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Atlas and axis injuries role of Halovest

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Abstract:

Background: The literature regarding the different patterns of atlas and axis injuries and their appropriate management and the progressive development in the management of these injuries is scarce from our world, so we presenting here our experience of management of these injuries by applying Halovest.

Materials and Methods: Thirty patients (22 males, 8 females) with atlas and axis injuries were treated and **then** followed-up for an average of 24 months. The data was analysed with respect to type of injury and use of Halovest in the treatment of these injuries. **The patients with neuro defecit were scored as per ASIA grading scale (from Grade A to Grade E).**

Results: The halo-vest immobilization was used for a mean period of 12 ± 3weeks (range 9 to 15 weeks) for atlas and axis injuries. Four patients had neurodeficit. Two patients recovered from ASIA Grade C to ASIA Grade D. One patient improved from ASIA grade D to ASIA grade E while as one patient with neurodeficit was lost to follow up. No death or worsening of the neurodeficit was observed during the follow up period.

Conclusion: The clinical as well as radiological outcome of these injuries is mostly satisfactory with the conservative management using Halovest. **More studies should be conducted to form the guidelines regarding patient selection for conservative management using halovest.**

Key words: atlas fracture, axis fracture, upper cervical spine injuries, halovest

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Introduction

Cervical spine starts just below the skull and ends above thorax. Upper cervical spine injuries amount about 24% of the fractures and dislocations of the cervical spine injuries. [1]More than 60% of spinal injuries affect the cervical spine, and of all cervical fractures approximately 20% involve upper cervical vertebrae. [2]Conservative treatments include the rigid cervical orthosis, halo-vest immobilization, and cervicothoracic orthosis (Minerva jackets). Jafferson [3] found that injuries to the cervical spine involve two particular areas C1 to C2 and C5 to C7. There is very limited muscular support around cervical spine area and it supports the weight of head (12-15 pounds), placing it at higher risk of sudden movements and whip-lash injuries, that can cause damage to bones, ligaments, arteries and more seriously to the cervical cord and exiting nerve roots. Injuries to the cervical spine produce neurological damage in approximately 40% of the patients. 10% of traumatic spinal cord injuries have no obvious raentgenographic evidence of vertebral injury. [4] Surgical procedures include anterior screw fixation, posterior C1-C2 screw fixation, and transarticular screw fixation.

Nickel and Perry [5] first described the halo apparatus in 1959. Many professionals have adopted halo-vest immobilization as non-surgical method to treat cervical spine injury. Halo-vest immobilization has many disadvantages also, such as skin breakdown, worsened neurologic function, and pin-related problems. [6]

We present here our experience to evaluate the effectiveness, associated complications, and long term results of halo-vest immobilization for upper cervical fractures.

Material and methods

All the patients with upper cervical spine injuries attended either the emergency or out-patient department of orthopaedics, during the period of one year from May 2008 to June 2009 formed the study group. A total of 30 cases of upper cervical spine injury patients including males and females were received during this period. The cases were divided into six groups on the basis of presenting injury.

1. Occipital fractures
2. Craniocervical dissociation
3. Fractures of atlas
4. C1-C2 ligamentous instability
5. Odontoid fractures
6. Traumaticspondylolisthesis (Hangman fracture)

As per the condition of the patient in accident emergency, resuscitative measures essential to restore the cardiovascular status to normal or near normal were administered. Associated injuries of the limbs were splinted with appropriate splints. For suspected associated abdominal, thoracic and head injury, the general surgeon on duty was involved. Care was taken not to damage the spinal cord further or exaggerate the spine injury during the examination and diagnostic procedures. **Cervical collar was used to immobilise the cervical spine till the diagnosis was confirmed**. Intravenous fluids, analgesics, antibiotics were administered as and when required. Glasgow Coma Scale score was documented.

X-rays and CT scans were done to identify and classify the upper cervical spine injuries. Patients having neurological involvement were further investigated with MRI to see the status of cord and ligamentous instabilities. MRI of the cervical spine was also done to rule out neural compression and to look for evidence of cord edema or gliosis.

Among the 30 patients of upper cervical spine injury, there were 11 patients of atlas fractures, 3 patients of atlanto-axial subluxation, 12 patients of dense fracture, and 4 patients of hangman's fracture. No patient of occipital condyle fracture or occipitocervical dissociation **was** received during the study period.

For operative treatment, pre anaesthetic investigations were done. All unstable injuries of the cervical spine, with or without neurological deficit with operative indications were treated operatively.

All atlas fractures (n=11) received were of stable type, so all were treated conservatively with Halovest immobilization for a period of 8 to 12 weeks. One patient of burst fracture atlas with central cord syndrome presentation was managed by Halovest immobilisation for a period of 14 weeks.

One patient of atlanto-axial subluxation (type I) was managed by traction followed by halovest for a period of 8 weeks. Another

patient of atlanto-axial subluxation (type II) without neurodeficit was managed by traction followed by Halovest immobilisation for a period of 10 weeks.

Another patient of atanto-axial subluxation (type II) with neurodeficit was managed by posterior C1-C2 fusion followed by Minerva jacket immobilisation for a period of 12 weeks. One patient of type I dense fracture with neurodeficit (quadreparesis) was managed by strict bed rest and Philadelphia collar for 8 weeks. All the four patients of type III dense fracture were without neurodeficit and managed conservatively by Halovest for a period of 9-14. There were 7 patients of type II dense fracture, 4 patients were fixed anteriorly by one cannulated screw, one patient who presented late and fracture was displaced was managed by posterior C1-C2 arthrodesis. One patient who was not fit for surgery was treated conservatively by Halovest immobilisation for a period of 12 weeks. One patient of type II dense facture refused both Halovest immobilisation and surgery and was managed by Philadelphia collar and strict bed rest for a period of 12 weeks. Dens Access Device and 4 mm cannulated titanium screw were used for fixation of dens anteriorly with the help of two image intensifier.

There were 4 patients of hangman's fracture, three patients were type I hangman fracture without neurodeficit and were managed conservatively with Halovest immobilisation for a period of 12-14 weeks. One patient of type IIA Hangman fracture was managed by Halovest immobilisation for a period of 15 weeks.

The indications for halo-vest immobilization include unstable but neurologically stable cervical fractures or incomplete cord injuries. The halo-vest devises were applied in a standardized manner based on the usual clinical method. The patient was placed in a supine position with the head supported by a wooden board. The four cranial pins were inserted until they contacted bone after local infiltration of lidocaine. The surgeon and the assistant simultaneously tightened each diametrically opposite pin using the torque screwdriver to a maximum torque of 8 in/lb. Check radiographs were taken to confirm reduction. The pins were retightened to the same torque level after one day. The follow-up examination was done for an average period of one year, with the patient reporting at intervals of 3 weeks, 6 weeks, 3 months, 6 months and at one year. The Halovest was removed after completion of treatment in the OPD department.

The decision to remove the halo-vest was based on a plain radiograph with evidence of union and absence of pain or minimal pain in the neck. Periodic neurological and general physical examinations were conducted. Psychological counselling was given throughout the treatment and vocational guidance was given at the time of discharge from the hospital.

Serial radiographs were obtained at one, three and six weeks, then at three, six months, and one year.

Results

Thirty patients, twenty two males (73%) and 8 females (27%) of various age groups were included in this study.

Table 1. Age distribution

Variable (Years)	No. of cases	%age
<10	0	0
11-20	1	3
21-30	5	17
31-40	6	20
41-50	7	23
51-60	3	10
61-70	8	27
71-80	0	0
>80	0	0
Total	30	100

Table I showing distribution of cases in different age groups

Table II. Mode of injury

Variable	No.	%age
RTA	21	70
Fall from height	7	23
Fall of heavy object over head	1	3.5
Sports	0	0
Any other	1	3.5
Total	30	100

Table II showing mode of trauma, RTA was commonest mode of injury in 21 (70%) of patients

Twenty six (86.6%) of patients were without neurodeficit while as 4 (13.3%) of patients were associated with neurodeficit.

Table III. Associated injury

Associated injury	No. of cases	%age
Any other spine injury	1	3.33
Head injury	4	13.3
Scalp injury	4	13.3
Chest trauma	2	6.66
Limb injury	1	3.33
Any other	0	0
Total	12	39.92

Table III showing associated injuries of the upper cervical spine injuries.

Twenty four (80%) patients received conservative treatment while 6 (20%) received operative treatment.

Table IV. Duration between injury and admission

Variable	No. of Cases	%age
<24 hrs	13	43.3
24hr- 1week	13	43.3
1week-2 week	1	3.33
2week-1 month	2	6.66
>1month	1	3.33
Total	30	

Table IV showing distribution of patients as per time taken to get admitted in hospital, 13(43.3%) patients got admitted within 24 hours

Table V. Site of involvement

Type of injury	No. of cases	%age
Atlas fractures	11	37
Atlanto-axial subluxation	3	10
Dense fracture	12	40
Hangman's fracture	4	13
Total	30	100

Table V. showing the distribution of patients as per their pattern of injury

Table VI. Modality of treatment used

Type of fracture	Total No. of Patients	HVI	Operative	Refused either procedure	Not fit for procedure
Atlas fractures	11	11	0	0	
Atlanto-axial subluxation	3	2	1	0	
Dense fracture	12	5	5	1	1
Hangman's fracture	4	4	0	0	
Total	30	22	6	1	1

Table VI showing the modality of treatment used in various fractures of upper cervical spine injury

Table VII. Halovest immobilization I duration and outcome

Type of fracture	Total no. Of patients	Duration of HVI Weeks	Mean Weeks	Outcome	
				Union No. of patients	Failure No. of patients
Atlas fracture	11	8-14	12.18	9	2
Atlanto-axial subluxation	2	8-10	9	2	0
Dense fracture	5	9-14	11.8	4	1
Hangman's fracture	4	12-15	13.5	4	0
Total	22			19	3

Table VIII. Complications Related To Treatment Modalities

S no.	Complications	No. of Cases
1	Neck stiffness	6
2	Residual neck pain	1
3	Pin lossenig	3
4	Torticollis	1
5	Seizures	1
6	Pin site scar	1
7	Pin tract infections	1
8	Occipital hypoaesthesia	1
9	Dysphagia	1
10	CSF leak	1
11	Loss of reduction	1

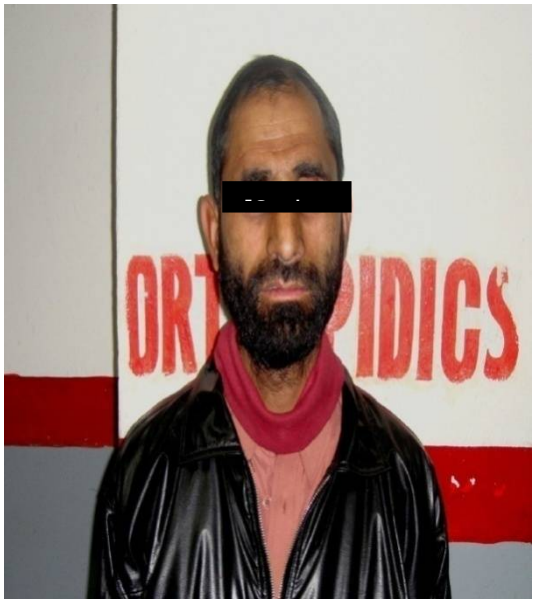
The Halovest immobilization lasted for a mean period of 12 ± 3weeks (range 9 to 15 weeks). Among the 4 patients having neurodeficit associated with upper cervical spine injury, two patients recovered from ASIA grade C to ASIA grade D, one patient improved from ASIA grade D to ASIA grade E while as one patient with neurodeficit lost to follow up. No death or worsening of the neurodeficit of the patients was observed in our study.

Case No. 1

Type III Dens Fracture

CT Showing Type III Dens Fracture

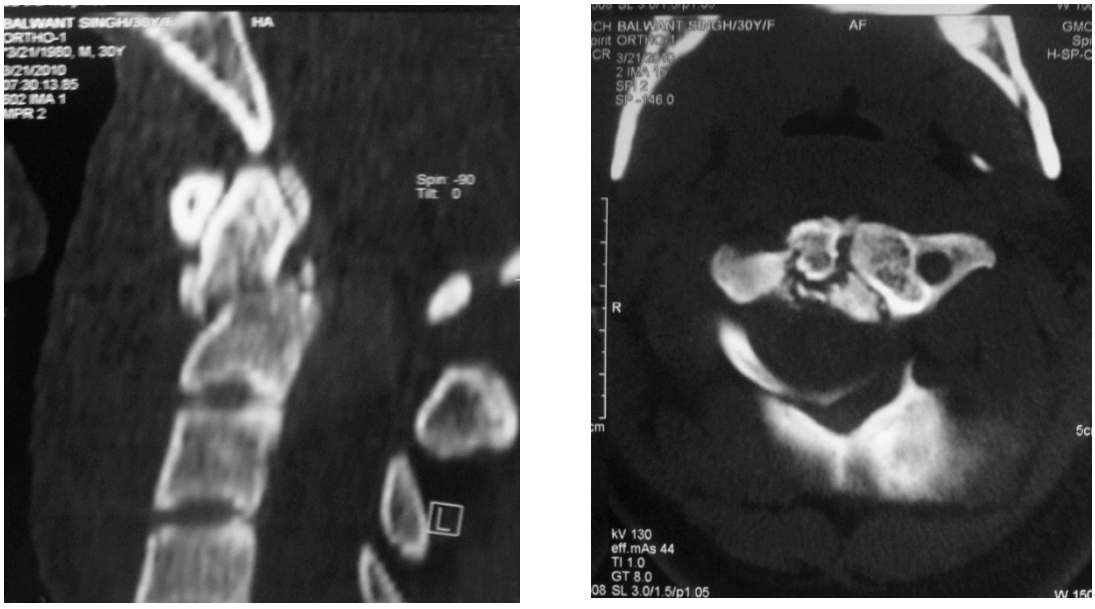
Photograph of Patient with Halovest



X- ray showing union. **Follow up photograph**

Case No. 2

Type III Dens Fracture



CT Scan Showing Type III Dens Fracture

X – Ray showing fracture reduction

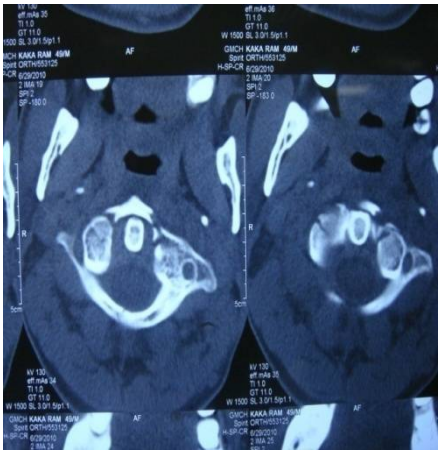
Patient with Halovest

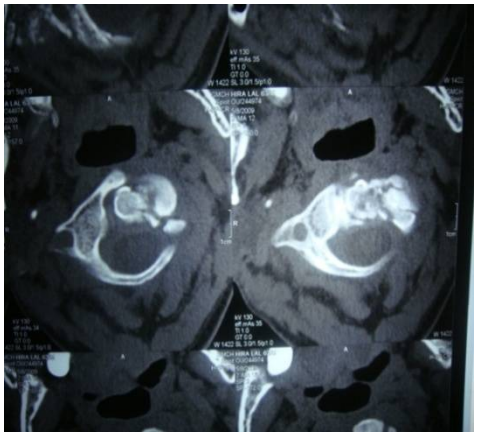
Follow up X-Rays showing fracture union

Follow up photographs showing neck movements

Case No. 3

Atlas fracture





Case no. 4

Hangman's fracture

Discussion

Most of upper cervical spine injuries do present without any neurodeficit due to wide spinal canal at craniocervical junction. As stated in literature one third of spinal canal is occupied by odontoid process, one third by spinal cord and one third space is free to accommodate displaced spinal cord during trauma. Neurodeficit occur in patients of smaller diameter spinal canal and who sustain high velocity trauma. [7]

The halovest is a rigid ring that attaches to the outer cortex of the cranium through four sharp-tipped pins. Screw loosening may occur at the interface of halo pin and cranium, and the resulting micro motion may induce a crack at the fractured site. Pin site problems tend to have an impact on the outcome of HVI. Daentzer, et al [8] reported that 7 seven out of 9 nine patients **had pin site infection which was controlled by oral antibiotics. There was no long term complication with these cases**. **They also recommended to take care about the pin track with regular dressings and avoid loose pins by tightening them regularly.** Complication rates reported from the use of the halo device range from 0% to 100% and the complications include pin loosening, migration, penetration, scalp infection, skull fracture, cerebral haemorrhage, paresthesia, and pressure sores [Ref].[9]

Although the definition of failure varies widely among studies, failure rates after halovest treatment of upper cervical fracture range from 18% to 85%.[10,11,12] This study showed a failure rate of 15.78% and a complication rate of 81.81%, in line with previously published reports. [10, 11] Our low rates of failure may be due to using both operative and non operative modality of treatment in these types of injuries and high rates of complications may be less experience of dealing such injuries and less quality Halovests available with us. We found a high likelihood of failure in the treatment of odontoid fractures. This finding is consistent with that of Bransford, et al. [13]

The fracture healing rates reported for these injuries range from 67% to 93.9%. [14, 15] We observed healing in 86.36% of patients,

with a mean bone healing time of 12.26 weeks. The reason behind the high rates union of this study may be due to small number of patients.

Patients feel inconveniences in sleeping, personal hygiene, and appearing conspicuous for such a long time. Halo-vest device is versatile modality of treatment in dealing such injuries non-operatively, however the shape and mode of attachment of the device may impose a significant burden on the patient and attendants. This study highlights these issues in detail. The small number of patients of this study potentially biases our final findings

Conclusion

Most of atlas and axis injuries need good conservative care and few require surgery, which is sometimes technically demanding. The results of conservative and surgical treatment are good in spite of high but manageable complications. Late presentation is often associated with secondary complications especially persistent pain and myelopathy. Our study showed a 15.78% failure rate for HVI, with complications in 81.81% of patients. Neck stiffness was the most common complications followed by pin loosening. The high probability of complications and failure should inform our decision to perform HVI, and we should attend promptly to pin site problems in particular. The findings of our study may assist the physician in the decision to use HVI or not, and to predict and treat the outcomes of HVI in atlas and axis injuries.

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