Original research article

Comparison of perioperative complications following staged versus one-day anterior and posterior cervical decompression and fusion crossing the cervico-thoracic junction

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A B S T R A C T

Introduction: Multilevel cervical pathology may be treated via combined anterior cervical decompression and fusion (ACDF) followed by posterior spinal instrumented fusion (PSIF) crossing the cervico-thoracic junction.

The purpose of the study was to compare perioperative complication rates following staged versus same day ACDF combined with PSIF crossing the cervico-thoracic junction.

Material and methods: A retrospective review of consecutive patients undergoing ACDF followed by PSIF crossing the cervico-thoracic junction at a single institution was performed.

Patients underwent either same day (group A) or staged with one week interval surgeries (group B). The minimum follow-up was 12 months.

Results: Thirty-five patients (14 females and 21 males) were analyzed. The average age was 60 years (37–82 years). There were 12 patients in group A and 23 in group B. Twenty-eight complications noted in 14 patients (40%) included: dysphagia in 13 (37%), dysphonia in 6 (17%), post-operative reintubation in 4 (11%), vocal cords paralysis, delirium, superficial incisional infection and cerebrospinal fluid leakage each in one case. Significant differences comparing group A vs. B were found in: the number of levels fused posteriorly (5 vs. 7; p = 0.002), total amount of intravenous fluids (3233 ml vs. 4683 ml; p = 0.03), length of hospital stay (10 vs. 18 days; p = 0.03) and transfusion of blood products (0 vs. 9 patients). Smoking and cervical myelopathy were the most important risk factors for perioperative complications regardless of the group.

Conclusions: Staging anterior cervical decompression and fusion with posterior cervical instrumented fusion 1 week apart does not decrease the incidence of perioperative complications.

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1. **Introduction**

Combined anterior-posterior cervical decompression and fusion crossing the cervico-thoracic junction is performed in patients with cervical deformity and multilevel spinal cord compression. There is much debate about performing combined anterior-posterior cervical decompressions and fusions as well as whether to perform staged or same day surgery. Complications in cervical spine surgery increase proportionately to the number of levels operated and total operative time [1]. Complications associated with multilevel cervical spine surgery include, dysphagia, dysphonia, postoperative airway compromise, non-union, infection, and medical complications. Estimated rates of airway compromise after cervical spine surgery range from 1.7% to 6%, and include a spectrum from postextubation edema to life-threatening acute airway obstruction [2–5]. General complication rate following anterior cervical decompression and fusion (ACDF) is reported to be lower than posterior spinal instrumented fusion (PSIF) [6]. Patients undergoing combined ACDF and PSIF, especially extended to cervico-thoracic junction are at greater risk of perioperative complications [7]. ACDF and PSIF may be staged (with several days interval) or performed on the same day, and the indication for staging these procedures is reported to be the patients general condition [8,9]. There is a paucity of data comparing the perioperative complication rate in patients undergoing staged versus same day combined anterior-posterior cervical decompression and fusion crossing the cervico-thoracic junction.

The aim of the study is to analyze and compare the perioperative complications following staged versus same day ACDF combined with PSIF crossing the cervico-thoracic junction.

2. **Material and methods**

A retrospective review of medical data of all consecutive patients undergoing ACDF followed by PSIF crossing the cervico-thoracic junction treated between January 2010 and October 2012 at a single institution was performed. The patients underwent either same day (Group A) or staged (Group B) surgery. All staged procedures were performed one week apart. All of the patients were operated on by the same surgical team (first and senior author). Patients underwent either anterior cervical diskectomies and fusions, anterior cervical corpectomies and fusion (ACCF), or hybrid constructs. Anterior interbody fusions were performed by use of allograft, PEEK cages filled with either allograft or autograft, fibular allograft strut, titanium mesh cages or expandable cages depending on pathology, number of levels treated and patients’ preference. All patients were stabilized anteriorly with semi-constrained cervical plates (DePuy or Medtronic) spanning the operated segments.

PSIF included placement of cervical lateral mass, pedicle or intralaminar screws, and thoracic pedicle screws connected with 3.5 mm rods. Posterior decortication of the instrumented vertebrae and frozen allograft chips mixed together with local

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**Fig. 1** – Upright neutral radiograph of the cervical spine demonstrating C3–C7 anterior cervical decompression and fusion and C3-Th2 posterior instrumented fusion: (a) antero-posterior view; (b) lateral view.
autograft were the base for spondylosis. All PSIF constructs crossed the cervico-thoracic junction (the distal instrumented vertebra varied from T1 to T5) (Fig. 1).

Medical records provided the following data: age and sex of the patients, index diagnosis – indication for surgery, diabetes and smoking status, post-operative changes in neurological status, number of levels fused anteriorly and posteriorly, total time of surgery (from incision to closure of the wound for both ACDF and PSIF), total estimated blood loss (EBL), total transfusion of blood products, total amount of intravenous fluids (IVF) given to the patient perioperatively and length of hospital stay. All perioperative complications were reported. The minimum follow-up period was 12 months.

Unpaired interval data were compared with Student’s t-test. A p-value of 0.05 was considered significant. Nominal data were compared with Fisher’s exact test. The data was analyzed using the JMP 10.0.2 (SAS Institute Inc., Cary, NC) statistical software.

3. Results

Thirty-five of the 43 patients met the inclusion criteria. There were 14 women and 21 men. The average age was 60 years (range 37–82 years). There were 12 patients who underwent one-day (Group A) and 23 – staged (Group B) surgery. There were 27 patients with degenerative cervical spondylosis with myelopathy (Figs. 2 and 3). Five patients had unstable cervical vertebrae fracture, two had metastatic tumor in the cervical spine and one had osteomyelitis of the cervical vertebra (Table 1).

Total number of 28 complications occurred in 14 patients (40%; 14/35). Seven of these patients had one complication (20%; 7/35), one patient had two complications (3%; 1/35) and

<table>
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<th>Table 1 - Demographic data of the study group.</th>
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<tbody>
<tr>
<td>Number of patients</td>
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<tr>
<td>---------------------</td>
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<tr>
<td>Group A</td>
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<tr>
<td>Group B</td>
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<tr>
<td>Total</td>
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Table 3 – Perioperative complications rate according to the age of the patients.

<table>
<thead>
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<th>≤60 years of age</th>
<th>&gt;60 years of age</th>
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<tbody>
<tr>
<td>Group A</td>
<td>2/6 (33%)</td>
<td>3/6 (50%)</td>
</tr>
<tr>
<td>Group B</td>
<td>4/13 (31%)</td>
<td>5/10 (50%)</td>
</tr>
<tr>
<td>Total</td>
<td>6/19 (32%)</td>
<td>8/16 (50%)</td>
</tr>
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</table>

six patients had three or more complications (17%; 6/35). The most common complication was dysphagia that occurred in 13 patients (37%; 13/35) and two of them required PEG tube implantation. Six patients had dysphonia (17%; 6/35) and one of them had vocal cord paralysis (3%; 1/35). Four patients (11%; 4/35) required post-operative re-intubation because of airway edema or vocal cord paralysis; two of these patients required tracheostomy. Each of the following: postoperative delirium, superficial incisional infection and leakage of the cerebrospinal fluid occurred once in the study group. Comparison of perioperative complications between Group A and Group B is presented in Table 2. Complications were noticed in 50% (8/16) of patients aged over 60 years and in 32% (6/19) of patients younger than 60 years (Table 3).

Comparing clinical data of Group A versus Group B there were no significant differences in the number of levels fused anteriorly, total surgical time, and total EBL, Table 4. Statistically significant differences were noted for the number of levels fused posteriorly, total amount of intravenous fluids (IVF) given to the patients and length of hospital stay (Table 4). There was no need for transfusion of blood products in the group A, while nine patients in the group B required transfusion (27 units of red blood cells, seven units of platelets and four units of fresh frozen plasma).

The neurological status improved after the surgery in 31 patients, was the same as before the operation in two patients (one had no neurological deficits before and after the surgery; the other had still tenderness in deltoid area, tingling in the fingers and weakness of deltoid – 4/5 as before operation) and was worse in two patients (weakness of the left deltoid worsened from 4/5 to 3/5 in one patient; subjective worsening of tingling in the fingers of the left hand in addition in the other patient), Table 5. Both patients with worsening of neurological status had changes noted in intra-operative monitoring (MEPs and SSEPs). There were six patients who had changes in intraoperatively recorded SSEPs and MEPs, but had improvement in their neurological status on last follow up.

Eight of the 16 smokers (50%; 8/16) had at least one complication among the total of 14 complicated patients (57%; 8/14). All four patients who needed postoperative re-intubation were smokers as well as the two patients that had postoperative pneumonia and one with SSI. Complications occurred in two of three smokers in group A (66%; 2/3) and in 6 of 13 smokers in group B (46%; 6/13).

Three of the seven patients with diabetes (43%; 3/7) had perioperative complications. All of them were smokers. All three patients had dysphagia and dysphonia, and two of them required re-intubation. Complications occurred in one of three diabetic patients in group A (33%; 1/3) and in two of four diabetic patients in group B (50%; 2/4).

Among four patients that needed re-intubation two (50%; 2/4) had staged procedures. Three of these patients (75%; 3/4)
suffered from cervical spondylosis with myelopathy, one had osteomyelitis. Three of these patients that needed re-intubation (75%; 3/4) had ACDF on four levels (more than average) and all of them had PSIF on more levels than average (three patients: seven levels; one patient: eight levels). Total surgical time was longer than average in two (50%; 2/4), EBL was higher than average in three (75%; 3/4) and IVF was more than average in two (50%; 2/4) of them. All that needed re-intubation had neurological improvement although two of them (50%; 2/4) had changes in intraoperative neuromonitoring. None of these patients had SSI, dural tear or CSF leakage.

4. Discussion

Complications following combined anterior–posterior cervical spine surgery may lead to prolonged hospital stay, increased morbidity and mortality, and worse clinical outcomes [6,7]. This is the first series to report on the difference in complication rates in patients undergoing same day versus staged anterior–posterior decompression and fusion crossing the cervico-thoracic junction. The complication rate following combined ACDF and PSIF crossing the cervico-thoracic junction is reported to be as high as 69% [7]. In our series, 40% of patients had a complication in the perioperative period. This is in-line with data reported by Fehlings et al. [10]. Our series does not take into consideration non-union, instrumentation related problems and other complications that could occur with longer follow-up.

The most frequent perioperative complication in our patients was dysphagia. This is consistent with data published by other authors [7,10–17]. The incidence of perioperative complications was similar for the patients undergoing same-day and staged anterior–posterior decompression and fusion even though staging the procedures is sometimes considered as safer for the patient. We found no statistically important differences in total number of levels fused anteriorly, total estimated blood loss and total surgical time. Patients treated via staged surgical procedures required more intravenous fluids and more blood product transfusions. Both are likely to be caused by syndrome of inappropriate antidiuretic hormone (SIADH) that has been reported in association with a variety of surgical procedures and anesthetic agents [18–23]. The incidence of SIADH in patients undergoing spinal fusion was reported to be 5–100% and is considered as self-limiting phenomenon that resolves within two or three weeks [21–23]. However an additional stress (e.g. the second surgery within seven days as in our study) might enhance the vicious circle of SIADH.

Staging resulted in longer lengths of stay. Without seeing a clear benefit in terms of complication reduction, the cost associated with longer lengths of stay may not be justified. Age of the patients is reported to be the risk factor for perioperative complications following cervical spine surgery [24,25]. In this series patients younger than 60 years of age had relatively more perioperative complications in comparison to the older patients. There were no differences between staged and one-day surgery in these age groups.

The incidence of CS palsy in this series was 6% (2/35) and was similar to that reported by other authors (0–30%) [26,27]. For the six patients who had changes in intraoperative neuromonitoring, an action plan was implemented which involved trouble shooting the equipment, raising mean systolic blood pressure to >90 mmHg, removing instrumentation and/or deformity correction when applicable. All of these patients demonstrated improvement in neurological function after the surgery.

Smoking is an important risk factor in spinal procedures. However Fehlings et al. did not find smoking to increase the incidence of complications [10]. In our series smoking seemed to be the most important factor related to perioperative complications. Eight smokers (50%; 8/16) had at least one perioperative complication. Sixty two percent of patients with complications were smokers. All of the patients requiring postoperative reintubation, as well as those that developed pneumonia and SSI were also smokers. Because of the small number of patients statistical analysis between the two study groups was not possible, but the data indicates smoking as an important risk factor for perioperative complications in both staged and same day procedures. Seventy-five percent of the patients that
needed re-intubation suffered from cervical myelopathy, most had multilevel ACDF or ACCF and multilevel PSIF, and 50% needed IVF more than average. This is in-line with previously reported risk factors for airway complications: cervical myelopathy, multi-level anterior procedures, smoking history, previous pulmonary disease, operative times over 10 h, and intraoperative fluid replacement volumes of over 6200 ml [3–5].

The limitations of this study include its retrospective nature, lack of randomization, and small sample size. In this series there appeared to be no benefit to staging surgeries 1 week apart, and in fact staged patients required more blood transfusions. Whether waiting a longer period in-between stages would result in more favorable complication profile warrants further investigation.

5. Conclusions

Anterior cervical decompression and fusion followed by posterior spinal instrumentation and fusion are highly demanding procedures for the surgeon and for the patient. Perioperative complications following these procedures are relatively frequent, but most of them resolve without further sequelae. There is no statistically significant difference between the rates of complications after staged and non-staged anterior–posterior cervical decompression and fusion crossing the cervico-thoracic junction. Staging ACDF and PSIF crossing the cervico-thoracic junction 1 week apart leads to longer hospital stay and blood transfusions.

Conflict of interest

None declared.

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None declared.

Ethics

The work described in this article has been carried out in accordance with The Code of Ethics of the World Medical Association (Declaration of Helsinki) for experiments involving humans; Uniform Requirements for manuscripts submitted to Biomedical journals.

REFERENCES


