DOI 10.18019/1028-4427-2017-23-2-180-186

Role of postoperative wound drains in spinal surgery

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Introduction There is no unified opinion on the use of drains and their indication in spinal surgery. The main discussion focuses on the issue of infection rate reduction and its prophylaxis. It is believed that drains increase postoperative morbidity: infectious complications, anemia, and indications to blood transfusion. **Material and methods** One hundred and fifty patients that underwent surgical interventions on the spine from the posterior surgical approach were included into this study. According to surgical invasiveness, patients were divided in groups. Group 1 was 29 persons with lumbar disc hernias. Group 2 were 85 patients with degenerative dystrophic diseases and posttraumatic deformities of the lumbar spine in one to three spine motor segments. Group 3 were 37 patients that had multilevel spinal deformities. Drains were not used in group 1 due to low invasiveness of the operation. Patients of groups 2 and 3 were divided into subgroups in which active drains were used or not used. Parameters for analysis were age, weight, duration of surgery, blood loss, length and deepness of wounds, duration of draining, amount of wound discharge, number of wound punctures and punctuate volume, duration of inpatient stay, associated diseases (arterial hypertension, diabetes, obesity and other chronic diseases in the remission stage), presence of infection complications in the postoperative period (superficial or deep), conduction of blood transfusion, neurologic deficits due to epidural hematoma. Method of variation statistics was used: calculation of mean (M) and its error (± m), r-Pierson correlation coefficient according to Chaddock scale; significance of statistical difference was assessed with Student's t-test. **Results and discussion** Most studies that assess the efficiency of using drains show no difference in wound healing, infectious complication rates and epidural hematomas in spinal surgery. Different requirements are defined to wound drains according to volume, duration, techniques and instrumentation used in surgery. Discectomies and interventions of decompression stabilization at one to three levels do not require wound drains. **Conclusion** Treatment results and complication rate do not depend upon surgical wound drains. Draining used in multilevel stabilization operations on the thoracic and lumbar spine with the variants of vertebrotomies increases the frequency of hemotransfusion in the postoperative period and inpatient stay.

Keywords: drainage, surgical wound, drain, infectious complication, blood loss, blood transfusion, epidural hematoma

Surgical interventions on the spine feature several specific differences: wound deepness at approach, spinal muscle mass, duration of surgery, bleeding, and use of various fixation systems. The surgeon stands at a dilemma of whether use or do not use wound drains.

Accumulation of blood and wound discharge in the cavity of a postsurgical wound may cause epidural hematoma, creates the risk of infection and myonecrosis, hinders wound healing and promotes secondary fibrosis [1, 2]. Hematoma associated with both muscle and epidural space fibrosis is the reason of postoperative pain syndrome, according to several authors [3, 4].

The main discussion on the use of drains in spinal surgery focuses on the issue of infection rate reduction and its prophylaxis. The efficiency of using drains for this purpose, especially by instrumentation fixation of the spine, is disputable [5, 6]. Draining tubes may cause local inflammation response at their introduction site and are the gates for infection penetration. A number of surgeons believe that the use of drains increases postoperative morbidity: infectious complications, anemia, and indications to hemotransfusion [7, 8].

There is no unified opinion on the use of drains and indications for their use in spinal surgery [9]. Most of the authors conclude that the use of drains does not affect the postoperative period course [2, 5, 7, 10].

Purpose of study Analysis of the treatment results by posterior surgical approach to the spine with postsurgical wound draining and without it by different volume of interventions and instrumentation.

Study design Prospective cohort randomized study

Material and methods

We present the treatment results of 150 patients who were divided into three groups according to invasiveness of operations performed. Group 1 was 29 patients with lumbar discs hernias. Surgical management comprised a low invasive removal of the disc hernia. Group 2 was 85 patients with degenerative diseases and posttraumatic deformities of the lumbar spine in one to 3 lumbar motor segments. The operation techniques used in them was decompression and stabilization with application of transpedicular fixation and PLIF. Group 3 was 37 patients with multilevel deformities of the spine. Variants of vertebrotomies and extended fixation of the thoracic and lumbar spine were used in this group. All operations performed followed the aseptic and antiseptic rules in the operation theatre, use of preventive antibacterial therapy (cephasolin) and thromboembolism prophylaxis (sodium enoxaparin).

Draining of postoperative wound was not used in

Gubin A.V., Prudnikova O.G., Burtsev A.V., Khomchenkov M.V., Kotelnikov A.O. Role of postoperative wound drains in spinal surgery. *Genij Ortopedii*. 2017. T. 23. No 1. pp. X-X. DOI 10.18019/1028-4427-2017-23-2-180-186

the group with intervertebral disc hernias due to low invasiveness of the operation. Patients of groups 2 and 3 were divided into subgroups in which active drains were used or not used. Hemostasis during the intervention was performed by electrocoagulation and local hemostatic means. Drains were installed upon completion of intervention. The draining system comprised two tubes that were placed paravertebral, exited through an additional skin incision, were fixed to the skin and connected with an active aspirator. Their checking and postoperative wound healing was realized during dressing change daily for three days, and then once in two days until patient's discharge from the hospital. Wound puncture and evacuation were performed if the discharge accumulated and there was wound fluctuation. Patients with intraoperative incidental durotomy were excluded from the study.

Parameters to analyze were patients' age, weight, duration of surgery, blood loss, wound size and deepness, duration of draining, amount of wound discharge, number of wound punctures and punctuate volume, duration of inpatient stay, associated diseases (arterial hypertension, diabetes, obesity and other chronic diseases in the remission stage), presence of infection complications in the postoperative period (superficial or deep), conduction of blood transfusion, neurologic deficits due to epidural hematoma.

Method of variation statistics was used: calculation of mean (M) and its error (± m), r-Pierson correlation coefficient according to Chaddock scale; significance of statistical difference was assessed with Student's t-test.

General characteristics of patients are given in **Table 1**.

General parameters of interventions are given in **Table 2**.

It should be noted that inpatient stay of group 1 patients after surgery is regulated by medico-economic standards and does not reflect the wound healing. Patients of groups 2 and 3 were discharged from the hospital upon wound healing and their general status stabilization.

Table 1

General characteristics of patients

	Group 1	Group 2		Group 3	
	Disc hernia (n = 29)	Interventions at 1 to 3 levels and fixation (n = 85)		Multilevel interventions and fixation (n = 36)	
		Draining used (n = 41)	No draining (n = 44)	Draining used (n = 20)	No draining (n = 16)
Age, years	43.7 ± 9.2	53.3 ± 9.0*	52.7 ± 8.5*	37.8 ± 14.1*	34.3 ± 15.5*
Males/females	17/12	20/21	28/16	3/17	6/11
Weight, kg	79.2 ± 11.8	90.4 ± 15.6*	81.7 ± 12.1*	61.9 ± 9.9*	62.0 ± 7.8*
Arterial hypertension, %	37.9	51.2	65.9	20	6.25
Diabetes, %	3.4	9.7	4.5	5	6.25
Obesity, %	3.4	7.3	11.3	0	0
Other chronic diseases, %	17.2	26.8	15.9	15	18.75

* – significance of difference between subgroups (drains used or not used) according to Student's t-test, $p < 0.05$

Table 2

General parameters of surgical interventions

	Group 1	Group 2		Group 3	
	Disc hernias (n = 29)	Interventions at 1 to 3 levels and fixation (n = 85)		Multilevel interventions and fixation (n = 36)	
		с дренажом (n = 41)	без дренажа (n = 44)	с дренажом (n = 20)	без дренажа (n = 16)
Operation time, min	61.8 ± 17.7	118.0 ± 31.7*	92.1 ± 24.3*	165.2 ± 33.0*	176.8 ± 43.6*
Blood loss, ml	54.8 ± 31.7	201.2 ± 82.6*	179.3 ± 102.2*	367.5 ± 158.0*	393.7 ± 172.0*
Wound length, mm	39.4 ± 9.7	107.9 ± 24.8*	90.6 ± 22.6*	286.2 ± 76.9*	262.2 ± 64.0*
Wound deepness, mm	45.1 ± 8.4	65.2 ± 12.1*	60.9 ± 9.3*	52.5 ± 9.5*	55.9 ± 15.2*
Postoperative in patient stay, days	9.6 ± 2.2	9.1 ± 1.5*	9.7 ± 1.9*	13.45 ± 4.8*	12.8 ± 2.3*

* – significance of difference between subgroups (drains used or not used) according to Student's t-test, $p < 0.05$

RESULTS

As far as drains were not used in group 1, it is impossible to conduct a comparative analysis. Mean period of wound healing was 3.3 ± 0.7 days. Wound healed by primary intension. Wound puncture and revisions were not performed. Neurologic complications due to epidural hematoma were not diagnosed.

Comparative analysis of treatment outcomes in group 2 did not reveal any statistical difference between the subgroups (**Table 3**).

Patients both with drains and without them did not have any neurologic complications due to epidural hematoma.

Infectious complications such as a superficial inflammation along with diverged postoperative wound edges were diagnosed in one patient (2.4 %) after discharge from the hospital who had drains and one patient (2.2 %) who did not have them. Inflammation was stopped with conservative treatment and the wound healed under the crust. Deep inflammation was not detected.

Total blood loss calculated was considerably lower (by 62 %) in patients without drains. Total blood loss weakly correlated both with the duration of inpatient stay and arterial hypertension in patients with and without drains. Other associated diseases (diabetes, obesity, etc.) did not have any impact on the inpatient stay.

In patients with drains, the area of the surgical wound (mm^2) correlated weakly with weight (r = 0.3) and total blood loss (r = 0.3) and did not influence the terms of inpatient stay after surgery (r = -0.3) (**Fig. 1**).

Correlation between the surgical wound area and patient's weight was not revealed in the absence of drains (r=-0.1) either, as well as total volume of blood loss (r=0.1) but a moderate correlation was revealed with the terms of inpatient stay after surgery (r = 0.4) (**Fig. 2**).

The comparison of treatment results in group 3 did not reveal any neurologic complications in the subgroups with drains and without them (**Table 4**).

The total blood loss in this group was 31 % more in patients with drainage than in patients without drains. But even draining for 3 days did not exclude wound puncture and evacuation of the hemorrhagic discharge in 30 % of cases after the removal of drains. Indication for puncture was the discharge accumulation in the wound cavity and subcutaneous fluctuations. In patients without drains, aspiration puncture of the surgical wound was performed in 87.5 % of cases. Blood transfusion during drainage was performed on indications in post-hemorrhagic anemia in 30 % of patients, without drainage – in 6.25 % of patients.

Table 3

Treatment parameters analyzed in group 2

	Group 2: Interventions at 1 to 3 levels and fixation (n = 85)	
	Drains used (n = 41)	Drains not used (n = 44)
Operation time, min	118.0 ± 31.7*	92.1 ± 24.3*
Intraoperative blood loss, ml	201.2 ± 82.6*	179.3 ± 102.2*
Area of the surgical wound, mm^2	6984.1 ± 1642.7*	5491 ± 1347.9*
Drain period, days	2.2 ± 0.3	–
Discharge volume, ml	336.5 ± 90.7	–
Wound puncture, % of patients	–	15.9
Puncture volume, ml	–	157.1 ± 82.1
Total blood loss calculated, ml	537.8 ± 131.2*	204.3 ± 126.7*
Superficial inflammation, %	2.4	2.2
Deep inflammation, %	–	–
Neurologic complications due to epidural hematoma, %	–	–
Blood transfusion, %	–	–
Inpatient stay after surgery, days	9.1 ± 1.5*	9.7 ± 1.9*

* – significance of difference between subgroups (drains used or not used) according to Student's t-test, $p < 0.05$

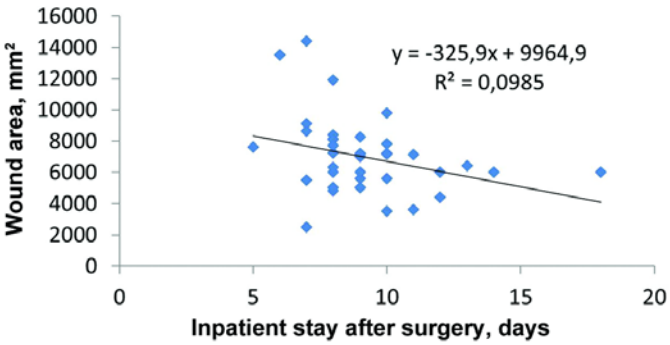

Fig.1 Regression line of the surgical wound area and inpatient stay of patients with drains (group 2)

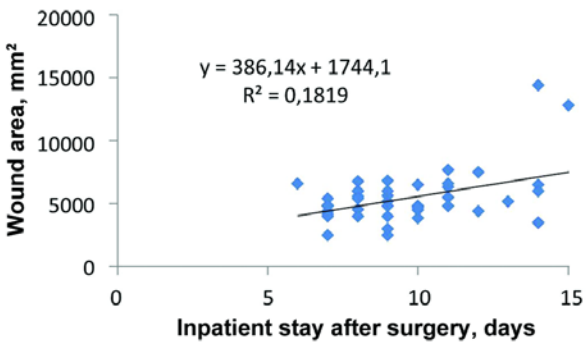

Fig. 2 Regression line of the surgical wound area and inpatient stay of patients without drains (group 2)

Correlation between the total amount of blood loss and the duration of hospital stay after surgery was significantly higher (r = 0.7) in patients with drainage than in patients without drains (r = 0.3) (**Fig. 3**).

In this group of patients, the amount of blood loss did not correlate with arterial hypertension. There was no significant correlation between inpatient stay and concomitant diseases either. The relationship between the surgical wound area and the total amount of blood loss in patients with drainage and without it was weak (r = 0.4 and r = 0.1, respectively). A moderate correlation was found between the area of the surgical wound and the stay in the hospital after surgery in patients with draining (r = 0.7) and it was low (r = 0.2) in patients without drains (**Fig. 4** and **Fig. 5**).

Table 4

Treatment parameters analyzed in group 3

	Group 3: Multilevel interventions and fixation (n = 36)	
	Drains used (n = 20)	Drains not used (n = 16)
Operation time, min	165.2 ± 33.0*	176.8 ± 43.6*
Intraoperative blood loss, ml	367.5 ± 158.0*	393.7 ± 172.0*
Area of the surgical wound, mm^2	15045 ± 5165.2*	15746.8 ± 7043.7*
Drain period, days	2.5 ± 0.5	–
Discharge volume, ml	485 ± 139.5	–
Wound puncture, % of patients	30*	87.5*
Puncture volume, ml	281.6 ± 110.4*	285.7 ± 111.4*
Total blood loss calculated, ml	937.0 ± 319.7*	643.7 ± 248.5*
Superficial inflammation, %	–	–
Deep inflammation, %	–	–
Neurologic complications due to epidural hematoma, %	–	–
Blood transfusion, %	30*	6.25*
Inpatient stay after surgery, days	13.45 ± 4.8*	12.8 ± 2.3*

* – significance of difference between subgroups (drains used or not used) according to Student's t-test, $p < 0.05$

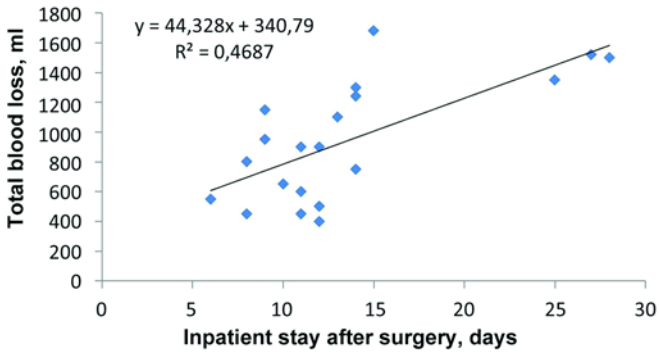

Fig. 3 Regression line of total blood loss and inpatients stay of patients with drains (group 3)

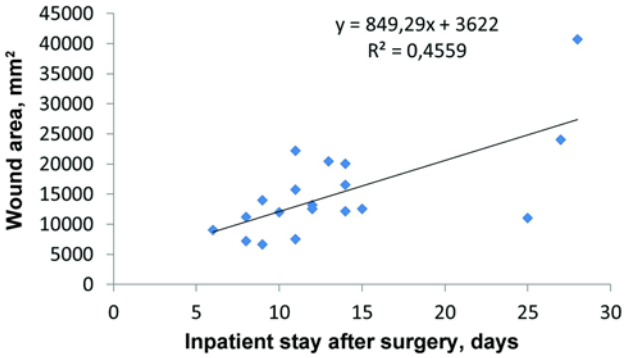

Fig. 4 Regression line of the surgical wound area and inpatient stay of patients with drains (group 3)

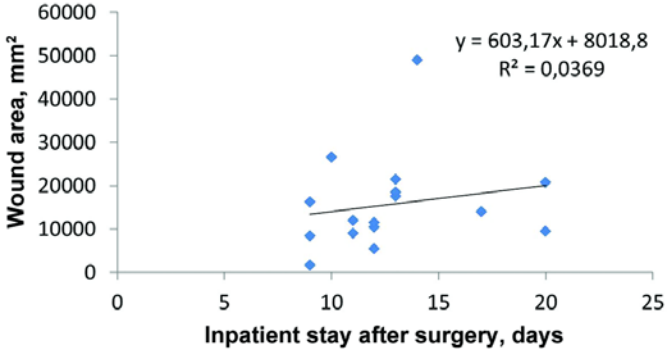

Fig. 5 Regression line of the surgical wound area and inpatients stay of patients without drains (group 3)

DISCUSSION

The main purpose of using drains in spinal surgery is evacuation of postoperative hematoma and prevention of complications associated with its presence. Discussion issues are wound healing terms, infectious complications, symptomatic epidural hematomas and blood transfusion in the postoperative period.

Waly F. et al. (2015) in their systematic review that included five studies evaluating the use of draining in the surgery for lumbar spine degenerative diseases concluded that there was no difference in the incidence of infectious complications and postoperative hematomas in patients with wound drainage and without it. However, the small size of the published samples, the lack of data on other concomitant and aggravating factors could affect the results of the studies [9].

In the published meta-analysis with the data from randomized and non-randomized controlled trials, Liu Y., Li Y., and Miao J. (2016) found no significant difference between the drainage and non-drainage groups relative to the incidence of infectious complications, symptomatic epidural hematoma, and blood transfusion. Infectious complications occurred in 1.68 % of cases with the use of drains and in 1.32 % in groups without drains [11].

MRI studies in the postoperative period showed a much smaller volume of hematomas in the intervention zone in the presence of drains [3]. However, other studies found a greater amount of hemorrhagic discharge on the bandages, indicating an independent evacuation of the hematomas if present [4, 5, 12]. Some studies showed that drainage does not increase blood loss in the postoperative period, and thus the number of blood transfusions does not increase [10-12].

The rate of symptomatic epidural hematomas which can lead to neurologic impairment (motor deficiency, sensory disorders, pelvic organ dysfunction) is reported as 0.1-2.9 % and in some cases requires surgical treatment [2, 7, 13]. With standard -0, the complication rate is 0 %, with lumbar laminectomy and spinal fusion it is 0.45-0.67 %, with decompression of the thoracic region it makes 4.46 % [14]. In our study, no symptomatic epidural hematoma was diagnosed in any group of patients.

A comparative analysis of Blank J., Flynn J.M., Bronson W., and Ellman P. (2003) of posterior instrumental fixation in patients aged 11-18 years with idiopathic scoliosis showed that the use of drains can reduce the rate of wound complications without a significant need for blood transfusion. In the group with wound draining, blood transfusion was more frequent (without statistical significance). In the group without drains, evacuation of hematoma occurred in 58 % of cases via the wound that worsened its healing, and three out of 12 patients showed superficial inflammation [12].

The results of a multicentre retrospective study of Diab M. et al. (2012) testify to the absence of differences in the incidence of infectious and neurological complications, as well as the length of hospitalization in patients aged 13-18 years with multilevel posterior instrumental fixation in idiopathic scoliosis. But the frequency of hemotransfusion in patients with drains was 43 % versus 22 % without them [15].

According to Walid M.S. et al. (2012), the rate of blood transfusion in posterior interventions on the lumbar spine was 23.9 % for cases with wound draining and 6.8 % in the absence of draining [10]. In a survey of Waly F. et al. (2015), blood transfusion in similar interventions was performed in 28.8 % of patients by draining, and without drainage in 11.4 % of patients [9].

In our study, adults with multilevel fixations of the thoracic and lumbar spine for spinal deformities showed a statistically significant ($p < 0.05$), 5 times greater frequency of blood transfusion in patients with wound draining. The total blood loss in patients with drainage was 31 % more than in patients without drains. In this group of patients, postoperative wound care required the evacuation of a wound discharge with a syringe both in patients without drains and with drains (after their removal) in order to prevent the bleeding of the hematoma through the edges of the wound, followed by their divergence and prolonged healing.

In the group of patients with one to three-level interventions and stabilization of the lumbar spine, blood transfusion was not performed both in patients with and without draining. The total blood loss was significantly lower (by 62 %) in patients without wound draining.

According to the literature, the rate of infectious complications in spinal surgery is 0.7-6 % but grows if fixation devices are used [3, 10, 16]. The effectiveness of using drains to prevent infectious complications by instrumental fixation of the spine is controversial [5, 6]. A negative aspect in the use of drainage is the presence of an entrance route at the site of draining tube installation and the presence of an additional foreign body in the surgical wound communicating with the external environment.

In a comparative analysis of two groups after lumbar discectomy, Choi H.S. et al. (2016) found that drains did not elevate infectious complications [7].

In our study, infectious complications of postoperative wounds were superficial and were noted in patients

with one to three-level decompression-stabilizing interventions in the lumbar spine with drainage in 2.46 % of cases and without drainage in 2.2 %. Deep inflammation was not diagnosed.

Associated diseases (diabetes mellitus, obesity, or other chronic diseases) did not affect the course of the postoperative period. Neither the area of the surgical wound nor hypertension correlated with the volume of blood loss in both groups of patients.

The patients were discharged from the hospital as their general condition stabilized, the neurological manifestations of the disease subsided, and the postoperative wound healed. In the group of patients with multilevel fixation of the spine in the presence of drainage, the stay in the hospital after the operation significantly increased. This group had a greater total blood loss and more blood transfusion occasions that required a longer period of time to stabilize the condition and the increase in their inpatient stay.

In patients with one to three-level decompression-stabilizing interventions on the lumbar spine without wound draining, a moderate correlation between the size of the surgical wound and the length of stay in the hospital after surgery was observed.

In our group of patients with discectomy, drainage of wounds was not used due to a minimally invasive nature of the intervention, small size of surgical wounds and insignificant blood loss. These patients had no symptomatic epidural hematomas, infectious complications or blood transfusions.

CONCLUSION

Discectomy and one- to three-level decompression-stabilizing operations on the lumbar spine do not require wound drainage. The results of treatment and the complication rate do not depend on the presence of drains in the surgical wound.

In multilevel stabilizing operations on the thoracic and lumbar spine with vertebrotomy variants, drainage of the wound increases the rate of blood transfusions in the postoperative period and prolongs the period of hospitalization. These interventions are in most cases accompanied by the accumulation of hemorrhagic discharge in the cavity of the wound even after removal of the drains. In order to prevent the hematoma from emptying through the edges of the wound and the delay of its healing, we recommend extracting the wound discharge with a syringe. The indication for this manipulation is a visualized accumulation of the discharge in the wound cavity with a soft tissue tension and fluctuation.

The tactics of surgical wound care and drainage always remains the surgeon's choice and is determined by his/her training and practice.

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Received: 23.11.2016

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