

Original Research Article

Impact of Head and Spinal Lesions among Patients Who Fell Into Open Drains in Japan: A Systematic Review of Japanese Literature

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Abstract: We performed a retrospective study to determine whether or not head and/or neck trauma is a risk factor of a poor outcome among traumatized patients who fell into open drains. An Ichushi search (Japania Centra Revuo Medicine) was performed using the key words "drain" and "ditch" to identify articles on traumatized cases by Japanese authors published from 1983 to 2016. These cases were included as subjects. The exclusion criterion was no trauma after falling into drain. The subjects were divided into two groups: the head and/or spine (HS) group, which included cases who had suffered head and/or spine injury due to falling into an open drain, and a control group, which included patients without any such injuries. We investigated the following data: age, sex, situation of injury, drunken state or not, cerebral performance category (CPC) scale at discharge and the mortality rate. We then compared the findings between the two groups. There were 32 cases in the HS group and 47 controls. There were no significant differences between the two groups in the age, sex, situation and drunken state. Although we noted 14 poor outcomes and 5 mortalities in the HS group, there were no poor outcomes or mortalities among cases in the control group. This difference was statistically significant. Head and spinal traumatic lesions were significant risk factors for a poor outcome among traumatized patients who had fallen into an open drain.

Keywords: Trauma; drain; head; spine.

INTRODUCTION

Drains are water tracts along one or both sides of a road for the drainage of rain or domestic water. In Japanese cities, drains are covered with concrete to create walking spaces and prevent the spread of odors. In rural areas, however, due to budget limitations or to make it easier to clean them, such drains are often left open [1]. Accidental falls into open drains are a constant occurrence in rural areas. We previously demonstrated that victims of such falls suffer a variety of traumas, including head, neck and truncal injuries [1]. Generally, head and/or neck trauma is a risk factor for a poor outcome among patients with multiple injuries [2-5]. We therefore performed a retrospective study to determine whether or not head and/or neck trauma is also a risk factor of a poor outcome among traumatized patients who fell into open drains.

SUBJECTS AND METHODS

This retrospective study protocol was approved by the review board of Juntendo Shizuoka Hospital, and the examinations were conducted in accordance with the standards of good clinical practice and the Helsinki Declaration.

An Ichushi search (Japania Centra Revuo Medicine), which collects summaries of Japanese medical articles, was performed using the key words "drain" and "ditch" to identify articles on traumatized cases by Japanese authors published from 1983 to 2016. These cases were included as subjects. The exclusion criterion was no trauma after falling into drain.

The subjects were divided into two groups: the head and/or spine (HS) group, which included cases who had suffered head and/or spine injury due to falling into an open drain, and a control group, which included patients without any such injuries. We investigated the following data: age, sex, situation of injury (walking, cycling, driving or others), drunken state or not, cerebral performance category (CPC) scale at discharge and the mortality rate. We then compared the findings between the two groups. The CPC scores described the following: (i) no major disability, (ii) moderate disability, (iii) severe disability, (iv) coma or vegetative state and (v) death. In addition to the HS and control groups, patients were also divided into two groups based on outpatient treatment versus hospitalization. CPC categories iii to v were classified as a poor outcome.

The chi-squared test or unpaired Student's *t*-test were used for the statistical analyses, as appropriate. A *p*-value of < 0.05 was considered to indicate a statistically significant difference. All data are presented as the mean ± standard error.

RESULTS

There were 85 cases of falling into an open drain [1, 6-10]. Among them, six cases suffered no trauma. After excluding these cases, the remaining 79 cases were included as subjects. There were 32 cases in the HS group and 47 controls. The cases reported by

Miura *et al.* were not counted as cases because those authors did not describe individual data in their report [11].

The results of an analysis including all subjects are shown in Table 1. There were no significant differences between the two groups in the age, sex, situation and drunken state. Although we noted 14 poor outcomes and 5 mortalities in the HS group, there were no poor outcomes or mortalities among cases in the control group. This difference was statistically significant.

Table-1: Results of an analysis of the subjects

	Head & Spinal injury n= 32	Control n = 47	p value
Sex (male/female)	19/13	28/19	n.s.
Age, years	59.0 ± 3.5	54.4 ± 3.0	n.s.
Situation			n.s.
Walking	15	29	
Bicycling	12	7	
In a vehicle	4	9	
Other	1 (motorcycle)	2 (motorcycle, tractor)	
Drunk	2	2	n.s.
Poor outcome	14	0	p>0.0001
Death	5	0	p>0.01

Mean ± standard error

n.s., not significant

DISCUSSION

In the present study, we found that head and spinal traumatic lesions were significant risk factors for a poor outcome among traumatized patients who had fallen into an open drain. Previous studies that examined the trends of general trauma, such as that suffered in traffic accidents or by falling from a building, also found that head and/or neck trauma was a risk factor of poor outcomes [2-5]. Miura *et al.* reported 17 autopsies following a self-inflicted bicycle accident, and 15 (88%) were triggered by falling into a drain or irrigation channel [11]. The cause of death was cervical spinal injury in 7 cases (41%), drowning in 6 cases and head injury in 3 cases. Our hypothesis for this severity is as follows: when a human falls into an open drain, the concrete corner of the drain hits part of the body. The transfer of energy from the concrete corner, with a small cross-sectional area, to a small field on the body, may lead to more severe injuries of the internal organs than one might predict, similar to a handlebar or horse kick injury [1].

Our previous report showed that females and older patients tended to more frequently require admission due to severe injury than males and younger

patients [1]; however, we observed no such tendency in the HS group, possibly because we evaluated subjects whose cases had been reported by other authors. Most of the subjects had been treated in a hospital because they had severe injuries. In contrast, our traumatized subjects from a previous report included those with minor injury who were able to return to home [1]. This difference in the severity of trauma between the previous and present studies may explain the discrepancy in the findings.

CONCLUSION

Head and spinal traumatic lesions were significant risk factors for a poor outcome among traumatized patients who had fallen into an open drain.

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