retained period and the hospital stay[17] . However, our study showed no difference of the total drain content between non-continuous and continuous drain groups, resulted in the similar drain retained period and hospital stay.

Major limitations of this study are of a retrospective nature. The patients were recruited and resulted in different average age between groups. The exclusion criteria were to reduce the bleeding tendency in both groups. The sample size of 56 patients may not provide the rare situations e.g. epidural hematoma. Further study with a larger sample size and or prospective design will add more information for the non-continuous drain use.

Conclusions

The use of non-continuous drain following posterior instrumented fusion in thoracolumbar spinal injury can reduce the level of postoperative hemoglobin difference. However, there was no statistically significant difference in terms of postoperative PRC transfusion, VAS, a total drain content, the entire period of drain use, the hospital stay and wound complications.

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การศึกษาเปรียบเทียบประสิทธิภาพและความปลอดภัยในการใช้สายระบายเลือดโดยอุดกั้นการระบายเลือดชั่วคราวหลังจากการผ่าตัดกระดูกสันหลังส่วนอก

กัณฐิกา วศินพงศ์วณิช, พบ, วีระ สุดประเสริฐ, พบ, เทอดพงษ์ ธนาวิริยะชัย, พบ, คงธัช ชูวงศ์โกมล, พบ

วัตถุประสงค์: *เพื่อศึกษาถึงประสิทธิภาพในแง่ของการลดการให้เลือดและความปลอดภัยในการใช้สายระบายเลือดโดยอุดกั้นการระบายเลือดชั่วคราวหลังจากการผ่าตัดกระดูกสันหลังส่วนอก*

วิธีการศึกษา: *ศึกษาโดยการเก็บข้อมูลผู้ป่วยย้อนหลัง โดยเปรียบเทียบผู้ป่วยที่ได้รับการผ่าตัดกระดูกสันหลังส่วนอกระหว่าง ปี พ.ศ. 2556 - 2559 ระหว่าง 2 กลุ่ม กลุ่มที่ 1 ผู้ป่วยได้รับการอุดกั้นการระบายเลือดชั่วคราวเป็นเวลา 2 ชั่วโมง หลังผ่าตัด กลุ่มที่ 2 ผู้ป่วยได้รับการระบายเลือดผ่านสายระบายเลือดตามปกติ ผู้ป่วยทั้ง 2 กลุ่มได้รับการประเมินปริมาณเลือดในขวดระบายเลือด ณ ชั่วโมงที่ 8, 16, 24, 48 และ 72 ชั่วโมงหลังผ่าตัด นอกจากนี้ ได้เก็บข้อมูลในเรื่องของระยะเวลาการใช้สายระบายเลือด ระดับความเข้มข้นของเลือดที่เปลี่ยนแปลง ระยะเวลานอน โรงพยาบาลการให้เลือดทดแทน ระดับความเจ็บปวด และภาวะแทรกซ้อนของแผล*

ผลการศึกษา: *ผู้ป่วยจำนวน 56 คนที่ได้รับการผ่าตัดเชื่อมกระดูกส่วนอกเป็นสัดส่วนเพศชายต่อเพศหญิง 18:10 อายุเฉลี่ย 38±18 ปี พบความแตกต่างอย่างมีนัยสำคัญทางสถิติ ระหว่างปริมาณสารในขวดระบายเลือด ณ เวลา 8 ชั่วโมงหลังผ่าตัด, การเปลี่ยนแปลงระดับความเข้มข้นของเลือด ระหว่างการหยุดกั้นสายระบายเลือด 2 ชั่วโมง กับกลุ่มควบคุม ในขณะที่การให้เลือดหลังผ่าตัด ระดับความเจ็บปวด ระยะเวลานอน โรงพยาบาลประมาณสารในขวดระบายทั้งหมด ระยะเวลาในการใช้สายระบายและภาวะแทรกซ้อนของแผลไม่แตกต่างกันอย่างมีนัยสำคัญทางสถิติในสองกลุ่ม*

สรุป: *การอุดกั้นสายระบายเลือดเป็นเวลา 2 ชั่วโมงหลังผ่าตัดในผู้ป่วยผ่าตัดกระดูกสันหลังส่วนอกไม่ช่วยลดการเสียเลือดจากสายระบายเลือดหลังผ่าตัดและไม่ลดโอกาสการให้เลือดหลังผ่าตัด ไม่ลดระยะเวลาการนอน โรงพยาบาล แต่ไม่เพิ่มภาวะแทรกซ้อนอย่างมีนัยสำคัญทางสถิติ*