Original Article

Adaptive Non Watertight Versus Watertight Dural Closure in Supratentorial Craniotomies

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ABSTRACT

Background: Watertight dural closure has been taken for granted among generations of neurosurgeons. In many situations, dura could not be primarily watertightly closed or intentionally left open during intracranial craniotomies. Objectives: To compare postoperative complications related to CSF leak after adaptive non watertight dural closure to standard watertight dural closure during supratentorial craniotomies in absence of hydrocephalus. Patients and Methods: Prospective cohort study of seventy two Patients with supratentorial pathologies located in three groups according to method of dural closure, primary or secondary watertight closure and adaptive non watertight closure, to investigate postoperative complications related to dural closure and CSF leak. Results: Postoperative complications occurred in three cases of group A, four cases of group B and six cases of group C. Subcutaneous CSF collection occurred in one case 4% (Group A), one case 5% (Group B) and two cases 8% (Group C). CSF leak occurred in one case in each group (4% in group A, 5% in group B, 4% in group C) with no need for surgical intervention. Delayed wound healing without CSF leak and with no need for surgical intervention in one case 4% (group A), one case 5% (group B), two cases 8% (group C). Meningitis occurred only in one case 5% (group B) and one case 4% (group C). All complications were non significant between the three groups (P value < 0.05). Conclusion: Adaptive non watertight dural closure could be a good, safe and fast alternative to primary or secondary watertight dural closure in supratentorial craniotomies but not superior to them.

INTRODUCTION

It has been taken for granted among generation of neurosurgeons that watertight dural closure should be done at the end of intracranial operative procedures. This concept started in 1908 when Henry Cushing stated that dura should be accurately approximated in its two layers.1,2

In many situations, primary watertight dural closure could not be done3-7 and in others, dura is left intentionally open as in extracranial bypass surgery as the dura is completely excised over the cortical area of anastomosis between the superficial temporal and recipient cortical arteries without increased risk of CSF leak or wound infection8-10

Based on surgeons’ experience of extracranial bypass surgery, researchers recommended to reevaluate necessity of watertight dural closure in other supratentorial intracranial surgeries as patients with supratentorial pathologies seem to have lesser risk of overt CSF leak.1,11,12

PATIENTS AND METHODS

A prospective cohort study of seventy two patients with supratentorial pathologies who underwent surgery at our Unit of Neurosurgery Department in Ain Shams University Hospitals between February 2014 and end of December 2015.

In this study, we aimed to investigate postoperative complications after three different methods of dural closure in supratentorial intracranial surgeries and to compare patients in whom primary or secondary watertight dural closure was done with those who had adaptive non watertight dural closure. Clinical outcome and postoperative complications were assessed.

Patients included in the study were between 18 and 65 years old with supratentorial lesion (tumors, vascular, others like hematomas) and underwent elective surgery. Patients with infratentorial or spinal intradural lesions, underwent previous intracranial surgery, have hydrocephalus or CSF shunt, received radio- or chemotherapy, have local or systemic infection, immuno-compromised, patients reopened due to any cause in the early postoperative period and patients developed postoperative hydrocephalus were excluded.

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Three Groups were investigated: twenty six cases in group A (primary watertight dural closure), twenty one cases in group B (secondary watertight dural closure) and twenty five cases in group C (adaptive non watertight dural closure) for postoperative complications related to dural closure and CSF leak.

In group A, the dura was closed with simple interrupted sutures with vicryl 4-0 with interspace of 2-3 mm. In group B, the dura was closed in the same manner but with pericranial grafting.

In group C, the dural margins were only adapted (approximated) with three to six interrupted simple sutures with vicryl 4-0 with interspace of 2-3 cm.

After closing the dura, all further operative steps were the same in all three groups.

The dura was covered with sponge gel and fixation of the bone flap with vicryl no. 1 was done. The muscular and galeal layers were closed with simple interrupted sutures with vicryl 2-0 and the skin was closed with simple interrupted sutures with vicryl 3-0.

Prophylactic preoperative antibiotic was given in all three groups. Subgaleal drain was inserted in all three groups.

Postoperative follow up period was the first four weeks after surgery and incidence of postoperative complications was recorded. Postoperative complications were subgaleal fluid collection, CSF leak, impaired wound healing with or without CSF leak, wound infection, meningitis and postoperative hydrocephalus.

Meningitis was diagnosed by high grade fever (>38.5°C), CSF cell counts >200/μL, CSF glucose <45 mg/dL, white blood cell count >10^9/L, or positive bacteriological findings in CSF samples.

Postoperative hydrocephalus was diagnosed by serial follow up computed tomographic scans.

**RESULTS**

This study was a prospective cohort study. We compared the outcome of primary and secondary watertight dural closure done by some surgeons in our unit with the outcome of adaptive non watertight dural closure done by us.

Secondary watertight dural closure was done instead of primary watertight closure due to dural shrinkage caused by bipolar coagulation (6 cases), dural contraction as a result of dural dessication (10 cases) or dural excision in 5 cases of convexity meningioma.

**Table 1** shows patient characteristics in the three groups including age, sex, risk factors and histopathology which were non significant (p value <0.05) and homogenously distributed among these three groups.

**Table 2** shows postoperative complications of the three groups.

Seventy two Patients are included in this study. In twenty six patients, dura was closed primarily watertight (Group A). Secondary watertight dural closure was done in Group B, twenty one patients (a scalp periosteal graft was used for watertight dural closure). In Group C, dura of twenty five patients was just adapted.

Postoperative complications (as shown in figure one) occurred in three cases of group A, four cases of group B and six cases of group C. Subcutaneous CSF collection occurred in one case 4% (Group A), one case 5% (Group B) and two cases 8% (Group C). No surgical intervention was needed for all cases of subcutaneous CSF collection as CSF collection gradually and spontaneously subsided and resolved (non significant between the three groups, P value < 0.05)

CSF leak occurred in one case in each group(4% in group A, 5% in group B, 4% in group C) with no need for surgical intervention. It was managed with tight bandage in two cases (of Group A and C) and subarachnoid lumbar drain for three days in one case (Group B) and CSF leak stopped after that (No significance of CSF leak was found between the three groups)

Delayed wound healing without CSF leak and with no need for surgical intervention in one case 4% (group A), one case 5% (group B), two cases 8% (group C). It was managed with daily dressing under coverage of antibiotics according to culture and sensitivity with delayed hospital stay (nine days till sutures were removed) (non significance between the three groups)

Meningitis occurred only in one case 5% (group B) and one case 4% (group C) (non significant between the three groups). It was managed with empirical antibiotics (positive CSF culture and sensitivity in one case of group C) (non significant between the three groups), (Figure 1).
Table 1: Patients characteristics

<table>
<thead>
<tr>
<th>Group</th>
<th>Primary watertight, (n=26)</th>
<th>Secondary watertight, (n=21)</th>
<th>Adaptive (Dural approximation), (n=25)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (±SD)</td>
<td>54.3 (±12.4)</td>
<td>48.9 (±11.7)</td>
<td>55.6 (±10.4)</td>
</tr>
<tr>
<td>Males</td>
<td>15 (58%)</td>
<td>10 (48%)</td>
<td>13 (52%)</td>
</tr>
<tr>
<td>Females</td>
<td>11 (42%)</td>
<td>11 (52%)</td>
<td>12 (48%)</td>
</tr>
<tr>
<td>Smoking</td>
<td>9 (35%)</td>
<td>6 (29%)</td>
<td>7 (28%)</td>
</tr>
<tr>
<td>Diabetes</td>
<td>7 (27%)</td>
<td>5 (24%)</td>
<td>6 (24%)</td>
</tr>
<tr>
<td>Diagnosis (Pathology)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Meningioma</td>
<td>9 (35%)</td>
<td>7 (33%)</td>
<td>3 (12%)</td>
</tr>
<tr>
<td>Glioblastoma multiform</td>
<td>6 (23%)</td>
<td>4 (19%)</td>
<td>9 (36%)</td>
</tr>
<tr>
<td>Low grade glioma</td>
<td>5 (19%)</td>
<td>4 (19%)</td>
<td>6 (24%)</td>
</tr>
<tr>
<td>Metastasis</td>
<td>3 (12%)</td>
<td>2 (10%)</td>
<td>3 (12%)</td>
</tr>
<tr>
<td>Vascular (Aneurysm)</td>
<td>1 (4%)</td>
<td>1 (5%)</td>
<td>2 (8%)</td>
</tr>
<tr>
<td>Others (Hematoma)</td>
<td>2 (8%)</td>
<td>3 (14%)</td>
<td>2 (8%)</td>
</tr>
</tbody>
</table>

Table 2: Postoperative complications of the three groups

<table>
<thead>
<tr>
<th>Group</th>
<th>Primary watertight, (n=26)</th>
<th>Secondary watertight, (n=21)</th>
<th>Adaptive (Dural approximation), (n=25)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subcutaneous CSF collection, no surgical intervention</td>
<td>1 (4%)</td>
<td>1 (5%)</td>
<td>2 (8%)</td>
</tr>
<tr>
<td>CSF Leak, no surgical intervention</td>
<td>1 (4%)</td>
<td>1 (5%)</td>
<td>1 (4%)</td>
</tr>
<tr>
<td>Delayed wound healing, no CSF leak, no surgical intervention</td>
<td>1 (4%)</td>
<td>1 (5%)</td>
<td>2 (8%)</td>
</tr>
<tr>
<td>Meningitis</td>
<td>0</td>
<td>1 (5%)</td>
<td>1 (4%)</td>
</tr>
</tbody>
</table>

DISCUSSION

We found no significance as regard outcome and complications rate between primary or secondary watertight and non watertight adaptive dural closure in supratentorial craniotomies.

Barth et al. have found insignificant difference between primary or secondary watertight closure and non watertight dural approximation as regard CSF leak and postoperative complications in supratentorial craniotomies. Watertight dural closure is not mandatory in supratentorial procedures. It was a heritage since the beginning of 20th centuries based on unfavorable experience of CSF leak and fistula after intracranial procedures and its challenging treatment.

Also what favours non-necessity of watertight dural closure in supratentorial procedures is, that dural opening over extracranial vascular bypass surgery is left intentionally open.

Secondary watertight dural closure was needed in twenty one cases (44.7%) of total forty seven cases (group A and B) of watertight dural closure attempt, due to dural shrinking as a result of bipolar coagulation (six cases), dural dessication and contraction (ten cases) or dural excision in convexity meningiomas (five cases).

70% of primary watertight dural closure is not applicable due to bipolar coagulation, dural dessication
or partial dural excision because of infiltration by convexity meningioma.\textsuperscript{1}

This requires harvesting scalp periosteal graft or using synthetic dural substitutes and consumes more extra time.

Autologous grafts like pericranium or fascia lata\textsuperscript{4,6,7,13} or synthetic dural substitutes like vicryl collagen (Ethicon)\textsuperscript{7,13,14} are still used up until now in the daily neurosurgical practice.

These materials are difficult to handle, do not guarantee watertight dural closure and may result in scar formation on the underlying brain surface, that is why, new sealants as glycol hydrogel and 3-layers polymer dural substitute are developed to ensure true watertight dural defect sealing.\textsuperscript{5}

CSF leak rate of our study is insignificant (12\%) in comparison to literature data (7-13\%).\textsuperscript{11,12,15,16}

Our study was done only in supratentorial craniotomies after reviewing the literature.

Watertight dural closure is recommended more in cases of head trauma, cranial base surgery, infratentorial craniotomies after reviewing the literature.\textsuperscript{1}

CONCLUSION

Adaptive non watertight dural closure could be a good, safe and fast time saving alternative to primary or secondary watertight dural closure in supratentorial craniotomies but not superior to them.

Declaration

The author(s) declare no conflict of interest or any financial support and confirm the approval of the submitted article by the concerned ethical committee.

REFERENCES


