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Original Article

Modified anterior transarticular C1/2 fixation for odontoid fractures: An approach with high complication rate in geriatric population

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ABSTRACT

Background: In patients over 75 years of age, we applied a modified anterior transarticular C1/2 fixation with reduced pharyngeal mobilization versus the standard anterior triple/quadruple osteosynthesis procedures.

Methods: From 2010 to 2018, 29 patients underwent a modified anterior transarticular C1/2 fixation utilizing single odontoid screw fixation through a right-sided Smith-Robinson – (i.e., short and steep screw trajectory for the right and long trajectory for the left side) approach. All the patients were 75 years of age or older (mean age 82.6) and had sustained odontoid Type II fractures. In addition, a subset exhibited further ligamentous injuries and/or atlas fractures. Their Mean Age-adjusted Charlson Comorbidity Index was 5.3 points (range 3–12), while mean American Society of Anesthesiologists scores averaged 2.9 (range 2–4).

Results: The mean operating time was 55.8 min, there were no intraoperative complications, and there was minimal blood loss in all cases. The most common medical complications included aspiration pneumonia (24.1%, $n = 7$), altered mental status (17.2%, $n = 5$), and cardiac decompensation (6.9%, $n = 2$). One patient with delayed dysphagia and an infected implant resulting in loosening/dislocation required implant removal and long-term antibiotic therapy. The 30-day mortality rate was 13.8% (four patients) and the 1-year mortality rate was 27.6% (eight patients).

Conclusion: Anterior transarticular C1/2/odontoid fixation with reduced pharyngeal mobilization and shorter operative times was associated with high morbidity/mortality rates. Dysphagia/aspiration was the major postoperative complications leading to some deaths especially in patients with dementia/Parkinsonism.

Keywords: Geriatric population, Odontoid fractures, Transarticular C1/2 fixation

INTRODUCTION

Odontoid fractures, representing only 9–15% of all cervical spine fractures, are more common in the elderly population (i.e., largely Type II fractures in patients over 75 years of age).[1,3,4,9] Potential advantages of the anterior versus posterior approach include shorter operative time, use of the supine position, minimal intraoperative blood loss, lower implant costs, and reduced infection rates.[5] Here, we identified the 30-day and 1-year morbidity/mortality rates for 29 patients over 75 undergoing anterior C1/2 fixation for odontoid fractures treated with odontoid screw fixation.

MATERIALS AND METHODS

We performed modified anterior transarticular C1/C2 fixations for Type II odontoid fractures in 29 patients who averaged 82.6 years of age (i.e., all over 75 years old, between 2010 and 2018). We used a right-sided Smith-Robinson-approach and a short/right steep screw trajectory with a long left-sided screw trajectory. Factors studied included medical comorbidities (Age-adjusted Charlson Comorbidity Index [CCI: mean 5.3 points]; American Society of Anesthesiologists [ASA: mean 2.9 points: 20 severe and nine mild systemic disease]), neurologic deficits, and 30-day/1-year survival rates [Table 1]. Two patients developed aspiration pneumonia before surgery, one of women required cardiopulmonary resuscitation/intubation preoperatively.

Etiology of Type II fractures in 29 patients

Fractures were attributed to fall in all 29 patients; fall from a standing position (27 patients) one patient fell from a ladder, and another fell during mountain climbing. Eleven patients (37.9%) had associated atlas fractures; 6 (20.7%) of the 11 had attendant Jeffereson fractures. Six other patients had nonspinal fractures [Table 1]. Indications for surgery included neck pain, and if patients could be medically cleared for surgery. One patient had a closed reduction followed by traction with a Halo-Ring for 2 days preoperatively to avoid severe C1/C2 displacement.

RESULTS

Surgery-related complications

All 29 patients sustained no intraoperative complications. Further, the intraoperative blood loss was minimal [Table 2]. CT scans in the early postoperative period showed no neurovascular compromise by screws in 26 patients, but penetration of the atlantooccipital joint without neurological sequelae for six patients due to transarticular screws. Postoperative sequelae included new onset of quadriparesis (one patient) and delayed dysphagia (one patient) at 5 postoperative months due to a low-grade infectious (propionibacterium acnes) resulting in implant loosening/dislocation and requiring implant removal and long-term antibiotic therapy [Table 2]. Although all patients suffered from postoperative dysphagia, 7 (24.1%) required feeding tubes [Table 3]. Other complications included aspiration pneumonia (seven patients, 24.1%), altered mental status (17.2%, n = 5), dementia (three patients), and psychological problems (one patient with preoperative history). Blood transfusions were mandatory in three patients, two whom were anemic preoperatively.

Mortality

The 30-day mortality rate was 13.8% (n = 4), due to pneumonia [three patients] and heart failure [one patient]. However, one more patient died as a result of pneumonia occurring on the 32nd postoperative day [i.e., total in-hospital mortality rate was 17.2% [n = 5]). The 1-year mortality rate was 27.6% (n = 8). The mean ASA and CCI scores in these cases were higher versus the remaining cohort. Further the probability of severe complications was higher in patients with dementia, cardiac diseases, peripheral vascular disease, Parkinsonism, and chronic renal disease. In addition, early mortality was highest among those with peripheral vascular disease (100%), dementia (50%), Parkinsonism (50%), and tumors (33%) [Table 4].

DISCUSSION

Our 29 patients with Type II odontoid fractures over the age of 75 warranted surgical C1/C2 odontoid fixation. Dysphagia is one of the leading causes of perioperative morbidity in odontoid fractures in the elderly especially following anterior approach due to manipulation of the pharynx/esophagus during placement of the screws.[5-7] Despite universal

Table 1: Patients characteristics.

Sex	**21 females 8 males**
Age; mean (range) in years	82.6 (75.4–95.1)
Associated atlas fractures; number (%)	11 (37.9)
Associated non-spinal fractures; number (%)	6 (20.7%)
Age adjusted CCI score; mean (range)	5.3 (3–12)
ASA score; mean (range)	2.9 (2–4)

ASA: American Society of Anesthesiologists, CCI: Charlson Comorbidity Index

Table 2: Operative details and postoperative complications.

Operative time; mean (range) in minutes	55.8 (30–117)
Intraoperative blood loss	Minimal
Intraoperative complications	0%
Revision surgery; number (%)	1 (3.4%)
Screw misplacement without neurological sequelae	6 (20.7%)
Wound infection	0%
Neurological deficit; number (%)	1 (3.4%)

Table 3: Postoperative medical complications.

Complications patients (No, %)	
Pneumonia	7 (24.1)
Altered mental status	5 (17.2)
Cardiac decompensation	2
Acute on top of chronic renal failure	1
Anemia (blood transfusion)	3 (10.3)
Deep venous thrombosis	1
Urinary tract infection	3 (10.3)

Table 4: Age and comorbidity in cases of severe morbidity or mortality.

	All cohort (29 patients)	Severe complications (eight patients)	30-day mortality (four patients)	In-hospital mortality (five patients)	1-year mortality (eight patients)
Age (mean)	82.6	85.6	84.7	85.7	86.0
ASA score (mean)	2.9	3.2	3.3	3.2	3.4
CCI score (mean)	5.3	7.1	6.3	6.0	6.8
Comorbidity (number of patients)					
Dementia	6	4	3	3	3
Ischemic/valvular cardiac disease	9	5	2	2	4
Peripheral vascular disease	1	1	1	1	1
Atrial fibrillation	9	4	1	1	2
Chronic renal disease	5	3	1	1	3
Tumor with/without metastasis	3	3	1	1	2
Parkinsonism	2	2	1	1	2

ASA: American Society of Anesthesiologists, CCI: Charlson comorbidity index

Table 5: Comparison of the results of different studies.

	Ryang *et al.*[5]	Cutler *et al.*[2]	Vasudevan *et al.*[8]
Surgical approach	Posterior	Anterior	Anterior
Number of patients	50	103	30
Mean age (years)	87.2	73.9	70.7
30-day mortality	6%	6.8%	3.3%
Overall complications	52%	37.9%	50%
Pneumonia	36.4%	3.9%	30%
Operative revisions	6%	5.8%	0
Blood transfusion	38%	22.3%	Not included

postoperative dysphagia, only seven patients with preoperative dementia developed postoperative aspiration pneumonia requiring NG tubes. In the study by Vasudevan *et al.,* 47% of the patients developed severe postoperative dysphagia/requiring gastrostomy (92% of them were >75 years old) and 30% developed pneumonia (89% >75 years old). Notably, their 90-day mortality rate was just 3.3%.[8] Indeed, aspiration pneumonia was the most common cause of death in our series, accounting for 75% of the 30-day mortality (three out of four patients) and 80% of the in-hospital deaths (four out of five patients) unlike what Culter *et al.,* found.[2] Nevertheless, we experienced no other postoperative complications following anterior procedures which compared favorably with the various other surgery-related complications for posterior procedures (i.e., higher revision rates of 6% and significant intraoperative bleeding warranting transfusions in 38% of cases).[5]

Table 5 provides a summary of the results of three studies performed on odontoid fractures in old population.

CONCLUSION

Despite utilizing a modified anterior transarticular C1/2/odontoid fixation technique in 29 patients over 75 years of age, involving less pharyngeal mobilization/shorter operative times, there were still high 30-day and 1-year postoperative morbidity/mortality rates.

Declaration of patient consent

Patients' consent not required as patients' identities were not disclosed or compromised.

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Conflicts of interest

There are no conflicts of interest.

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