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Evaluation of the benefit of placing a drain in the epidural space in patients undergoing craniotomy

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ABSTRACT

Background. Placing a drain in each of the intracerebral, subdural, epidural, and subgaleal spaces during craniotomy may be a result of the traditional approach. It may be more appropriate to identify the locations of the drains individually for each case and avoid certain behaviours. We, therefore, planned a study on the necessity of epidural drains, which are commonly used.

Methods. The study was conducted by screening the charts of the patients who had undergone surgery at İzmir Bakırçay University Çiğli Training and Research Hospital's Neurosurgery Department between June 1st 2021 and September 1st 2022. The study was of the retrospective cohort type. There were two groups in the study. Twenty cases where only a subgaleal drain was used formed the first group (SG group). Twenty cases where subgaleal and epidural drains were used together formed the second group (SG+E group). A total of three parameters were evaluated between these groups. The first parameter was the myocutaneous tissue thickness on the first postoperative day. The second one was epidural collection thickness on the first postoperative day. The third parameter was the rate of wound site infection development in the two groups. The results of the two groups were compared with the Wilcoxon rank sum test. A two-way p-value below 0.05 was considered statistically significant.

Results. A statistically significant difference was present between the two groups in terms of myocutaneous tissue thickness ($p=0.035$). The mean myocutaneous tissue thickness was 15.8±3.24 mm in the SG+E group and 12.4±5.98 mm in the SG group. The mean epidural collection thickness in the SG+E group was higher than in the SG group and the difference was significant (10.3±3.29 mm and 6.30±3.13 mm, respectively, $p<0.001$). No infection developed in any of the patients in either group.

Conclusion. In patients undergoing craniotomy, placing a drain in the epidural space may be an ineffective intervention. The basic principle should be to complete the operation in the least invasive manner and the shortest time possible.

Keywords
epidural, drain, craniotomy, benefit

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INTRODUCTION

Manuals play a very important role in neurosurgery operating procedures. It is also common to be influenced by a senior in the form of a master-apprentice relationship and to maintain this influence over the years. There may sometimes be problems with this arrangement but appropriate surgical behavior is usually observed. Placing a drain in

each of the intracerebral, subdural, epidural, and subgaleal spaces during craniotomy may be a result of this traditional approach. It may be more appropriate to identify the locations of the drains individually for each case and avoid certain behaviors. We therefore planned a study on the necessity of epidural drains, which are commonly used.

Materials and Method

The study was conducted by screening the charts of the patients who had undergone surgery at İzmir Bakırçay University Çiğli Training and Research Hospital's Neurosurgery Department between June 1st 2021 and September 1st 2022. The study was of the retrospective cohort type. The inclusion and exclusion criteria were as follows.

Inclusion Criteria:

1. Supratentorial pathology
2. Cranial tumors, cranial vascular surgery cases, cranial compression fractures, and cranial epidural hematomas
3. Those with a subgaleal drain among the above cases
4. Those with a subgaleal and epidural drain among the above cases

Exclusion Criteria:

1. Infratentorial pathologies
2. Subdural hematomas
3. Cases with a subdural drain
4. Cases without any drain
5. Patients with uncontrolled or untreated comorbidities that could facilitate the development of wound site infection
6. Patients with a coagulation disorder

There were two groups in the study. Twenty cases where only a subgaleal drain was used formed the first group (SG group). Twenty cases where subgaleal and epidural drains were used together formed the second group (SG+E group). A total of three parameters were evaluated between these groups. The first parameter was the myocutaneous tissue thickness on the first postoperative day. The second one was epidural collection thickness on the first postoperative day. While performing the calculations, the thickest part of the relevant area was measured in coronal sections of cranial tomography. The distance from the highest point of the scalp to the bone was measured when calculating the second parameter. The third parameter was the rate of wound site infection development in the two groups. In order to evaluate the third parameter, the patients were followed-up for local infectious changes in the wound for 15 days.

Descriptive statistics were expressed as numbers and percentages for categorical variables and as mean±standard deviation for constant variables. The results of the two groups were compared with the Wilcoxon rank sum test. A two-way p value below 0.05 was considered statistically significant. The analyses were performed with the R software, version 4.0.0.

Results

There were 12 females (60%) and 8 males (40%) in Group 1. The mean age was 56.3 years. Group 2 included 9 females (45%) and 11 males (55%). The mean age was 63.4 years. Myocutaneous tissue thickness and epidural collection thickness measurements of all patients are shown in Table 1 and Table 2.

Table 1. Myocutaneous tissue thickness measurements in the tomography of the patients in Group 1 (subgaleal drain) and Group 2 (subgaleal+epidural drain) on the 1st postoperative day (mm).

Patient	Group 1 (SG)	Group 2 (SG+E)
1	15	13
2	14	16
3	7	9
4	7	18
5	14	14
6	15	15
7	18	16
8	16	18
9	7	12
10	10	15
11	6	15
12	7	16
13	22	21
14	15	24
15	25	18
16	20	13
17	3	16
18	6	18
19	11	15
20	10	14

Table 2. Epidural collection tissue thickness measurements in the tomography of the patients in Group 1 (subgaleal drain) and Group 2 (subgaleal+epidural drain) on the 1st postoperative day (mm).

Patient	Group 1 (SG)	Group 2 (SG+E)
1	11	8
2	10	11
3	3	5
4	5	12
5	5	9
6	12	8
7	13	10
8	7	10
9	6	9
10	5	8
11	4	12
12	6	16
13	3	9
14	8	19
15	3	12
16	5	15
17	3	8
18	6	9
19	3	8
20	8	8

A statistically significant difference was present between the two groups in terms of myocutaneous tissue thickness (p=0.035, Table 3, Figure 1). The mean myocutaneous tissue thickness was 15.8±3.24 mm in the SG+E group and 12.4±5.98 mm in the SG group.

The mean epidural collection thickness in SG+E group was higher than in the SG group and the difference was significant (10.3±3.29 mm and 6.30±3.13 mm, respectively, p<0.001, Table 3, Figure 2).

Table 3. The comparison of myocutaneous tissue and epidural collection thickness between Group 1 (subgaleal drain) and Group 2 (subgaleal+epidural drain).

	All patients, n=40	Group 1 (SG), n=20	Group 2 (SG+E), n=20	p
Myocutaneous tissue thickness (mm)	14.1±5.05	12.4±5.98	15.8±3.24	0.035
Epidural collection thickness (mm)	8.30±3.76	6.30±3.13	10.3±3.29	<0.001

Group 1 and Group 2 were also compared in terms of infection development. No infection developed in any of the patients in either group. These results were not suitable for statistical analysis.

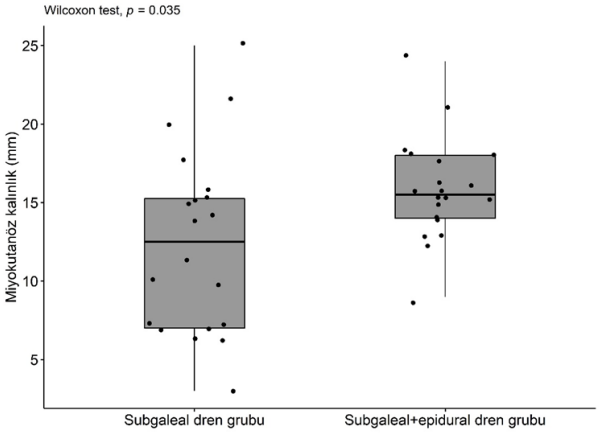

Figure 1. The comparison of myocutaneous tissue thickness between Group 1 (subgaleal drain) and Group 2 (subgaleal+epidural drain).

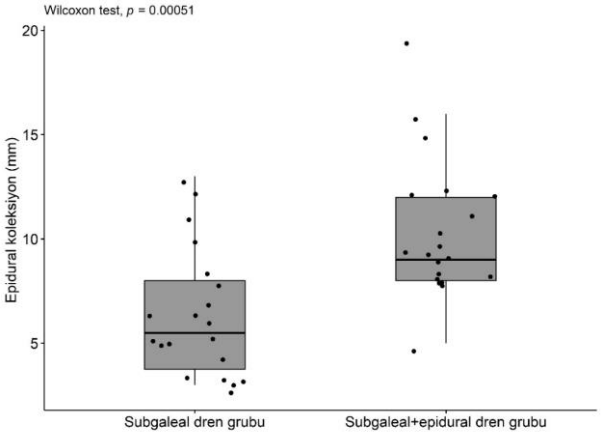

Figure 2. The comparison of epidural collection thickness between Group 1 (subgaleal drain) and Group 2 (subgaleal+epidural drain).

Discussion

Neurosurgeons place a drain in the epidural space on the assumption that it will decrease hematoma development and related complications at the surgical site. This practice is sometimes maintained as a habit or because the physician has learned this from a senior (1). We evaluated whether epidural drain placement is beneficial in the current study. We also wanted to see how a catheter placed in the epidural area changes infection rates. Historically, subgaleal drains were first used by Ames et al. (6). The number of studies evaluating the effect of placing subgaleal plus epidural drains or only subgaleal drains after craniotomy on the infection

and other complication rates is low. The number of studies comparing the relative benefits of drain location is also low. We believed that a simple and conclusive study was required. This study was planned to understand the necessity, advantages, and disadvantages of epidural drain placement and to evaluate the adequacy of using a subgaleal drain only.

The results indicated that the epidural hematoma thickness on the first postoperative day in patients with both subgaleal and epidural drains (S+E) was statistically significantly higher than those with a subgaleal drain only (S). These results demonstrate that the current approaches are incorrect. The reason for the current results may be the accumulation of blood oozing from the bone in the epidural area while opening the epidural catheter site and the widening of the burr hole for the drain. Another possibility is the insufficiency of the suspending sutures where the drain is placed in the epidural space. Although it is difficult to reach a clear conclusion, these are the primary factors to consider.

The current results make epidural catheter use controversial. Drain placement in Group 2 (S+E) patients actually prolongs the duration of surgery. At this stage, the surgeon places the drain in the epidural space, fixes it, and widens the burr-hole to prevent compression in the area where the drain will pass in the craniotomy flap and calvarium. All these cause loss of time and prolongation of the surgery. We observed this procedure to take 7 minutes on average in our cases. Although not on a case-by-case basis, this would indicate a serious collective waste of time considering the high number of cranial surgeries performed. At the same time, widening the burr-hole where the epidural drain will pass creates an additional defect. This makes the procedure more invasive.

Another important point is that large amounts of CSF drainage can occur when watertight suturing cannot be achieved in the dura and the epidural drain is directed below the ear level. Complications such as subdural hematoma, decreased intracranial pressure, headache, brain edema, intracerebral hematoma, herniation, coma, and death may occur (2,3). A case where large amounts of cerebrospinal fluid drainage and low intracranial pressure following subdural hematoma surgery caused cerebellar hematoma (the zebra sign) is present in the literature. The hydrocephalus that developed later was reported to cause serious prolongation of hospitalization and decrease the Glasgow outcome score of the patient (9). The point we want to emphasize by providing this example is that an epidural catheter can also increase morbidity due to excessive CSF drainage.

Blood accumulation in the epidural space remains limited when the epidural space is reduced by suspending the dura with suspension sutures. The reason may be the prevention of potential bleeding with pressure as the space is reduced. Besides, the blood may have passed from the bone defects at the craniotomy borders to the subgaleal area and then drained from there with the subgaleal drain. We believe that both these factors played a role. Placing a drain in the epidural space to decrease epidural hematoma may therefore be useless. An epidural hematoma quickly solidifies once it develops and cannot enter the drain. The main approach to decrease an epidural hematoma should be to suspend the dura at appropriate intervals in order to reduce the epidural dead space.

An epidural drain has been reported to be effective in preventing subgaleal collection when the dura cannot be closed watertight during craniotomy in the parietal region in a study by Xin Li et al. However, a drain was not used in the control group in that study. We believe that similar results could also be observed if a subgaleal drain had been used in the control group. Subgaleal drainage is also a less invasive and more practical method than epidural drainage (10).

Philip A Boney et al. have reported that the location of the drain used in epidural hematoma was associated with repeat surgery and the length of the hospital stay due to residual or recurrent hematoma. They reviewed 52 cases, with a subgaleal drain in 25, epidural drain in 8, and both in 13 patients, no drain was used in 6 cases. The location of the drain was not found to be statistically significant as regards repeat surgery, but the length of hospitalization decreased as the use of drains decreased. These results are similar to ours (11).

The issue also needs to be evaluated in terms of susceptibility to infection. No statistically significant difference in terms of infection was found between the two groups in our study. Placing a second drain could increase the chance of skin bacteria being carried in. The procedure is also more invasive. The

increased duration of the surgery could increase the risk of infection (4).

The two groups in the current study were evaluated in terms of myocutaneous tissue thickness on the first postoperative day. The value was statistically significantly lower in Group 1 (SG). The reason could be the blood leaking from the bone tissue, muscle, and skin-subcutaneous tissue during epidural drain placement. An increased myocutaneous tissue thickness could impair wound healing. Any collection must be removed. The hospital stay of the patient will then be prolonged. From this point of view, placement of an epidural catheter may do more harm than good.

Prophylactic drain placement has been discontinued over the years in many surgical procedures other than neurosurgery. Schietroma M et al. have reported routine drain use after thyroidectomy to be unnecessary and postoperative drain placement to increase pain (7). Besides, the use of a drain after lumbar surgery did not change the epidural hematoma or infection rate but increased the patient's pain-related symptoms (8). However, the number of neurosurgical studies on this issue is inadequate. A subgaleal collection could prolong wound healing. A scalp hemorrhage can develop into a chronic cavity and cause serous fluid accumulation when a subgaleal drain is not placed, as this is a very vascular area. It can also impair wound healing and predispose to wound infection. Therefore, we think that a subgaleal drain is necessary. However, the subgaleal space is tighter close to the vertex and a subgaleal drain is not used with limited incisions close to the vertex in practice. The basic principle should be to complete the operation in the least invasive manner and the shortest time possible.

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