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ABSTRACT

Introduction: Cervical spine injury is the most feared spinal injury for physicians, patients, and their families. All patients with unstable subaxial cervical spine injury must be managed by cervical traction and stabilization. Lateral cervical X-ray remains standard diagnostic tools to evaluate the stability of cervical spine structure and has a high diagnosis value in evaluating the success of the cervical traction. The success of the cervical traction could be predicted by observing the alignment of the cervical based on series lateral cervical spine X-ray.

Materials and methods: This retrospective study involves 30 patients with subaxial cervical spine injury admitted to the Emergency Unit of Dr. Hasan Sadikin Hospital, Bandung, Indonesia, from 2012 to 2016. This study uses the logistic regression analysis with p < 0.05 considered to be significant and the confidence interval (CI) of 95%.

Results: The results of this study showed that the failure of cervical traction (closed reduction) was mainly determined by interval admission time and facet lock (FL). The interval admission time (p = 0.015; two-sided tail, Pearson’s chi-square) and distribution of FL showed significant results (p = 0.001; two-sided tail Fisher’s exact test). Odds ratio (OR) whether FL is present or absent is 3.8; 95% CI 0.5 to 27.1, with p = 0.001.

Conclusion: It is concluded that informed consent regarding cervical traction failure is needed in subaxial cervical injury >24 hours, where in patients with FL cervical traction trail is not needed, instead immediate definitive management (opened reduction) with stabilization is recommended.

Keywords: Cervical traction, Evaluation of series lateral cervical spine X-ray, Patient’s characteristic, Subaxial cervical spine injury.


Source of support: Nil

Conflict of interest: None

INTRODUCTION

Cervical spine injury is the most feared spinal cord injuries (SCI’s), for the physician, patient, and family, where there is a correlation between the degree of injury to the disability and/or death rate. The higher the level of injury suffered by the patient, the higher the disability and/or death rate. Most of the injuries from cervical spine are caused by falling from altitude and traffic accidents, usually in cervical spine at level 3 to 7 (C3–C7) compared with injuries to C1 and C2.1,3

Research on cervical spine injury in Indonesia is very interesting considering that 3.9% of patients with head injury in cases of accidents to admitted to the Emergency Unit of Hasan Sadikin Hospital from 2012 to 2016 had the potential to seriously injure the cervical spine. Currently, there are no reports of prediction factors on the success of cervical traction on the Indonesian population with cervical injury, in Bandung in particular.

Subaxial cervical spine injury was classified into six types, by Allen et al,4 based only on the injury mechanisms of radiology pathology: Flexion compression, extension compression, vertical compression, flexion distraction, extension distraction, and lateral flexion, which was then refined by Vaccaro et al,5 with a subaxial cervical spine injury classification system (SLIC).6 With SLIC three components are assessed: Morphological injury, discoligament complex, and neurological status.5 Nearly one-third of cases of cervical injury occur at C2 level, but it does not explain the highest cause at that level.7,8

The incidence rate of cervical injury in a year is reported to be 64/100,000 inhabitants with two peak ages: One in the second and third decades of the male population, then another in elderly women. The most common mechanism of cervical spine injury is a fall from height, with a vertical compression mechanism known as axial loading, followed by the second most common motor vehicle accident. Although some data show surprising results, some clinically injured patients have mild cervical spine injuries; they remain the most common SCI, which represents 55% of all SCI cases.9 After an initial trauma evaluation has been performed, it is important to continue with an appropriate radiographic evaluation. This type of radiographic assessment has evolved as a more advanced imaging technique, with technological advancements
the imaging field considered a standard in many institutions. Lateral cervical X-ray is still considered standard in analyzing the stability of the cervical bone structure and are felt to still have high diagnostic value in evaluating the efficacy of cervical traction of cervical spine injury patients. Although relatively easy and inexpensive, cervical X-ray provides low visualization of cranio-cervical and cervico-thoracic junction assessments in the literature that can lead to a 15 to 30% diagnostic error.\(^6,10\)

All patients with an unstable subaxial cervical spine injury should be treated promptly using cervical traction. Although in some patients the long immobilized and cervical traction measures work well, in the remaining patients there is no stabilization and it requires operative action. Due to the importance of a cervical traction action in the treatment of subaxial cervical spine injuries and, to our knowledge, there is no literature analyzing the factors that influence the success of cervical traction by using its success parameters simply by achieving a cervical spine realignment based on an evaluation of lateral cervical X-ray, the authors felt the need to analyze what factors could predict the success of traction from anamnesis, clinical examination, and simple radiological examination in hospitals with limited facilities, resources, and socioeconomic conditions.\(^11,12\)

The purpose of this study was to determine the predictive factors of success of a cervical traction by using its success parameters only by looking at the achievement of cervical bone realignment based on the evaluation of series lateral cervical X-ray in patients with subaxial cervical spine injury.

**MATERIALS AND METHODS**

**Research Subject**

The study subjects were all patients aged 15 to 80 years, with cervical spine injuries requiring cervical traction who came to Hasan Sadikin Hospital, Bandung, Indonesia, from 2012 to 2016 and agreed to do a series lateral cervical X-ray.

The inclusion criteria used were all patients aged 15 to 80 years with the possibility of subaxial cervical spine injury and provide appropriate radiological features requiring cervical traction action coming to Hasan Sadikin Hospital, Bandung, from 2012 to 2016, and agreed to do series lateral cervical X-ray. While the exclusion criteria are patients who refuse to be sample research, is in pregnancy, has a congenital abnormalities, and postcervical surgery.

**Research Methods**

This study is a retrospective cohort study of the predictive factors of cervical traction success, with only a cervical spine realignment being evaluated based on the evaluation of the series lateral cervical spine X-ray, in subaxial cervical spine injury patients performed by cervical traction.

The independent variables in this study were age, sex, event interval, accident type, Glasgow coma scale (GCS), diagnosis and fracture type of cervical spine injury, those underwent cervical traction, and presence or absence of FL. The dependent variable in this study was the success rate of cervical traction, with only a cervical spine realignment being achieved based on the evaluation of series lateral cervical spine X-ray in patients with subaxial cervical spine injuries. Confounding variable in this research is socioeconomic condition of patient.

The selection of subjects was carried out systematically with sampling technique by determining samples based on the sequence of consecutive population members according to the patients who met the inclusion criteria until the sample number was reached.

Determination of the number of samples is calculated based on the hypothesis test of correlative analysis with the formula:

\[
Y = f(X) = a_1X_1 + a_2X_2 + a_3X_3 + a_iX_i
\]

- Y: Dependent factor
- Xi: Independent factor
- ai: Constants of independent factor

Risk factor (OR) can be obtained by using Equation (2):

\[
OR = e^{ax}
\]

- e: exp
- ax: Constants of independent factor

RESULTS
A total of 30 research subjects, all adult patients, aged 15 to 80 years, with cervical spine injuries requiring cervical traction to come to Hasan Sadikin Hospital, Bandung, from 2012 to 2016 and agreeing to do series lateral cervical X-ray have been included in this study.

Table 1 shows the age distribution, with most successful age group in this research sample as age group 41 to 50 years, with \( n = 8 \) (26.6%), while the group with the smallest number is the age group >70 years with a value of \( n = 1 \) (6.7%). The age range of patients in this study ranged from age 15 to 80 years, with an average of 41.47 ± 16.75. The age distribution on a successful cervical traction was not statistically significant \((p = 0.079; \text{Pearson's chi-square})\).

Table 1 shows the gender distribution in this study was men with \( n = 24 \) (80%), while female patients amounted to 6 patients (20%), whereas the distribution of sex on a successful cervical traction was not statistically significant \((p = 0.674; \text{Fisher's exact test})\). Odds ratio for GCS value (<13/<13) is 1.00 with 95% CI 0.167 to 5.985; which is not statistically significant.

Table 2 shows the most time interval of patient arrival in this study sample is >24 hours with \( n = 17 \) (56.7%), while the least time interval in this research sample was <6 hours with \( n = 5 \) (16.6%). The interval ranges from 1 to 720 hours, with an average of 93.2 ± 154.41 hours or 3.8 days. The distribution of intervals of patients’ arrival to Hasan Sadikin Hospital on successful cervical traction was significantly statistically significant \((p = 0.015; \text{two-sided tail Pearson's chi-square})\).

Table 3 shows the type of accident and fall from the height is the most cases in this study sample, with \( n = 19 \) (63.3%). While the case of traffic accident in this research sample is 11 (36.7%) cases, the accident type distribution on a successful cervical traction was not statistically significant \((p = 0.5; \text{Fisher's exact test})\). Odds ratio for this type of accident is 1.333 with 95% CI 0.301 to 5.915, which is not statistically significant.

Table 4 shows the GCS value >13 is the most cases in this study sample with \( n = 28 \) (93.3%) cases, whereas GCS <13 is 2 (6.6%) cases; the GCS distribution on a successful cervical traction was not statistically significant \((p = 0.759; \text{Fisher's exact test})\). Odds ratio for GCS value (<13/>13) is 1.000 with 95% CI 0.057 to 17.621, which is not statistically significant.

Table 5 shows the diagnosis with Frankel A is the most cases in this study sample with \( n = 13 \) (43.3%) cases, followed by Frankel B with \( n = 12 \) (40%) cases, Frankel C with \( n = 2 \) (6.6%) cases, and Frankel D with \( n = 2 \) cases.
Predictive Factors of Cervical Traction

(6.6%) cases; while Frankel E with \(n = 1\) (3.3%) cases is the least case; the diagnosis on a successful cervical traction was not statistically significant (\(p = 0.358\); Pearson's chi-square).

Table 6 shows the type of burst fracture and none is the most common case in this study sample, with \(n = 9\) (30%) cases, followed by a blocked fracture with \(n = 7\) (23.3%) cases, linear fracture with \(n = 3\) (10%) cases, and compression fractures with \(n = 2\) (6.6%) cases. The type of fracture in a successful cervical traction was not statistically significant (\(p = 0.55\); Pearson's chi-square).

Table 6 shows the type of burst fracture and none is the most common case in this study sample, with \(n = 9\) (30%) cases, followed by a blocked fracture with \(n = 7\) (23.3%) cases, linear fracture with \(n = 3\) (10%) cases, and compression fractures with \(n = 2\) (6.6%) cases. The type of fracture in a successful cervical traction was not statistically significant (\(p = 0.55\); Pearson's chi-square).

• Patients with FL with no alignment (malalignment) as much as 12 (80%) cases; FL achieved alignment (realignment) as much as 2 (13.3%) cases.
• Patients without FL that are not achieved alignment (malalignment) are 3 (20%) cases; without FL achieved alignment (realignment) of 13 (86.7%) cases.

The FL distribution on a successful cervical traction was statistically significant (\(p = 0.001\); two-sided tail with Fisher's exact test). Odds ratio for the presence or absence of FL is 3.8 with 95% CI 0.5 to 27.1, which was statistically significant (\(p = 0.001\)).

CONCLUSION

The results of multiple logistic regression analysis showed that the most dominant factor associated with traction efficacy, seen from the evaluation of series lateral cervical X-Ray, was FL, indicating cervical traction failure 3.8 times higher in the presence of FL, than patients not present with FL. With the presence of a FL, it is estimated that traction failure increased to 26% and mortality to 7% and unilateral FL has a trend of higher traction failure compared with bilateral FL; the presence of damage to the accompanying ligaments is one of the complicating factors of its realignment process.13

Overall, the results of this study show that all the characteristics of patients with subaxial cervical injury by cervical traction (closed reduction), found that the

Table 6: Distribution of cervical traction success based on type of fracture

<table>
<thead>
<tr>
<th>Type of fracture</th>
<th>Malalignment</th>
<th>Realignment</th>
<th>Total</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>9 (60%)</td>
<td>0</td>
<td>9</td>
<td>0.55</td>
</tr>
<tr>
<td>Burst</td>
<td>2 (13.3%)</td>
<td>7 (46.7%)</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>Dislock</td>
<td>3 (20%)</td>
<td>4 (26.7%)</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>Linear</td>
<td>0</td>
<td>2 (13.3%)</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Compression</td>
<td>1 (6.7%)</td>
<td>2 (13.3%)</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>15</td>
<td>15</td>
<td>30</td>
<td></td>
</tr>
</tbody>
</table>

Table 7: Distribution of successful cervical traction of patients based on the presence or absence of FL

<table>
<thead>
<tr>
<th>FL</th>
<th>Malalignment</th>
<th>Realignment</th>
<th>Total</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>3 (20%)</td>
<td>13 (86.7%)</td>
<td>16</td>
<td>0.001</td>
</tr>
<tr>
<td>Yes</td>
<td>12 (80%)</td>
<td>2 (13.3%)</td>
<td>14</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>15</td>
<td>15</td>
<td>30</td>
<td></td>
</tr>
</tbody>
</table>

arrival interval and FL were the main factors of cervical traction failure. In the treatment of subaxial cervical injuries >24 hours, there need to be informed consent to traction failure, and where there is no need for FL trial traction (closed reduction) experiment, a definitive treatment of open reduction with stabilization must be done.

REFERENCES