The Role of Combined Anterior Retropharyngeal Approach and Posterior Fixation in Surgical Treatment of Upper Cervical Lesions

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Abstract

Background Data: Surgical exposure of the upper cervical spine is considered difficult due to the presence of essential and vital nearby structures. Anterior retropharyngeal approach provides direct and wide exposure to treat different lesions in the upper cervical spine. These lesions usually associated with instability and posterior fixation is commonly used to treat this type of instability.

Purpose: To evaluate the role of combined anterior retropharyngeal approach and posterior fixation in treatment of upper cervical lesions.

Study Design: A retrospective clinical case series

Patients and Methods: This study included 10 patients with C2 neoplasm in 4 patients and spinal infection in 6 patients. Nurick's scale and neck disability index were used to evaluate the functional outcome among our patients. All patients were surgically treated using combined anterior retropharyngeal approach and posterior fixation in the same operation.

Results: By using anterior retropharyngeal approach, open biopsy was performed in 4 patients and 6 patients operated for drainage of the retropharyngeal abscess with debridement and decompression. All patients were operated using posterior fixation in the same anesthesia including cranio-cervical fixation in 6 cases and posterior cervical fixation for C1-C4 in 4 cases by using screws-rod system). During our period of follow up the functional state of all patients was improved, there were only two patients with transient dysphagia. A solid fusion was achieved in all cases.

Conclusion: The anterior retropharyngeal approach is feasible and effective in surgical exposure and treatment of upper cervical lesions. Anterior decompression and posterior fixation can be done successfully and safely by using a combined anterior retropharyngeal-posterior approach in the same anesthesia. (2015ESJ090)

Keywords: anterior retropharyngeal approach, posterior cranio-cervical fixation
Introduction

Several approaches have been described in the literature for anterior exposure of the upper cervical spine, however some controversy remains about the best approach. Smith-Robinson approach was described for anterior exposure of the subaxial cervical spine C3-C7. Upward extension of this approach to expose the upper cervical spine is dangerous and associated with many complications. In 1962, Fang and Ong reported the transoral approach to expose the upper cervical spine. The retropharyngeal approach was first described by Stevenson et al, in 1966, and the approach was modified by McAfee et al, to the currently most commonly used approach for exposing C2.

The retropharyngeal approach is considered a good alternative to the transoral approach as it provides direct, wide and bilateral exposure to upper cervical spine and it allows a clean field away from the oral cavity. Management of CSF fistula and cervical instrumentation can be done safely by this approach during the primary surgery. This is a retrospective clinical case series study to evaluate the role of combined anterior retropharyngeal approach and posterior fixation in surgical treatment of upper cervical lesions.

Patients and Methods

This study was conducted on 10 patients with different lesions in the upper cervical spine included; retropharyngeal abscess with epidural extension to C1 and C2 in 6 patients, C2 neoplastic lesion in 4 patients.

All patients were surgically treated using the combined anterior retropharyngeal approach and posterior fixation in the same operation. Patients were admitted and operated upon in the Department of Neurosurgery, Tanta University Hospital during the period from August 2013 to February 2015.

Pre-operative Evaluation:

All patients were evaluated and subjected to complete clinical history and examination. General and neurological examination was performed, it included; motor system examination, sensory system examination and local examination (range of neck movement and cervical lymph node examination). The preoperative disability and functional state was determined by using Nurick's scale and the neck disability index.

Metastatic work-up was done in cases with neoplastic lesions and routine laboratory investigations were performed for all patients. Radiological assessment including plain radiography: Lateral, attended flexion and extension views (with high precautions) and open mouth view were done for all cases. Multi-slice CT-scan of the cervical spine (saggittal and coronal reconstruction), and MRI cervical spine with Gadolinium were done for all cases.

Operative Technique:

Awake intubation was performed in all patients. Following intubation, the patient is positioned on the operating table in supine position and the head is extended and rotated slightly to the opposite site. A transverse submandibular skin incision is placed on the right side and 2 cm below the mandible. The incision is extended from the midline to the anterior border of the sterno-cleidomastoid muscle.

After wide subcutaneous dissection, the superficial cervical fascia including the platysma muscle is opened transversely (undervision) in line with the skin incision. The superficial fascia and platysma muscle are mobilized superiorly and subsequently the submandibular gland, facial artery and vein are visualized. The retromandibular branches of facial vein are ligated and the facial artery is dissected until fully retracted. After careful superolateral retraction of the submandibular gland, the digastric muscle and tendon, fascial sling and stylohyoid muscle are then exposed. The facial sling is transected and the stylohyoid muscle is divided. The digastric muscle and stylohyoid muscle are retracted superiorly to expose the hypoglossal nerve which is gently dissected and retracted upwards then the hypoglossus muscle and the greater cornu of the hyoid bone will be exposed. Incision of the thin fascia overlying the hyoid bone is made and the retropharyngeal space is developed between the carotid sheath laterally and the larynx and pharynx medially with blunt dissection. Medial retraction is done along the greater horn of the hyoid bone and the superior pharyngeal constrictor muscle. Excessive retraction is avoided during surgery. The prevertebral fascia is opened to expose the anterior surface of the upper cervical spine.

After finishing, the goal of surgery: Biopsy from a neoplastic lesion or drainage of retropharyngeal abscess and microscopic anterior decompression
(debridement). The platysma muscle and skin are closed in separate layers. Closed drainage system was inserted in cases of infection (retropharyngeal abscess) and removed within 48h after surgery.

**Posterior Fixation:**
After the end of the anterior approach, the patient is positioned in prone position in the same anesthesia and skull traction is used to facilitate reduction during surgery. The incision is a linear midline skin incision then the musculature is dissected from the midline laterally and self retaining retractors are placed to expose the entire lateral mass of the cervical spine and occiput. Lateral mass screws rod system is used for posterior fixation and when occipito-cervical fixation is needed occipital plate is inserted and attached to the screw rod system. Bone fusion is done by using iliac bone graft. A hard cervical collar is used for 1-3 months after surgery.

**Post-operative Evaluation:**
Clinical follow-up by using Nurick's Scale and Neck disability index to evaluate the functional outcome after operation and during six months after. Radiological follow-up including plain X-ray cervical spine and multi-slice CT-scan were done in all cases within 72 hours after surgery and every 2 months up to 6 months to assess construct stability and fusion. Magnetic resonance image (MRI) of the cervical spine was done in cases of infection (retropharyngeal abscess) during the first week after surgery and repeated after the end of medical treatment (antibiotics). In cases of neoplastic lesions MRI of the cervical spine was done after the end of treatment in the oncology department.

**Results**

This study included 10 patients with different upper cervical spine lesions, operated upon and were followed up for six months post-operatively. Seven out of the 10 patients (70%) were males while three were females (30%) with a male to female ratio of 2.3:1. The age of the patients ranged between 45-69 years with a mean age of 48.6±10.6 years.

The series included retropharyngeal abscess eroding C1 lateral mass and C2 body with epidermal extension in 6 cases (60%), and C2 neoplastic lesion in 4 cases (40%) (metastatic lesion in 3 patients and myeloma in one). Duration of symptoms ranged between 3 weeks to 4 months with a mean duration of 53.3±31.7 days. Neck pain was the commonest presenting symptom occurring in all cases (100%) followed by heaviness in both lower limbs in 5 patients (50%), fever and dysphagia each in 6 cases (60%), and dyspnea in three cases (30%).

Examination of patients revealed upper and lower limb weakness in 5 patients (50%), isolated upper limb weakness in one patient (10%), hyper-reflexia in 6 patients (60%), independent ambulation in 5 patients (50%) and cervical lymphadenopathy was present in 6 patients (60%) (Table 1). Preoperative evaluation of patients according to Nurick's Scale revealed that grade (0) was present in 4 patients (40%), grade 1 in one patient (10%), grade 4 presented in 2 patients (20%) and grade 5 presented in 3 patients (30%) while no patients was grade 2 or grade 3. (Table 2) Distribution of patients according to neck disability score revealed no patient with score 0-4 (no disability) or score 5-14 (mild disability), patients with score 15-24 (moderate disability) were 4 (40%), patients with score 25-34 (severe disability) were 3 (30%) while patients with score 35-50 (completely disabled) were 3 (30%). (Table 3)

Radiological evaluation revealed C2 neoplastic lesions in 4 cases (40%), cord compression in 6 cases (60%), retropharyngeal abscess in 6 cases (60%), cranio-cervical instability in 6 cases (60%) and isolated atlantoaxial instability in 4 cases (40%).

**Operative Results:**
All patients were operated in supine position by using anterior retropharyngeal approach. Six cases of them (60%) operated for drainage of retropharyngeal abscess and microscopic debridement of infected tissue was done by using small curette and suction to expose the ventral dura of the cord (anterior decompression). Culture was done for the drained pus and revealed that the causative organism was mycobacterium tuberculosis in 2 cases (20%), β-hemolytic streptococci in one case (10%), Klebsiella pneumonia in one case (10%) while there was no growth detected in another two cases (20%).

Four cases had neoplastic lesions in C2 (40%), operated upon for biopsy and histopathological analysis revealed metastatic lesions in three cases (from lung lesion in 2 patients and breast cancer in one patient) (30%) while myeloma in one case (10%).

All patients (100%) operated upon for posterior fixation to treat cranio-cervical or atlanto-axial instability in the same operation. After the end of
anterior approach, the patient was positioned in prone position and posterior midline approach was used. Cranio-cervical fixation was done in 6 cases of infection (retropharyngeal abscess) by using occipital plate and lateral mass screws (C3-C5) rod system. Four cases of neoplastic lesions in C2 with atlantoaxial instability operated upon for posterior fixation by using lateral mass screws rod system (C1-C4) and bone fusion was done in all cases by using iliac bone graft. Posterior decompression (foramen magnum decompression, removal of the posterior arch of C1 and part of C2 lamina) was done in 6 cases (60%) of craniocervical fixation. A postoperative hard cervical collar was used for all cases for 1-3 months. Intra-operative cervical traction was used in 6 cases of craniocervical fixation for intraoperative reduction before fixation.

As regards Nurick’s Scale and neck disability index, the functional state of all patients improved after surgery and during our period of follow-up (6 months). Nurick’s Scale revealed that grade (0) was present in 5 patients (50%), grade 2 in two patients (20%), grade 3 present in 3 patients (30%) while no patient was under grade 1, grade 4 or grade 5. And statistical analysis revealed that there was a significant improvement in grades of patients post-operatively compared to pre-operative grades (P<0.05, Table 2,4).

The neck disability score revealed that; one patient with score 0-4 (no disability) (10%), patients of score 5-14 (mild disability) were 3 patients (30%), patients with score 15-24 (moderate disability) were 6 patients (60%), while there were no patients with score 25-34 (severe disability) or score 35-50 (completely disabled). Statistical analysis revealed that there was a significant improvement in neck disability score among patients of the study post-operatively compared to pre-operative scores (P<0.05, Table 3,4).

Intra-operative pharyngeal fistula was occurred in one patient of retro-pharyngeal abscess due to not only retraction injury to the thin layer of superior constrictor muscle that separates the hypopharynx from the area of dissection but also due to the effect of infection as there was excessive adhesions, friable muscles and disturbed anatomical landmarks, then the fistula was closed in two layers using absorbable sutures and a naso-gastric tube was inserted for 7 days without any post-operative complications. During our period of follow-up, there were only two patients (2/10, 20%) with transient dysphagia that resolved spontaneously within one month post-operatively. A solid fusion was achieved in all cases.

<table>
<thead>
<tr>
<th>Grade</th>
<th>Pre-operative Scale</th>
<th>Post-operative Scale</th>
<th>X² Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>No.</td>
<td>%</td>
<td>No.</td>
<td>%</td>
</tr>
<tr>
<td>0</td>
<td>4 40%</td>
<td>5   50%</td>
<td>0.018*</td>
</tr>
<tr>
<td>1</td>
<td>1 10%</td>
<td>0   0%</td>
<td>0.032*</td>
</tr>
<tr>
<td>2</td>
<td>0 0%</td>
<td>2   20%</td>
<td>0.022*</td>
</tr>
<tr>
<td>3</td>
<td>0 0%</td>
<td>3   30%</td>
<td>0.011*</td>
</tr>
<tr>
<td>4</td>
<td>2 20%</td>
<td>0   0%</td>
<td>0.015*</td>
</tr>
<tr>
<td>5</td>
<td>3 30%</td>
<td>0   0%</td>
<td>0.001*</td>
</tr>
<tr>
<td>Total</td>
<td>10 100%</td>
<td>10 100%</td>
<td></td>
</tr>
</tbody>
</table>

* means significant statistical difference

Table 2. Pre-operative and Post-operative Nurick’s Myelopathy Grade in Patients of the Study.

<table>
<thead>
<tr>
<th>Score</th>
<th>Pre-Op Score</th>
<th>Post-Op Score</th>
<th>X² Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>No.</td>
<td>%</td>
<td>No.</td>
<td>%</td>
</tr>
<tr>
<td>0-4 (No)</td>
<td>0 0.0%</td>
<td>1 10%</td>
<td>0.021*</td>
</tr>
<tr>
<td>5-14 (Mild)</td>
<td>0 0.0%</td>
<td>3 30%</td>
<td>0.001*</td>
</tr>
<tr>
<td>15-24 (Moderate)</td>
<td>4 40%</td>
<td>6 60%</td>
<td>0.021*</td>
</tr>
<tr>
<td>25-34 (Severe)</td>
<td>3 30%</td>
<td>0 0.0%</td>
<td>0.001*</td>
</tr>
<tr>
<td>35-50 (Complete)</td>
<td>3 30%</td>
<td>0 0.0%</td>
<td>0.001*</td>
</tr>
<tr>
<td>Total</td>
<td>10 100%</td>
<td>10 100%</td>
<td></td>
</tr>
</tbody>
</table>

* means significant statistical difference

Table 3. Pre-Operative and Post-Operative Neck Disability Score in our Patients.

Table 1. Clinical Manifestations among our Patients.

<table>
<thead>
<tr>
<th>Sign</th>
<th>No.</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upper and lower limb weakness</td>
<td>5</td>
<td>50%</td>
</tr>
<tr>
<td>Isolated upper limb weakness</td>
<td>1</td>
<td>10%</td>
</tr>
<tr>
<td>Hyper-reflexia</td>
<td>6</td>
<td>60%</td>
</tr>
<tr>
<td>Independent ambulation</td>
<td>5</td>
<td>50%</td>
</tr>
<tr>
<td>Cervical lymphadenopathy</td>
<td>6</td>
<td>60%</td>
</tr>
</tbody>
</table>

Table 4. Pre-operative and Post-operative Nurick’s Myelopathy Grade in Patients of the Study.
Figure 1. Preoperative (A, B, C) sagittal T2 MRI, Axial T2, and Sagittal CT-scan of a case of retropharyngeal abscess eroding C1-2 segment with significant cord compression operated by a combined anterior retropharyngeal-posterior approach for abscess drainage, anterior decompression and occipto-C3-5 posterior fixation in the same operation. Postoperative (D, E, F) Lateral radiograph, sagittal T2 MRI, and sagittal CT-scan showing good alignment and excellent regression of the infection.

Figure 2. Preoperative (A, B, C) sagittal T1 MRI, sagittal T2 MRI, and Sagittal CT-scan of case of retropharyngeal abscess eroding C2-1 segment with significant cord compression operated by a combined anterior retropharyngeal-posterior approach for abscess drainage, anterior decompression and occipto-C5-3 posterior fixation in the same operation. Postoperative (D, E, F) sagittal T1 MRI, sagittal T2 MRI, and lateral radiograph showing good alignment and infection control.
Discussion

The transoral approach is a popular anterior access to the upper cervical spine, but this approach had many disadvantages as the increased risk of infection, limited exposure, difficulties in treating CSF leakage; it doesn't allow simultaneous instrumentation during the primary surgery and mandibulotomy plus glossotomy may be needed for wide exposure which increase the risk for more complications.4,6,7,10

Mc Afee et al,9 used a superior extension of the anterior approach of smith and Robinson to provide exposure from C1 to the subaxial cervical spine. Retropharyngeal approach has many advantages and considered an alternative to the transoral approach in surgical treatment of anteriorly situated lesion from C1 to C3. It allows a wide bilateral exposure, it avoids entry into the contaminated oral cavity, simultaneous instrumentation and management of CSF fistula can be done safely by this approach.18

In our study the anterior retropharyngeal approach was used to treat different lesions in the upper cervical spine including (6 cases) of retropgharyngeal abscess eroding C1 and C2 with epidural extension operated upon for abscess drainage and debridement, (4 cases) of neoplastic lesion in C2 operated upon for biopsy which revealed 3 metastatic lesions and one case of myeloma. We agree with Vender et al,18 as this approach had many advantages and considered a good alternative to transoral approach.

In the study by Yang et al,20 neck pain and weakness in upper limb and lower limb were the commonest presenting clinical manifestation among patients of the study. Frankel scale was used to evaluate the functional state of the patients. After surgery and during the follow-up period, pain was relieved with various degrees in all patients, all patients with neurological deficit before surgery experienced significant improvement in the neurological function by at least one level on the Frankel scale. In our study, neck pain and weakness in upper limb and lower limb were the commonest presenting clinical manifestation among our patients. We used Neck Disability Index (NDI) and Nurick's scale to evaluate the functional state of our patients. The functional state of all patients improved postoperatively and during our period of follow-up.

The retropharyngeal approach has rare complications as injury to the marginal mandibular branch, hypoglossal and superior laryngeal nerve. Transient dysphagia and dysphonia are common problems related to this approach.20 In order to avoid pitfalls and complications of retropharyngeal approach; the skin incision should be 2 cm inferior to the angle of the mandible to avoid the marginal branch injury. Avoid excessive retraction on trachea and esophagus, early identification of the hypoglossal nerve, avoid excessive retraction on it and blunt dissection through the soft tissue to find a plane that allows the spine to be reached is essential to avoid nerve damage.11

Laus et al,8 reviewed 10 cases of anterior extraoral surgery to the upper cervical spine, they reported 4 cases of transient paralysis of the mandibular branch of facial nerve. In our study, no complications related to the marginal branch of facial nerve

Figure 3. Preoperative (A, B, C) sagittal T2 MRI, sagittal T1 MRI, and sagittal CT-scan of a case of a neoplastic lesion (lung metastasis) destructing C2 operated upon by a combined anterior retropharyngeal biopsy and posterior C1-4 posterior fixation in the same operation. Postoperative (D) lateral radiograph showing stable construct and good alignment.
occurred as the skin incision was 2 cm below the inferior border of the mandible in order not to injure this nerve. Sauners et al.,\textsuperscript{13} identified one case of hypoglossal nerve injury after anterior surgery to the upper cervical spine and the injury was due to traction injury during long operation. In our study, hypoglossal nerve injury didn’t occur in any case as we identify the nerve early and excessive traction on it was avoided during surgery. Park et al.,\textsuperscript{11} reported 2 cases (13.3%) of transient dysphagia after surgery; one patient achieved full recovery after one week and the other after 3 months. In our study, there were 2 cases (20%) of transient dysphagia after surgery which resolved spontaneously within one month.

Park et al.,\textsuperscript{11} advocated a standard exposure from the patients left side to decrease the risk of recurrent laryngeal nerve injury. McAfee et al.,\textsuperscript{9} reported that a right-sided exposure in the upper cervical spine which is suitable for a right-handed surgeon will not increase the risk of recurrent laryngeal nerve injury. We agree with McAfee and his colleagues, as all patients in our study underwent a right-sided anterior approach without injury to the recurrent laryngeal nerve.

As regards intra-operative complications in the study done 2001 by Behari et al.,\textsuperscript{1} there was one patient in which pharyngeal injury occurred during surgery due to retraction injury to the thin layer of the superior constrictor muscle and the fistula was closed in two-layers using absorbable sutures without post-operative complications.

In this work, pharyngeal fistula was occurred in one patient of infection not only due to retraction injury but also due to the effect of infection as there were excessive adhesions, friable muscles and disturbed anatomical landmarks. The injury was closed during surgery without postoperative complications.

The most widely used procedure in treating cranio-cervical junction instability has been the posterior occipito-cervical fixation, usually after anterior decompression with or without anterior reconstruction. Bone graft from iliac crest or from a rib could be used for bone fusion.\textsuperscript{14} In our study, there were 6 cases with cranio-cervical instability operated successfully for posterior cranio-cervical fixation after anterior decompression and we use iliac bone graft for bone fusion.

Hsu et al.,\textsuperscript{5} reported that the use of screws rod system in craniocervical fixation is effective and has many advantages; the rod is contoured simply to match the craniocervical curvature and connected easily to the cervical screws, less incidence of occipital screws pullout, it allows immediate stability after surgery, there is no need for postoperative halo vest and the use of hard cervical collar after surgery is enough. In this study fusion was achieved in all patients. In our work we used screw-rod system for craniocervical fixation and it was really helpful and successful. We didn’t use postoperative halo vest and hard cervical collar after surgery was enough. A solid fusion was founded in all patients.

In the study by Yang et al.,\textsuperscript{20} eleven patients with C2 tumors were operated for tumor resection and anterior reconstruction by anterior retropharyngeal approach. Occipto-cervical fusion through posterior approach was performed in the same setting. They concluded that, the anterior retropharyngeal approach is a useful and helpful route to treat tumor lesions at C\textsubscript{2} and is a good alternative to transoral approach in treatment of C2 lesions. Tumor resection and 2 column reconstruction could be done successfully through the combined anterior retropharyngeal-posterior approach in the same operation. In our study, all patients operated for combined anterior retropharyngeal-posterior approach in the same operation. The retropharyngeal approach provided a very wide exposure for anterior decompression and biopsy. The posterior approach was used for posterior fixation. The functional state of all patients improved after surgery and solid fusion occurred in all cases. So, we also considered the anterior retropharyngeal approach as effective, helpful approach in treatment of upper cervical lesions and the use of combined anterior retropharyngeal-posterior approach for anterior decompression and posterior fixation in the same operation is a safe and successful procedure.

Conclusion

The anterior retropharyngeal approach is feasible and effective in surgical exposure and treatment of upper cervical lesions (infection, tumors). This approach has many advantages and considered a good alternative to transoral approach in treatment of upper cervical lesions. Anterior decompression
and posterior fixation can be done safely in the same anesthesia by using combined anterior retropharyngeal-posterior approach.

References

دور التدخل الجراحي الأمامي "من خلف البلعوم" المصاحب بالتدخل الخلفي في علاج علل الفقرات العنقية العلوية

الخلفية العلمية: يعتبر التوضيح الجراحي للفقرات العنقية العلوية من الأمور الصعبة وذلك لوجود العديد من الأنسجة والمكونات الحيوية القريبة، ولذا فالتدخل الجراحي الأمامي من خلف البلعوم يساعد في توضيح مباشر وواسع لعلل الفقرات العنقية العلوية. هذه العلل غالباً ما يصاحبها عدم الاتزان بالفقرات والشائع علاجه هو التثبيت الخلفي للفقرات العنقية.

الغرض من البحث: الغرض من هذا البحث هو تقييم دور التدخل الجراحي الأمامي (من خلف البلعوم) المصاحب بالتدخل الخلفي في علاج علل الفقرات العنقية العلوية.

تصميم الدراسة: دراسة سريرية بأثر رجعي لسلسلة من الحالات

استنتاج: باستخدام التدخل الجراحي الأمامي "من خلف البلعوم" تم أخذ عينة جراحية لأربعة مرضى. وتم تدشين محتويات خراج خلف البلعوم من المريض، مع تنظيف محتوياته في ستة مرضى، وفي كل المرضى تم إجراء التثبيت الخلفي للفقرات في نفس الجراحة. وقد تحسنت الحالة الوظيفية في كل المرضى وعانتي مريضان فقط من عسر عابر للبلع، وتم الحصول على التحام صلب وقوي في كل الحالات.

الاستنتاج: التدخل الجراحي الأمامي من خلف البلعوم يعد وسيلة مجدية وفعالة في توضيح وعلاج إصابات الفقرات العنقية العلوية. وباستخدام التدخل الجراحي الأمامي "من خلف البلعوم" مع التدخل الجراحي الخلفي يمكن رفع الضغط الأمامي وثبيت الفقرات من الخلف بأمان ونجاح في نفس الجراحة.