

Original Article

Characteristics of patients who fell into open drains: a report from a single emergency center in East Shizuoka

Epidemiology of patients who fell into open drains in East Shizuoka

Kei Jitsuiki, Hiromichi Ohsaka, Kouhei Ishikawa, Toshihiko Yoshizawa, Kazuhiko Omori, Yasumasa Oode and Youichi Yanagawa

Department of Acute Critical Care Medicine, Shizuoka Hospital, Juntendo University, Izunokuni, Japan

Aim: To clarify the characteristics of injuries caused by falling into an open drain.

Methods: A medical chart review was retrospectively carried out of all patients in East Shizuoka, Japan, who were injured due to falling into an open drain, and who were subsequently transported to hospital by ambulance or a physician-staffed helicopter, between January 2013 and December 2014. The patients were divided into two groups, those treated as outpatients and those who were admitted to hospital.

Results: During the investigation period, there were 33 patients who had accidentally fallen into an open drain. The ages of the subjects ranged from 10 to 90 years, with an average age of 58.8 years. The average age of the subjects, the ratio of female patients, and the average injury severity score in the admission group were higher than that of the outpatient group. One patient in the admission group who had cardiac arrest due to a cervical cord injury eventually died.

Conclusion: Falls into open drains are especially frequent in elderly people and female patients, and older patients tend to more frequently require admission due to severe injury. To prevent injuries of this type, some measures are required to improve the safety of open drains.

Key words: Drain, injury prevention, open drain, outcome, Shizuoka, trauma

INTRODUCTION

A DRAIN IS water tract along one or both sides of the road for the drainage of rain or domestic water. In Japanese cities, drains are covered with concrete to create walking spaces and prevent odor. In rural areas, however, due to budget limits or to reduce the labor of cleaning, such drains are often left open. Accidental falls into open drains are a constant occurrence in rural areas. There are previous case reports in Japan^{1–9} that have described the various injuries caused by falls into open drains; however, few reports have investigated the characteristics of injuries caused by such falls.³⁶ Accordingly, we carried out a retrospective study in our institute on the nature of the injuries caused by falls into open drains in East Shizuoka, Japan.

Corresponding: Youichi Yanagawa, Department of Acute Critical Care Medicine, Shizuoka Hospital, Juntendo University, 1129 Nagaoka, 410-2295 Izunokuni, Shizuoka, Japan. E-mail: yyanaga@juntendo.ac.jp

Received 22 Oct, 2015; accepted 16 Mar, 2016

METHODS

THIS RETROSPECTIVE STUDY protocol was approved by the review board of Juntendo Shizuoka Hospital (Izunokuni, Japan), and the examinations were carried out according to the standards of good clinical practice and the Helsinki Declaration.

A physician-staffed helicopter emergency medical service commenced in the eastern part of Shizuoka Prefecture in 2004 and has been supported by our hospital, which has 552 beds, serves as the base hospital, and is responsible for the eastern region of Shizuoka Prefecture, including the Izu Peninsula. This region, approximately 4,090 km² in area, with a population of approximately 2 million, is mountainous, with only a few hospitals. The journey from the southern tip of the peninsula to the critical care medical center of our hospital takes 1.5 h by ambulance but only 15 min by helicopter. Currently, the most severe cases are transported using this helicopter emergency medical service to our hospital.^{37–40}

A medical chart review was retrospectively carried out of all patients who were injured due to falling into an open

drain, and who were subsequently transported to our hospital by ambulance or a physician-staffed helicopter, between January 2013 and December 2014. We investigated the following data: patient age, sex, situation of injury (walking, cycling, motorcycling, or driving), daytime or night time, season, lag-time between fall and rescue, drowning or not, diagnosis, injury severity score (ISS), whether the patient was treated as an outpatient or admitted to hospital, length of stay in the intensive care unit, length of hospitalization at our hospital, and Cerebral Performance Category scale at discharge from our hospital. The Cerebral Performance Category scores equated as follows: (i) no major disability, (ii) moderate disability, (iii) severe disability, (iv) coma or vegetative state, (v) death. The patients were divided into two groups, those treated as outpatients and those who were admitted to hospital. The following variables were each analyzed as two groups: age, sex, situation of injury (walking or non-walking), ISS, and survival rate.

The χ^2 -test, Mann–Whitney *U*-test, or unpaired Student's *t*-test were used for the statistical analyses, as appropriate. A *P*-value < 0.05 was considered to indicate a statistically significant difference. All data are presented as the mean \pm standard error.

RESULTS

DURING THE INVESTIGATION period, 9,841 patients were transported to our hospital by ambulance or a physician-staffed helicopter. Of these patients, 33 who had accidentally fallen into an open drain were treated as subjects. A physician-staffed helicopter was used to transport 2 of the 33 patients.

The diagnoses of all 33 patients are listed in Table 1. Craniofacial injuries were the most frequent injury type, following injuries of the extremities and truncal injuries. The background characteristics of the subjects are shown in Table 2. The ages of the subjects ranged from 10 to 90 years, with an average age of 58.8 years. The average age of the subjects in the admission group was higher than that of the outpatient group. However, this difference was not statistically significant (*P* = 0.1). The number of male subjects was higher than that of female subjects. The ratio of females in the admission group was significantly greater than that in the outpatient group. Nineteen cases had fallen while walking, three of them had fallen into the open drain while stepping out of the way of a car, and other three had fallen due to the influence of alcohol. Six cases

Table 1. Numbers and types of injuries due to falls into open drains in East Shizuoka, Japan, according to outpatient and admission groups, January 2013 to December 2014

Diagnosis	AIS	Outpatient, <i>n</i> = 19	Admission, <i>n</i> = 14	Major intervention
Head or facial soft tissue injury	1	11 (57%)	8 (57%)	Conservative 19
Cerebral concussion	2	0	4 (28%)	Conservative 4
Craniofacial fracture	2	0	2 (14%)	Conservative 2
Cervical sprain	1	1 (5%)	0	Conservative 1
Cervical cord injury (arrest)	6	0	1 (7%)	Mechanical ventilation 1
Chest contusion	3	5 (26%)	3 (21%)	Conservative 8
Rib fractures	2 or 3	2 (10%)	2 (14%)	Conservative 4
Sternoclavicular dislocation	2	1 (5%)	0	Conservative 1
Pneumothorax	3	0	2 (14%)	Chest drainage 1
Liver injury	2 or 3	0	2 (14%)	Embolization and operation 1
Aortic dissection	4	0	1 (7%)	Conservative 1
Pelvic fracture	3	0	1 (7%)	Conservative 1
Lower thoracic spine fracture	2	1 (5%)	0	Conservative 1
Contusion of extremity	1	5 (26%)	6 (42%)	Conservative 10 and operation 1
Fracture of extremity	2	2 (10%)	5 (35%)	Internal fixation 7
		Tarsus	Distal radius x2	
		Humerus	Bilateral forearm	
		Ulnar	Femoral neck	
			Humerus	

AIS, Abbreviated Injury Scale.

Table 2. Comparison between outpatient and admission groups of patients who were injured due to falls into open drains in East Shizuoka, Japan, January 2013 to December 2014

	Outpatient, <i>n</i> = 19	Admission, <i>n</i> = 14	<i>P</i> -value
Age, years	51.7 ± 4.9	63.6 ± 5.7	0.13
Sex (male / female)	14/5	5/9	0.03
Gate / non-gate	11/8	8/5	n.s.
Bicycle	2	4	
Car	6	1	
Tractor	0	1	
Daytime (yes)	11 (58%)	10 (71%)	n.s.
Season			
Spring	4	2	n.s.
Summer	4	2	
Fall	5	6	
Winter	6	4	
Lag time (yes)	0	3 (21%)	0.06
Drowning (yes)	0	0	n.s.
Alcoholic intoxication	2 (10%)	1 (7%)	n.s.
Accidental hypothermia	0	2 (14%)	n.s.
Injury severity score	2.6 ± 0.5	13.0 ± 4.9	0.02
Duration of ICU stay, days	0	2.1 ± 1.9 (0-27)	n.s.
Duration of hospitalization, days	0	12.5 ± 5.7	<0.01
Cerebral Performance Category	5	4.5 ± 0.3	n.s.
Survival rate	19 (100%)	13 (92.8%)	n.s.

ICU, intensive care unit; n.s., not significant.

fell while cycling, seven cases while driving a car, and one case while driving a tractor. In all of the cases involving a car or tractor, the side of the vehicle was trapped by the open drain after crashing into buildings or after the vehicle had fallen directly into the open drain. The average ISS in the admission group was significantly higher than that in the outpatient group. One patient in the admission group, who had cardiac arrest due to a cervical cord injury that she suffered when she fell into an open drain under the influence of alcohol, obtained return of spontaneous circulation. However, she eventually died due to hypoxic encephalopathy after admission.

DISCUSSION

THIS REPORT SHOWS that the injuries associated with falls into open drains are especially frequent in elderly people who are walking or driving a vehicle. Forty-two percent of the patients in this study required admission due to the severity of their various injuries, which, on some occasions, were lethal. This report also showed that female and older patients tended to more frequently require admission due to severe injury. Failure to detect the open drain due to

cognitive decline might explain the reason for the high frequency of injuries in elderly patients.⁴¹ Elderly female patients also tend to have poor defensive reactions during falls compared with younger male patients.⁴¹ Furthermore, female and elderly people tend to experience conditions that involve fragility of tissue, such as osteoporosis, compared to male and young people. These tendencies might explain why female patients and the elderly tended to more frequently require admission due to severe injury.

The severity of injury may depend on not only age and gender but also the depth of the drains, drowning or not, or time lag from the injuries to the emergency call. Unfortunately, due to the nature of the retrospective study, we could not collect data on the depth of drain. Nosaka *et al.* reported that, in ditch-related injuries, the depth of ditch was not so important, compared with the occurrence of head and spinal injuries, for poor prognostic factors.³⁶ In our study, there were no cases of drain-related drowning. However, Nosaka *et al.* and Miyaishi *et al.* reported a fatal case due to drain-related drowning.⁴² Accordingly, the drain-related drowning and environmental temperature when the drain-related drowning occurs, which may lead to accidental hypothermia, may be an important prognostic factor.

Table 3. Summary of published case reports on injuries due to falls into open drains

No.	Primary author	Year of publication	Age, years	Sex	Situation	Diagnosis	Outcome
1	Furukawa	2013	62	M	Gait	Facial neck penetrating injury	Survival
2	Harada	2012	80	F	Gait	Multiple fxs at extremities, cervical disc injury, fat embolism	Death
3	Wajima	2012	14	F	Bicycle	Axonal injury, dislocation of neck and pelvis, clavicular fx	Sequelae
4	Tanishi	2012	68	M	Gait	Femur shaft fx	Survival
5	Komatsu	2012	61	F	Gait	Calcaneus fx	Survival
6	Kato	2011	78	M	Car	Diaphragmatic rupture	Survival
7	Ohzono	2011	43	M	Gait	Humeral fx	Survival
8	Kashibara	2008	64	F	Gait	Elbow sprain	Survival
9	Nakamura	2009	69	F	Gait	Femur shaft fx	Survival
10	Yamaguchi	2009	66	F	Gait	Shoulder dislocation	Survival
11	Kinugasa	2009	68	M	Gait	Subastragalar dislocation	Survival
12	Kariya	2009	52	M	Gait	Knee sprain	Survival
13	Hashimoto	2009	70	M	Gait	Tibial fx	Survival
14	Usumoto	2008	40	F	Car	Subclavian and vertebral arterial injury	Death
15	Miyawaki	2008	39	M	MC	Thoracic spinal fx	Survival
16	Tsumura	2008	68	M	Bicycle	Skull fx, cerebral contusion	Sequelae
17	Kawamoto	2007	70	F	Gait	Patella fx	Survival
18	Sakamoto	2007	66	M	Gait	Cervical cord injury	Sequelae
19	Shiozuka	2005	41	M	Car	Pneumothorax	Survival
20	Itabashi	2005	80	F	Bicycle	Gall bladder injury	Survival
21	Matsuzaki	2005	49	M	Gait	Patella fx	Survival
22	Yoshikida	2004	68	M	Gait	Subastragalar dislocation	Survival
23	Kotani	2003	15	F	Bicycle	Humerus fx	Survival
24	Kuwabara	2003	82	F	Gait	Subdural hematoma	Survival
25	Haga	2003	42	M	MC	Penetrating eye ball injury	Survival
26	Hara	2002	72	F	Car	Cervical spinal dislocation	Survival
27	Kikuchi	2001	54	F	Car	Sacroiliac dislocation, fx of condyle of femur	Survival
28	Tuchida	2001	60	M	Gait	Dislocation of knee	Survival
29	Momokawa	2001	20	M	Car	Diaphragmatic rupture	Survival
30	Kanazawa	2000	74	F	Gait	Femoral neck fx	Survival
31	Nakamura	2000	39	F	Gait	Anterior cruciate ligament injury	Survival
32	Miyaishi	1999	70	F	Gait	Back contusion, drowning	Death
33	Konobu	1999	78	F	Gait	Femur fx, intestinal stenosis	Survival
34	Sato	1997	70	M	Gait	Tear of the basilar artery, dislocations of spine	Death
35	Nakajima	1993	47	M	Gait	Dislocation of list	Survival
36	Yoshioka	1985	52	F	Gait	Alcoholic, edema of vocal cord	Death

F, female; fx, fracture; M, male; MC, motorcycle.

The 33 patients in the present study were treated in our hospital. We believe that all of the life-threatening cases that were related to falling into open drains in East Shizuoka were transported to our hospital. However, we did not investigate all of the patients who were

transported by ambulance in East Shizuoka. In addition, minor or moderate injury cases might have been transferred to local hospitals. Accordingly, there was a bias in that the 33 patients in this study represented only the patient population in East Shizuoka.

We summarize the published Japanese case reports, describing the injuries suffered by patients due to falls into open drains, in Table 3,^{1–35} excluding Nosaka's report.³⁶ Table 3 reveals the various types of injuries and their severity. There were seven cases who died or who experienced sequelae. Four cases out of these seven had injuries of the central nervous system. Nosaka *et al.* reported that head and spinal injuries predominated among 13 cases of ditch-related injuries, with eight vertebral column injuries, three skull fractures, and three intracranial hemorrhages. These cases also had poor neurological outcomes.

A PubMed search using the key words “drain”, “ditch”, and “trauma” was undertaken to look for case reports, other than those written by Japanese authors. Only four reports were found that described injuries due to falls into open drains.^{43–47} Three of these four were case reports concerning spinal cord injury, lethal delayed cardiac rupture, and duodenal injury.^{43–45} The other cases that we found in the search focused on fatalities due to machine rollovers or the reporting system profile for incidents of drowning, which included falling accidents involving open drains. From the standpoint of the results of this study and previous reports, falling into an open drain can more easily result in severe or lethal consequences due to injury severity or drowning than a simple fall to the ground. Our hypothesis for this severity is as follows: when a human falls into an open drain, the concrete corner of the drain hits a part of his or her body. The transfer of energy from the end of 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.⁴⁸ We will prospectively collect data concerning ditch-related injuries (Investigation of etiology of injuries induced by open ditch, UMIN000017535) and we will check the body surface of ditch-related injuries to test whether our hypothesis is correct. Based on our hypothesis, we advocate that injuries caused by falls into open drains be treated as high energy injuries and that patients choose an appropriate trauma center in the prehospital setting, especially when the patients have head, neck, or truncal injuries.

From the point of drain- or ditch-related injury prevention, Nosaka *et al.* suggested considerable local government intervention.³⁶ However, as the scale of the problem is immense because of the area involved, the government response will need to be assisted with educational campaigns. Therefore, preventive educational action should be undertaken across multiple fields. While in Chicago (USA), property owners and tenants are obligated to exercise reasonable care in locating hidden dangers on their property and warning the public of any foreseeable or existing harm such as injuries from a pothole, ditch, or other open area

on the property (<https://chicagoinjurycenter.com/premises-liability/>). There were no recently published reports concerning drain- or ditch-related injuries in the USA. Accordingly, to prevent injuries of this type, we think open drains should be covered with concrete. However, when drains are covered, several issues need to be resolved in terms of agricultural water use and ecological or biological system damage. Although the width of the road might be a little narrower, building fences might also be a preventative measure. In addition, the installation of streetlights or warning signs could also be helpful and might be less expensive.

CONFLICT OF INTEREST

NONE.

ACKNOWLEDGEMENTS

NONE.

REFERENCES

- 1 Furukawa T, Naoki Otsuki N, Hidetoshi Matsui H, Nibu K. A case of impalement injury in the head and neck. *Practica Oto-Rhino-Laryngologica* 2013; 106: 355–8.
- 2 Harada T, Ago K, Hayashi K, Ago M, Ogata M. Traumatic lethal case based on findings of plankton in a patient whose nose is submerged. *Hoigau no Jissai to Kenkyu* 2013; 55: 27–32. In Japanese.
- 3 Wajima D, Ida Y, Yokota H *et al.* Experience of treatment for pediatric multiple injuries in secondary medical facility. *Shinkei Gaisho* 2013; 35: 68–74. In Japanese.
- 4 Tanishi S, Okabe S, Zaizen K, Hosaka N. A case of femoral compartment syndrome induced by a fracture of femoral shaft. *Niigata Seikeigeka Kenkyu Kaishi* 2013; 28: 53–58. In Japanese.
- 5 Kamatsu M, Suzuki S, Ito H, Nomura T. Three cases of tendo achilles avulsion fracture. *Seikeigeka* 2013; 63: 51–53. In Japanese.
- 6 Kato K, Ito Y, Ishii H, Takizawa M, Kobayashi H, Amaya S. A case of traumatic diaphragmatic hernia accompanied by rupture of the pericardium requiring thoracic and abdominal surgery. *J. Jpn. Surg. Asso.* 2011; 72: 3046–3049. In Japanese.
- 7 Ohzono H, Gotoh M, Mitsui Y *et al.* Isolated fracture of the lesser tuberosity of the humerus: a case report. *Kurume Med. J.* 2011; 58: 131–3.
- 8 Kajiwara M. A 64 year-old-female treated by Mitek G2 for collateral ligaments injury of elbow. *Nippon Hiji Kansetsu Gakkai Zasshi* 2008; 15: 151–153. In Japanese.

- 9 Nakamura S, Hirata M, Nakase M. A case of femoral distal fracture with knee arthrodesis treated by Ender nail. *Kossetsu* 2009; 31: 649–651. In Japanese.
- 10 Yamatuchi K, Osawa T, Kobayashi T, Yamamoto A, Shidara H, Takagishi K. Arthroscopic fixation technique for 2 patients with avulsion fracture of the greater tuberosity associated with anterior dislocation of the shoulder. *Katakansetsu* 2009; 3: 839–842. In Japanese.
- 11 Kinugara M, Murakami H, Matsumoto T, Shiode H, Matsushita M. Two cases of subtalar dislocation. *Cent Jpn. J. Orthop. Traumat* 2009; 52: 445–446. In Japanese.
- 12 Kariya T, Gomi T. A case of multiple ligaments injury of knee. *Kaisei Byoin Igaku Zasshi* 2009; 15: 22–23. In Japanese.
- 13 Hashimoto T, Toyota K, Toyota Y *et al.* A case of conservative therapy for a tibial plateau fracture. *Rigakuryoho Ibaraki* 2009; 12: 121–126. In Japanese.
- 14 Usumoto Y, Hiki W, Kudo K, Tsuji A, Ikeda N. An unusual case of fatal airbag Injury. *Fukuoka Acta Med.* 2008; 99: 225–229. In Japanese.
- 15 Miyawaki A, Moriyama T, Tachibana T, Yamanaka K, Adachi K, Yoshiya S. Two reduction cases of thoracic spine fracture dislocation by partial vertebral body excision. *Cent Jpn. J. Orthop. Traumat* 2008; 51: 769–770. In Japanese.
- 16 Tsumura R, Masuda R, Tanigawa K *et al.* A case of pseudoaneurysm in the anterior cerebral artery with drainage to the cavernous sinus. *Neurosurg. Emerg.* 2008; 13: 199–205. In Japanese.
- 17 Kawamoto H. A consideration for the trying early home return from a hospital for acute period. *Rigakuryoho Fukuoka* 2007; 20: 116–118. In Japanese.
- 18 Sakamoto T, Sadanaga T, Okazaki T. Sequential use of aminophylline and theophylline for the treatment of atropine-resistant bradycardia after spinal cord injury: a case report. *J. Cardiol.* 2007; 49: 91–96.
- 19 Shiotsuka K, Utsunomiya A, Suzuki S *et al.* Penetrating injury to the medulla oblongata and the heart by sewing needles. *JJAAM* 2005; 16: 261–266.
- 20 Itabashi Y, Baba T, Kato S, Sasaki M. A case report of avulsion of the gallbladder resulting from a blunt abdominal trauma. *J. Jpn. Surg. Assoc.* 2005; 66: 1424–1427. In Japanese.
- 21 Matsuzaki K, Miyagi I, Shimada W, Kikuchi K, Tsujimoto H. A case of fracture of patella. *J. Kansai Clin. Sports Med. Sci.* 2005; 14: 5–7. In Japanese.
- 22 Yoshida T, Mizuno Y, Kobayashi T. Two cases of subtalar dislocation. *Orthop. Surg. Traumat* 2004; 47: 1203–1206. In Japanese.
- 23 Kotani Y, Takashiro Y, Fukuda S, Kaneko M, Miyamoto H. An adolescent case of medial condyle of humeru. *Tsuyama Chuo Byoin Igaku Zasshi* 2003; 17: 93–95. In Japanese.
- 24 Kuwabara M, Koan Y, Fukuoka M *et al.* Two cases of diffusion images for traumatic subacute subdural hematoma. *No Shinkeigeka Sokuho* 2003; 13: 979–983.
- 25 Haga S, Ishido K, Koga T, Nishimura T, Sakata S. Two cases of improvement of visual acuity after transcranial evacuation for bulbar foreign body. *No Shinkeigeka Sokuho* 2003; 13: 651–656. In Japanese.
- 26 Hara S, Kasama F, Kusakabe T, Watanuki M, Satou K. Tetraplegia occurred after posterior open reduction and internal fixation for dislocated cervical spine. *Tohoku Arch. Orthop. Surg. Traumat* 2002; 46: 13–15. In Japanese.
- 27 Kikuchi K, Hara N, Takahashi K, Inoue M, Abumi K. Combined injury of sacroiliac joint fracture-dislocations and femoral neck fracture. *Hokkaido Seikeigeka Saigaigeka Zasshi* 2001; 43: 22–24. In Japanese.
- 28 Tsuchida T, Akasaki T, Yamashiro T, Aoki Y, Jo J. Irreducible dislocation of the knee joint. *Seikeigeka* 2001; 52: 430–432. In Japanese.
- 29 Momokawa K, Odagiri S. Five cases of chest injuries requiring operation. *Aomori Shimin Byoin Ishi* 2001; 11: 48–51. In Japanese.
- 30 Kanazawa Y, Tanaka T, Nakajima Y. A case of a patient with femoral neck fracture who needs prolonged duration for returning home after internal fixation. *Jpn. J. Phys. Ther.* 2000; 34: 725–729. In Japanese.
- 31 Nakamura E, Mizuta H, Kudo S, Takagi K. Atypical occult bony lesion associated with anterior cruciate ligament injury. *Seikeigeka to saigai geka* 2000; 49: 771–776. In Japanese.
- 32 Miyaishi S, Ono T, Yoshidome K, Yamamoto Y, Ishikawa T, Ishizu H. An autopsy case of drowned body with multiple injuries found at a pond. *Hoigaku no Jissai to Kenkyu* 1999; 42: 161–165. In Japanese.
- 33 Konobu T, Murao Y, Miyamoto S *et al.* Posttraumatic intestinal stenosis presenting as a perforation: report of a case. *Surg. Today* 1999; 29: 564–7.
- 34 Sato Y, Kondo T, Ohshima T. Traumatic tear of the basilar artery associated with vertebral column injuries. *Am. J. Forensic Med. Pathol.* 1997; 18: 129–34.
- 35 Nakajima S, Numata R, Yamauchi T. A case of anterior dislocation of the ulna at the inferior radio-ulnar joint. *Clin. Orthop. Surg.* 1993; 28: 839–842. In Japanese.
- 36 Nosaka N, Fujita Y, Morisada S, Ugawa T, Ujike Y. Characteristics and costs of ditch-related injuries: a report from a single emergency center in Okayama. *Acute Medicine & Surgery* 2014; 1: 145–149.
- 37 Omori K, Ohsaka H, Ishikawa K *et al.* Introduction of a physician-staffed helicopter emergency medical service in Eastern Shizuoka prefecture in Japan. *Air Med. J.* 2014; 33: 292–5.
- 38 Omori K, Kondo A, Oode Y, Itoi A, Sakuraba K, Yanagawa Y. Analysis of patients with bodyboarding injuries transported by physician-staffed emergency helicopter. *J. Emerg Trauma Shock* 2015; 8: 39–42.
- 39 Ishikawa K, Jitsuiki K, Ohsaka H *et al.* Management of a mass casualty event due to electrocution using Doctor Helicopters. *Air Med. J.* 2016 (in press).

- 40 Ohsaka H, Yanagawa Y, Miyasaka Y, Okamoto K. Successful treatment of a penetrating pulmonary artery injury caused by a Japanese sword in a patient transported by a physician-staffed helicopter. *J. Emerg Trauma Shock* 2015; 8: 125–6.
- 41 Hayat SA, Luben R, Keevil VL *et al.* Cohort profile: a prospective cohort study of objective physical and cognitive capability and visual health in an ageing population of men and women in Norfolk (EPIC-Norfolk 3). *Int. J. Epidemiol.* 2014; 43: 1063–7.
- 42 Nosaka N, Tsukahara K, Knaup E, Ugawa T, Ujike Y. Ditch-related falls: need for preventive educational campaigns. *Acute medicine & surgery* 2015 (in press).
- 43 Knudsen R, Gundtoft P. Traumatic cervical disc prolapse with severe neurological impact. *Ugeskr. Laeger* 2014 Dec; 15: 17. In Danish.
- 44 Kanchan T, Menezes RG, Acharya PB, Monteiro FN. Blunt trauma to the chest—a case of delayed cardiac rupture. *J. Forensic Leg. Med.* 2012; 19: 46–7.
- 45 Bergqvist D, Hedelin H. Roll seat belt induced injury of the duodenum. *J. Trauma* 1976; 16: 390–4.
- 46 DeGroot JM, Isaacs C, Pickett W, Brison RJ. Patterns of fatal machine rollovers in Canadian agriculture. *Chronic Dis. Inj. Can.* 2011; 31: 97–102.
- 47 Lunetta P, Tiirikainen K, Smith GS, Penttilä A, Sajantila A. How well does a national newspaper reporting system profile drowning? *Int. J. Inj. Contr. Saf. Promot.* 2006; 13: 35–41.
- 48 Oode Y, Maruyama T, Kimura M, Fukunaga T, Omori K, Yanagawa Y. Horse kick injury mimicking a handle bar injury or a hidden speared injury. *Acute Med. Surg.* 2015 (in press).