



Abstract

The Height of Fall as a Predictor of Fatality of Fall

Joo Hyun Suh, M.D., Eun Kyung Eo, M.D., Koo Young Jung, M.D.

Department of Emergency Medicine, College of Medicine, Ewha Womans University

Purpose: The number of the deceased from free-fall is increasing nowadays. Free-fall comes to a great social problem in that even the survivor will be suffering for cord injury or brain injury, and so on. We analyzed the cases of free-fall patients to find out whether the injury severity is mainly correlated with the height of fall.

Methods: We retrospectively investigated the characteristics of patients, who fall from the height above 2m from January 2000 to August 2004. We excluded the patients who transferred to other hospital, transferred from other hospital, and not known the height of fall. 145 patients were evaluated. Variables included in data analysis were age, height of fall, injury severity score (ISS), the being of barrier, and the survival or not. To find out the correlation between height of fall and death, we used receive operating characteristics (ROC) curve analysis.

Results: The mean age of patients was 36.5 ± 19.4 years old. 110 were male and 35 were female. Mean height of fall was 11.1 ± 8.5 m. 51 patients (35.2%) were died and 30 patients of them (58.9%) got emergency room on dead body. The mean height of fall is 8.9 ± 5.8 m for 94 survivors and 15.2 ± 11.0 m for the 51 deceased ($p < 0.001$). The area under the ROC curve was 0.646, which means the height of fall was not adequate factor for predicting for death. At 13.5m, as cut?off value, sensitivity is 52.9%, specificity is 86.2%, positive predictive value is 67.5% and negative predictive value is 77.1%. There were statistical differences in mortality rate and ISS between ' below 13.5m group ' and ' above 13.5m group ', but there was not statistical difference in head and neck AIS.

Conclusion: The height of fall is not adequate factor for prediction of death. So other factors like intoxication or not, the being of barrier or protection device need to be evaluated for predicting of free-fall patient 's death.

Key Words: Free-fall, Injury severity score, Height, Mortality

* Address for Correspondence : **Koo Young Jung, M.D.**

Department of Emergency Medicine, College of Medicine, Ewha Womans University
70 Chongro 6-ka, Chongroku, Seoul, Korea

Tel : 82-2-760-5452, Fax : 82-2-760-5299, E-mail : kyjung@ewha.ac.kr

: 2005 8 5 , : 2005 11 4 , : 2005 11 11 , : 2005 11 22

10
10 1993 76.5 2003 65.3
11.2 가
3.2 가 (1).
가

ISS

가
가 가

()

가

가,

ISS 가

가

t

Receiver Operating

Characteristic(ROC)

ISS

(2-

SPSS 12.0

p

0.05

4).

가

95%

가

145

36.5±19.4 (1 ~ 87

) , 110 , 가 35

11.1 ± 8.5 m (2 m ~ 41.6 m)

38 (26.2%) 가

2000 1 2004 8 2 m

32 (22.1%),

가6 (4.1%)

76 (52.4%)

36 (24.8%),

145

40 (27.6%)

가 31 (21.4%) (Fig. 1).

ISS 19.5

(injury severity score: ISS)

± 11.0

51 (35.2%)

30 (58.8%)

2.6 m (2

2.6 m, 3

5.2 m)

3.5 m

18.0

46.3±18.0

31.2±

(p<0.001, Fig. 2),

(15.2±11.0 m)

(8.9±5.8

가

m)

(p<0.001). ISS

26.4±10.9

15.7±10.6

Table 1

가 (p<0.001). 가 54 (37.2%) 가 28 , 가, 가 11 . 가 5 , 가 1 , 가 4 가 15 (10.3%) (Table 2). ROC 0.646 가 (Fig. 3). ROC 가 가 가 13.5 m . 13.5 m 가 27 (52.9%) , 13.5 m 81 (86.2%) . (cut-off value) 52.9%, 86.2%, 67.5%, 77.1% (Table 3). 13.5 m 13.5 m 13.5 m

abbreviated injury scale(AIS) 1.6 ± 1.7, 1.9 ± 1.8 가 (p=0.346, Table 4). ISS 0.368 ISS 0.376 ISS ISS = 10.1 + 0.18 x () + 0.44 x (m) . Risser (2) 6 2 4 6.4 ,?5 10 , 6 28 가 Velmahos (5) 187 가 Steedman (6)

(p<0.001) ISS(p<0.001) 가 ,

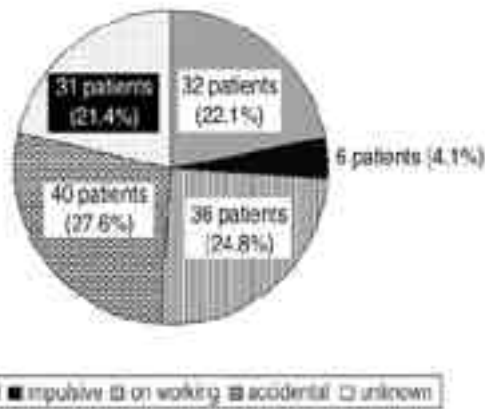


Fig. 1. The causes of free-fall in 145 victims.

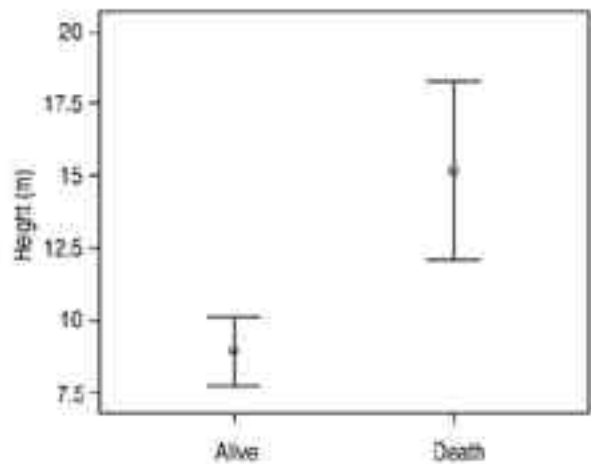


Fig. 2. Comparison of heights between the survived group and deceased group.

Table 1. Comparison of characteristics between the survived group and deceased group

	Alive (n=94)	Dead (n=51)	P value
Sex (M:F)	2.9:1 (70/24)	3.6:1 (40/11)	0.686*
Age (year)	31.2 ± 18.0	46.3 ± 18.0	< 0.001 [†]
Height (m)	8.9 ± 5.8	15.2 ± 11.0	< 0.001 [†]
ISS	15.7 ± 10.6	26.4 ± 10.9	< 0.001 [†]

*: Pearson's chi-square test

[†]: Student t-test

ISS: Injury severity score

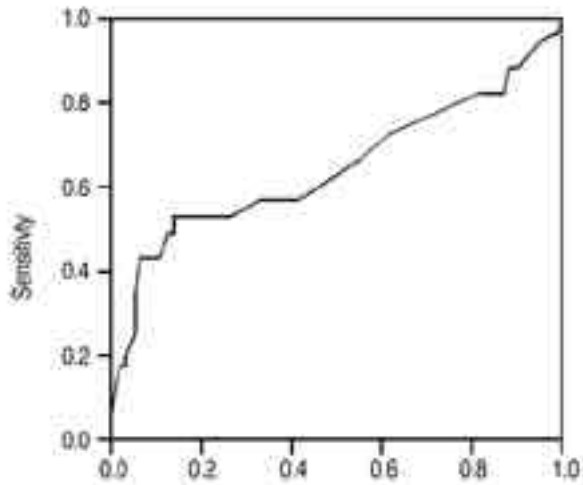


Fig. 3. Receiver operating characteristic curves to predict death using height.

6.1 m
가
가
(7) ISS = 2 + 0.08 x () - 1.54 x Glasgow coma scale(GCS) - 3 x () + 0.65 x (m) + 2.7 x ()
가
가
m
3 m
가
가 11.1 m
가 4.7 m

Table 2. Cases described about interferences in 15 of 145 fall victims

Patients No.	Age	Sex	Height(m)	Kinds of interferences	Alive/Dead	ISS	Remarks
1	39	M	27.0	Safety net	Alive	17	
2	80	M	23.4	Above tree	Dead	29	Colon cancer, suicide
3	3	M	23.4	Above tree	Alive	4	Only concussion
4	17	F	17.5	Above tree	Alive	8	Only buttock injury
5	1	F	15.6	Above tree	Alive	4	
6	30	M	10.5	Above motorcycle	Alive	9	
7	30	M	10.5	Above car roof	Alive	16	
8	41	M	10.0	Unknown interference	Alive	9	
9	30	M	10.0	Unknown interference	Alive	1	
10	33	F	7.8	Above car roof	Alive	13	
11	14	M	7.8	Above car roof	Alive	13	
12	7	M	5.2	Above tree	Alive	1	
13	47	M	3.0	Crow-bar(contact to patient 's belly)	Alive	9	Hemoperitoneum
14	10	F	3.0	Crow-bar(contact to patient 's perineum)	Alive	4	Perineal laceration
15	35	M	2.0	Crow-bar(contact to patient 's belly)	Alive	4	Liver contusion

ISS: Injury severity score

Table 3. ' Alive and death ' proportions if cut-off value is 13.5m

	Alive	Dead	Total
< 13.5m	81 (55.9%)	24 (16.5%)	105 (72.4%)
13.5m	13 (9.0%)	27 (18.6%)	40 (27.6%)
Total	94 (64.9%)	51 (35.1%)	145 (100.0%)

Sensitivity: 27/51 x 100 = 52.9%

Specificity: 81/94 x 100 = 86.2%

Positive Predictive Value: 27/40 x 100 = 67.5%

Negative Predictive Value: 81/105 x 100 = 77.1%

35.2% (7), (Table 2), (13, 14,15).
 3.5% GCS, Barlow (8)
 ROC 가 가
 가 13.5 m 가 Murray (9)
 52.9%, 86.2% 15 15 가
 13.5 m 67.5%, 77.1% 가 가
 13.5 m 가 가
 가 가 Sterling (10)
 가 ISS 가
 37 59.5% 70 가 4
 22 13.5 m 4 3
 13.5 m AIS(1.925)
 13.5 m 가
 AIS(1.619) t (Table 4)(6,7). (10,11).
 가 가
 가 가
 15 가 13.5 m 가 가
 5 가 4 가
 가 3.5 m
 . 1 3 10 가
 가 ISS 4
 가 (Table 2), (3).

Table 4. Comparison of characteristics between ' below 13.5m group ' and ' above 13.5m group '

	< 13.5 m	13.5 m	P value
ISS	17.4 ± 10.3	24.9 ± 11.0	< 0.001*
Head and neck AIS	1.6 ± 1.7	1.9 ± 1.8	0.346*
Mortality (%)	22.9%	67.5%	< 0.001 [†]

*: Student t test

[†]: Chi-square test

ISS: Injury severity score

AIS: Abbreviated injury scale

ISS
 13.5 m
 52.9%, 86.2%, 67.5%, 77.1%

가

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