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SURGICAL TREATMENT OF UPPER CERVICAL SPINE INJURIES (C1-C2): EXPERIENCE IN 26 PATIENTS

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ABSTRACT

Objective: To describe the spectrum of operations in unstable upper cervical spinal injuries in (atlanto-axial) region at our unit.

Study Design: A cross-sectional study.

Place And Duration: Spine Unit, Department of Orthopedics, Combined Military Hospital (CMH), Rawalpindi from Jan 2001 to Dec 2008.

Patients and Methods: Frequency of different kind of operations in 26 patients operated for upper cervical spinal injuries was reviewed. A performa was made for each patient and records were kept in a custom built Microsoft access database.

Results: Average age of patients studied was 27 years with male pre dominance. Total 12(46%) patients had Atlanto-axial instability, 8(31%) had Hangman's fracture and 6(23%) patients had odontoid peg fracture. While 11(42%) patients had no neurological deficit according to American spinal injury association impairment scale (AIS-E) and 15(58%) had partial neurological deficit. The patients were divided into three groups. Group A had odontoid peg fracture, Group B had atlanto-axial instability and Group C had Hangman's fracture. The spine was approached posteriorly in 19(73%) cases and anteriorly in 7(27%). Pedicle screw fixation was done in 6(23%) patients, odontoid peg screw fixation in 6(23%), Gallie's fusion in 5(19%), occipito-cervical fusion in 4(15%), posterior transarticular fixation in 3(12%), anterior transarticular fixation and decompression in others, 9(60%) patients improved neurologically postoperatively and there was no deterioration of neurological status. Nonunion in two (8%) cases and implant failure in one (4%) were complications.

Conclusion: Upper cervical injuries (C1-C2) are rare and their management is complex, necessitating lot of experience for their management. Early diagnosis and appropriate treatment is essential for good outcome. Each injury has to be managed at its own merit and a single operation may not be appropriate in all situations. General guidelines can be drawn from our study for the management of these cases on modern lines.

Keywords: Cervical Spine injury, Atlanto-axial instability, Atlas fractures, Axis fracture.

INTRODUCTION

Spinal injuries are among the most devastating injuries sustained by human beings. These injuries have high morbidity and mortality rates. The disability may be life-long and unfortunately their incidence is on rise in developing countries[1]. The upper cervical spine (C0-C2) is anatomically and biomechanically the most complex region of the spine. A thorough knowledge about the anatomical details, physiology, mechanism of injury and their classification is crucial for the adequate treatment[2]. The operative techniques are relatively complex and require precise understanding of anatomy of the vertebral artery[3]. The trauma to the upper cervical spine can result in a wide spectrum of injury patterns. Multiple factors influence observed pattern and severity of injuries like patient age, morphology of the cervical spine, the magnitude, direction, and maximal focus of the force. These injuries includes occipital condylar fractures, atlanto-occipital dislocations, fractures of atlas, atlanto-axial instability and fractures of axis.

The occipital condylar fractures and atlanto-occipital dislocation are rare injuries. The diagnosis is usually made with thin-sections computed tomography scans[4]. Atlanto-occipital dislocations are rare and fatal injuries. The atlas

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fractures may result in incongruence of the atlanto-occipital and the atlanto-axial joint facets[5]. Atlanto-axial instability can be caused by Os odontoideum, which can be either reducible or a fixed dislocation[1].

The axis fractures include traumatic spondylolisthesis, odontoid peg fractures, tear drop fracture of axis, laminar and articular pillar fractures. The injuries are severe in patients with underlying predisposing conditions e.g. degenerative spondylosis, ankylosing spondylitis, diffuse idiopathic skeletal hyperostosis[6]. Hangman's fracture or traumatic spondylolisthesis is the fracture of pedicle of axis due to hyper extension injuries as seen in motor vehicle accidents, diving, and falls or judicial hangings[7]. These are classified by Effendi into type I, II, III and are also called traumatic spondylolisthesis. Unilateral pars inter articularis fracture can occur with hyper extension and axial loading[8]. The odontoid peg fractures are classified by Anderson and D'Alonzo into type I, II and III.

PATIENTS AND METHODS

This descriptive study was conducted at spine unit, department of orthopedics at Combined Military Hospital Rawalpindi from Jan 2001 to Dec 2008. All patients requiring surgical treatment for injuries of occipito-cervical region were included in the study. We excluded all patients treated conservatively or unwilling and unfit for surgery for various reasons. Consent was taken from patients for inclusion in the study. The patients were operated by a single spinal surgeon* in Combined Military Hospital and Military Hospital in Rawalpindi. A performa was made for each patient and records were kept in custom build Microsoft access database.

Neurological assessment was done according to American Spinal Injury Association Impairment Scale (ASIA). Patients without sensory or motor function were AIS-A, incomplete injuries with sensory function only were AIS-B, with motor power of less than grade three were AIS-C, with motor power of grade three or more but less than normal were AIS-D and with normal power were AIS-E. Pre operative planning consisted of detailed patient evaluation. All imaging modalities were used to understand this complex region including radiographs, thin slice computed tomogram with three dimension reconstruction (thin slice CT with 3D recon) and magnetic resonance imaging. To understand course of vertebral artery computed tomography with angiogram (CT Angio) or magnetic resonance angiograms (MRA) were done.

We divided our patients into three groups depending upon etiology. Group A had odontoid fracture, Group B had atlanto-axial instability and group C had Hangman's fracture.

Group A: This group had six patients with odontoid peg fracture. Pre operative reduction was must to carry out odontoid peg fixation. It was achieved with skull traction and confirmed with image intensifier prior to draping. They were operated under two image intensifiers in anterio-posterior and medio-lateral planes in supine position. Spine was approached with collar incision. The fracture line at right angle to or an obtuse angle to the screw path was considered favorable while the fracture line along the screw path was considered unfavorable for this type of fixation. Guide wire was passed under fluoroscopic control and one or two cannulated 3.5 mm screws were inserted. In comminuted odontoid peg fracture and fractures unsuitable for peg screw fixation anterior transarticular fixation of C1-C2 was done. Post operatively a cervical collar was applied and rehabilitation program was started.

Group B: This group had 12 patients with atlanto-axial instability. It was documented by increased atlanto-dental interval of more than three millimeter in adults and more than four millimeter in children. Preoperative traction was applied in patients with neurological deficit with basilar invagination. The posterior approach was made for occipito-cervical fusion, posterior transarticular screw fixation, and Gallie's fusion.

In posterior upper cervical spine procedures patients were positioned prone with skull traction and pre-operative reduction was achieved. Posterior elements or iliac crest graft was used for fusion. Post operatively Philadelphia cervical collar was used.

Group C: This group had 8 patients with Hangman's fracture. This was fixed depending upon fracture reduction, pedicle size and fracture geometry. Absolute preoperative reduction was must to carry out pedicle screw (Judet screw) fixation. A minimum pedicle size of five millimeter was required to place 3.5 millimeter pedicle screw. If stability of pedicle screw was questionable per operatively by flexion extension of cervical spine then C2-C3 fusion using rod screw or lateral mass plate system was done. If comminution at entry site was present then anterior C1-C2 plate fixation was done.

RESULTS

Average age of our patients was 27 years, with range 60years, while 21 (81%) were males and 5 (19%) were females. Etiology included road traffic accidents in 10 (38%) cases, minor trauma in 10 (38%) and fall from height in 6 (23%). The neurological status of 11 (42%) patients was normal AIS-E, 12 (46%) had AIS-D and 3 (12%) had AIS-C deficit. These patients were operated depending upon their indications and the spectrum of operations in these patients is shown in table 1. There was neurological recovery in 9 (60%) of cases and no post operative neurological deterioration.

Group A: 6 (23%) patients of this group had odontoid peg fracture, 3 due to RTA and 3 due to fall from height. These were operated through anterior approach. In 5(83%) cases one or two cannulated screw were inserted and in 1(17%) case with comminution this was augmented with anterior trans-articular screw fixation (Ant- TAS) (Figure 1). Neurological status was AIS-E in 3(50%), AIS-D in 2(33%), and AIS-C in 1(17%) patient. Data had been analyzed using SPSS version 15. Descriptive statistics were used to describe the results.

There was no neurologic deterioration post operatively. Union was achieved in 5(83%) cases and there was 1(17%) implant failure.

Table-1: Spectrum of operative approach in case of C1 and C2 fractures.

Sr. #	Operation	No of patients
1	Axis PSF (Judet Screw)	6
2	Odontoid Peg screw fixation	6
3	Gallie's fusion	5
4	Occipito-cervical fusion	4
5	Post -TAS	3
6	Ant-TAS	1
7	Decompression	1

Figure-1: Odontoid peg screw fixation & Ant TAS- fixation.

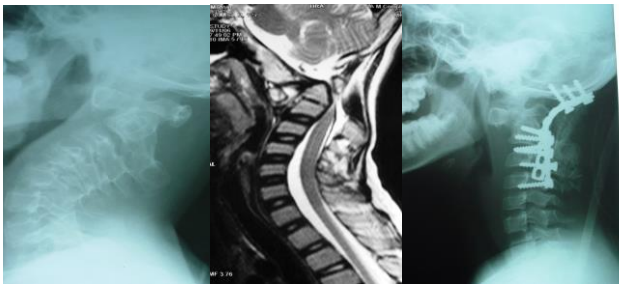

Figure-2: Occipito-cervical fusion.

Group B: 12 (46%) patients, 10 males and 2 females had atlanto-axial instability. Minor trauma, repetitive falls and progressive weakness were presenting complaint in majority i.e. 10(83%) cases and major trauma in 2(17%) cases. Neurologically 2(17%) patients were AIS-E, 9(75%) were AIS-D and 1(8%) was AIS-C.

Posterior approach to occipito-cervical junction was done in 11(92%) and anterior in 1(8%) case. Occipito-cervical fusion was done in 4(33%) (Figure 2), post-TAS in 3(25%), Gallie's fusion in 3(25%), ant-TAS in 1(8%) and decompression was done in 1(8%) case. Union was achieved in all cases.

Group C: 8 (31%) patients had Hangman's fracture, 6 were of Effendi type II and 2 were type III. The etiology was RTA in 7 cases and fall from height in case 1. Neurologically 6(75%) patients were AIS-E, 1(12.5%) was AIS-D and 1(12.5%) AIS-C. The spine was approached posteriorly in all cases. 3.5 millimeter Pedicle Screw fixation with Judet method was done in 6(75%) (Figure 3) and inter spinous wiring in 2(25%) cases. In 1(13%) case there was comminution at the entry site of pedicle screw of axis and cervical two lateral mass screws in cervical third vertebra were applied with 3.5 mm reconstruction plate. Union was achieved in 7(87.5%) patients. There was 1(12.5%) nonunion.

DISCUSSION

The upper cervical spine injuries are rare and their management is complex requiring anterior and posterior approaches. In our study posterior approach was done in 70%[19] cases and anterior in 30%[7].

Group A: Anderson and D'Alonzo Type II fracture of odontoid peg has high nonunion rate with conservative treatment. These fractures of axis can be treated by peg screw fixation in selected cases. This can be confused with Os odontoideum, a condition in which a smoothly corticated ossicle exists dorsal to the anterior arch of axis, taking the place of the rostral dens and there is no bony connection to the body of the axis[9]. The odontoid peg screw fixation is done in type II fractures and cases with inadequate fixation, which can be augmented with anterior transarticular screw fixation. In present study, in 5(83%) patients one or two odotoid peg screws were inserted and in 1 (17%) there was inadequate fixation which was augmented by ant-TAS fixation. There seems no difference in dens union patterns between those receiving one-screw and two-screw fixation[10]. In one study the authors reported 90% union in 6 cases of Type II Anderson and D'Alonzo system with anterior peg fixation[11]. In similar cases union was achieved in 5 (83%) cases in present study. Gallie's fusion can be done as salvage procedure in unreduced cases with about 50% reduction in cervical rotation.

Group B: The atlanto-axial instabilities can be treated with posterior transarticular screw fixation, anterior transarticular screw fixation, Gallie fusion and occipito-cervical fusion depending upon type, achieved reduction and duration. We treated atlantoaxial instabilty by Gallie's fusion in 5(43%) cases, posterior transarticular screw fixation in 3(25%) and occipto-cervical fusion in 4(33%).

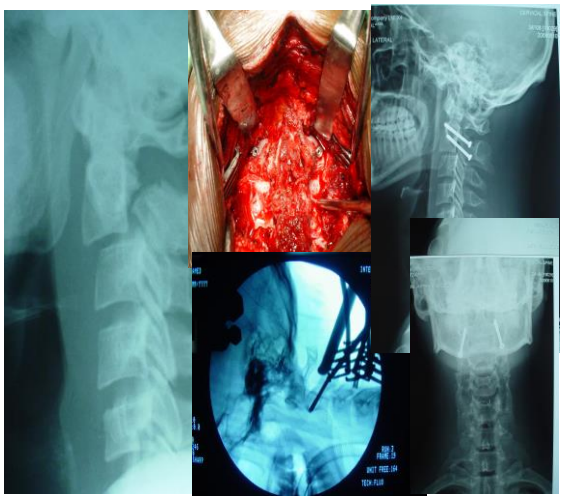

Figure-3: Pedicle screw fixation axis.

Atlanto-axial and occipito-cervical instability have traditionally been treated with posterior bone and wire fusion and external halo orthoses[12]. Over the past century, advances have been made in fixating an unstable atlanto-axial complex. Current options include posterior clamps, posterior wiring techniques, anterior or posterior C1-C2 transarticular screw fixation,

posterior C1 lateral mass screw with C2 pars or pedicle screw fixation, and anterior transoral C1 lateral mass to C2 vertebral body fixation[13]. Atlas fractures can cause atlanto-axial instability and basilar invagination with odontoid peg abutting clivus[14]. C1-C2 instability can be treated with atlanto-axial transarticular screw (C1-C2 TAS) placement, which is a safe and accurate surgical technique that may improve neurological function. Intra-operative navigation is helpful in the patients with difficult anatomy, who are otherwise not candidates for this type of internal fixation in achieving satisfactory screw placement[15]. Posterior transarticular screw insertion requires exposure to C7. Several authors therefore have described a percutaneous technique[16]. Posterior transarticular screw fixation C1-2 with the Magerl's technique is a challenging procedure for stabilization of atlantoaxial instabilities. In one study 93% fusion in thirty eight cases was achieved using Magerl's technique[17]. In present study 100% union was achieved in three cases with this technique. The vertebral artery can be injured during screw passage inside the axis[18]. Atlanto-axial fixation can be achieved by lateral mass and the C-2 pedicle by using polyaxial screws and rods with excellent results[19]. Union was achieved in all cases in present study.

Group C: Type II fractures with C2-C3 displacement can be fixed using Judet screws in C2 pedicles and through fractures or pseudoarthrosis[20]. The complex cases may require additional C2-3 stability of C3 with C2 pedicle screw and C3 lateral mass plate system[21] or rod and screw system. Unstable Hangman's fractures can be fixed with C2-3 anterior inter-body fusion with anterior plate fixation. In present study, Hangman's fracture was operated in 8 patients. Judet pedicle screw fixation was done in 6(75%) patients and inters spinous wiring (ISW) in 2(25%). In one study in four cases author achieved 100% union with Judet pedicle screw fixation[22]. In present study 83% union was achieved in six cases with this method. A unilateral pars interarticularis fracture of the axis can be treated by a Philadelphia collar[8] but displaced fractures require operative fixation.

CONCLUSION

Upper cervical injuries (C1-C2) are rare and their management is complex, necessitating lot of experience for their management. Early diagnosis and appropriate treatment is essential for good outcome. Each injury has to be managed at its own merit and a single operation may not be appropriate in all situations. General guidelines can be drawn from our paper for the management of these cases on modern lines.

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