

*Original Investigation*

Television Tip-Over Related Head Injuries: A Particular Type of Child Neglect

Burak EREN¹, Abdurrahim TAS², Feyza KARAGOZ GUZEY¹, Ilker GULEC¹, Azmi TUFAN¹, Murat KARACAN¹¹Health Sciences University, Bagcilar Training and Research Hospital, Department of Neurosurgery, İstanbul, Turkey²Health Sciences University, Gazi Yaşargil Training and Research Hospital, Department of Neurosurgery, Diyarbakır, TurkeyThis study has been presented orally at the 16th WFNS World Congress of Neurosurgery between 20 and 25 August 2017 at İstanbul, Turkey.**ABSTRACT****AIM:** To identify, report, and raise awareness of the risk factors for television (TV) tip-over.**MATERIAL and METHODS:** In total, 86 children who were brought to the emergency service and hospitalized at the neurosurgery clinic because of TV tip-over-related head trauma between August 2011 and August 2016 were included in the study.**RESULTS:** The 86 patients consisted of 47 males and 39 females. The mean age was 38.8 ± 19.5 (9–102) months. Low education level of the mother was a risk factor for this type of accident ($p=0.009$). In all the patients, injuries were caused by the tip-over of a cathode ray tube (CRT) TV. In 66 patients (77%), only the TV tipped over onto the child, whereas in 20 cases (23%), the TV tipped over with the TV stand. The TVs were not fixed to the stand or the wall in any of the homes. According to computerized tomography findings, 12 patients (13.9%) had intracranial hemorrhage and 19 patients (22%) had skull fractures. Five patients underwent neurosurgical intervention. Eighty-four patients (97.6%) were discharged with a GCS level of 15. One patient was discharged with a GCS level of 9/15 with a tracheostomy and nasogastric tube. One patient died.**CONCLUSION:** TV tip-over causes physical injury that may result in serious neurological damage and even death. It is becoming more common and may be prevented by taking simple precautions.**KEYWORDS:** Television tip-over, Television falls, Head trauma, Child trauma, Pediatric trauma**■ INTRODUCTION**

Television (TV) tip-overs may cause serious injury or death in young children. In the young children age group, 84% of major traumas occur at home. Three out of four of these traumas occur when an adult is not present (5).

The most common cause of furniture-related accidents is TV tip-over (42%–48%) (4,11). TV tipover injuries in children are becoming more frequently reported as TVs have become larger and more affordable and common. With larger TV screens and younger children, the severity of injury tends to increase. Head trauma occurs in approximately 70% of the cases (8). The majority of the parents of children suffering a

TV tip-over-related injury are unaware that this kind of event poses a significant risk for their children (19).

The purpose of this study was to identify, report, and raise awareness of the risk factors for TV tip-over.

■ MATERIAL and METHODS

In total, 86 children who were brought to the emergency department and hospitalized in the neurosurgery clinic of our hospital because of TV tip-over-related head trauma between August 2011 and August 2016 were included in the study. Patient's age; sex; family characteristics; clinical presentation on arrival and details about case management, including



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surgical intervention, duration of hospital stay and results were prospectively obtained from case records. In addition, information on how the accident occurred, TV shape, size, height of the TV and type of TV stand was also obtained.

Statistical Analysis

In this study, statistical analyses were carried out using the Number Cruncher Statistical System 2007 Statistical Software (Utah, USA). Descriptive statistical methods (mean and standard deviation) were used to analyze the data. In addition, unidirectional analysis of variance for comparisons of normally distributed variables, Kruskal–Wallis test for comparisons of non-normally distributed variables, Dunn's multicomparative test for subgroup comparisons, and χ^2 test for comparisons of qualitative data were used. The outcomes were evaluated at a significance level of $p < 0.05$.

RESULTS

In total, 86 pediatric patients were hospitalized because of TV tip-over-related head trauma in our neurosurgery clinic over a period of 5 years. Of these 86 patients, 47 were males and 39 were females. The mean age was 38.8 ± 19.5 (9–102) months. All incidents took place in the child's home. All patients exhibited similar family characteristics. None of the mothers were employed, and all mothers reported that they were at home at the time of the incident. In contrast, only 23.2% of fathers were at home at the time of the incident. It was found that low education level of the mother was a risk factor for this type of domestic accident ($p = 0.009$). However, there was no correlation of the accident with the education level of the father ($p = 0.67$). Seventy-four patients (86%) had siblings, and 36 patients (41.8%) had more than one sibling. The demographic characteristics of the patients are shown in Table I.

In all the patients, injuries were caused by the tip-over of a cathode ray tube (CRT) TV. Approximately 74.4% of the families had flat-panel (FP) TVs, such as liquid crystal display, light-emitting diodes, and plasma TVs. Average screen size of the TV was 27.7 ± 3 (20–32) inches. A variety of supportive structures were involved in the accident, but dressers were the most common. TVs were placed on stands that were either stable (70.9%) or had wheels (29.1%). The TVs were not fixed to the stand or the wall in any of the patient's home. In 66 patients (77%), only the TV tipped over onto the child, whereas in 20 cases (23%), the TV tipped over with the dresser. The average height of the fall was 1.06 meters (0.5–1.5). It was reported that in 83 cases, the child had him-/herself tipped over the TV, whereas the patient's sibling had tipped over the TV in the remaining three cases. The injured child was unattended in 65% of the cases.

The mean Glasgow Coma Scale (GCS) score at admission was 13.9 ± 1.1 (5–15). According to computerized tomography (CT) findings, 12 patients (13.9%) had intracranial hemorrhage and 19 patients (22%) had skull fractures. Six patients displayed otorrhea or rhinorrhea, and 17 patients (19.7%) had other injuries as well. The most common injuries were clavicular fracture in 9 patients and humeral fracture in five. Three patients had facial paralysis, one patient had pneumothorax, one suffered liver laceration, and one had a tibial fracture. The coexistence of intracranial hemorrhage and trauma to other systems was significantly higher ($p < 0.001$) (Table II). Five patients underwent surgery (Table III). The patients were hospitalized for a mean period of 2.1 ± 5.6 (1–46) days. Twelve patients with poor clinical status were hospitalized for 15.2 ± 35.6 (1–128) days in the intensive care unit (ICU). Eighty-four patients (97.6%) were discharged as with a GCS score of 15. One patient was discharged with a GCS score of 9/15 with a tracheostomy and nasogastric tube. One patient died.

Table I: Demographic Characteristics of the Cases

	0-24 months (n=20)	25-48 months (n=38)	>49 months (n=28)	p
Gender				0.25
Male	14 (70%)	20 (52.6%)	13 (46.4%)	
Females	6 (30%)	18 (47.4%)	15 (53.6%)	
Mother's educational status				0.009
Primary school	11 (55%)	33 (86.8%)	23 (82.1%)	
Secondary school	7 (35%)	4 (10.5%)	1 (3.6%)	
High school / University	2 (10%)	1 (2.7%)	4 (14.3%)	
Father's educational status				0.67
Primary school	11 (55%)	22 (57.9%)	17 (60.7%)	
Secondary school	4 (20%)	10 (26.3%)	6 (21.4%)	
High school / University	5 (25%)	6 (15.8%)	5 (17.9%)	
Siblings	1.15 ± 0.93	1.66 ± 1.55	1.82 ± 1.34	0.22

Siblings data are presented with means \pm standard deviations and others are presented with %. Significant p values were shown with bold characters. (n= Number).

DISCUSSION

TV tip-over accidents are mostly reported in young children, and they generally cause head trauma (13). Reports from a large series found that 0.4%–0.5% of all head traumas are caused by TV tip-overs (14, 15). Young children have thin skulls, and their large head-to-body ratio predisposes them to head injuries (22). The majority of these traumas take place in the child's own home and when an adult is not present (7). Mean age, gender, fraction of total injuries presenting in the head, surgical intervention, length of hospital stay and mortality rate

from international studies are presented in Table IV. The most frequently reported injuries are those to the head and neck.

Lichenstein et al. reported a mean age of 3.1 months (14), similar to our findings. Another study reported that 61% of the patients were boys (9). In our study, we found this percentage to be 54.6% and concluded that sex is not a risk factor for TV tip-over. However, according to Murray et al. (18), boys are at a higher risk of injury than girls. It has been reported that toddlers are susceptible to injury and that there is a relationship between low education level of the family and injuries to children (10). In our study, we found the low

Table II: Evaluation of Cases According to CT Findings

		Normal (n=55)		Skull fracture (n=13)		Skull base fracture+CSF leak (n=6)		Hemorrhage (n=12)		p
Age (Months)		39.8 ± 19.3		33.2 ± 14		41 ± 35.1		39.7 ± 17		0.736
Gender	Male	28	(50.9%)	8	(61.5%)	3	(50%)	8	(66.7%)	0.727
	Female	27	(49.1%)	5	(38.5%)	3	(50%)	4	(33.3%)	
Initial GCS		15		14.1 ± 0.9		13.3 ± 1.3		9.4 ± 3.1		0.0001
Discharged GCS		15		15		15		13.5±1.5		0.009
TV Size	51-69	11	(20%)	1	(7.7%)	2	(33.3%)	0	(0%)	0.178
	70-79	35	(63.6%)	10	(77%)	4	(66.7%)	12	(100%)	
	>80	9	(16.4%)	2	(15.3%)	0	(0%)	0	(0%)	
Other system trauma		5	(9.1%)	2	(15.3%)	3	(50%)	7	(58.3%)	0.0001
	Wheeled	19	(34.5%)	2	(15.4%)	1	(16.7%)	3	(25%)	0.471
TV Stand	Without wheels	36	(65.5%)	11	(84.6%)	5	(83.3%)	9	(75%)	

Age, Initial GCS and Discharged GCS score data are presented with means±standard deviations and others are presented with %. Significant p values were shown with bold characters. (n= Number, CSF= Cerebrospinal fluid, GCS= Glasgow Coma Scale).

Table III: Characteristics of Surgically Treated Patients

n	Age (months)	Gender	CT findings	Other trauma	Initial GCS score	Additional surgery	ICU stay (day)	Result (GCS score)
1	29	M	Depressed skull fr + Pneumocephalus	Nasal fr + Clavicula fr	15	None	0	15
2	60	F	Frontal SDH	Humerus fr	9/15	None	4	15
3	27	M	Frontal EDH + tSAH	Px + Clavicula fr	5/15	Thorax tube	9	Died
4	60	M	Intraorbital hematoma + Skull base fr	Facial paralysis	12/15	Duraplasty	1	15
5	25	M	Posterior fossa EDH + tSAH	Liver laceration + Clavicula fr	5/15	V-P shunt	128	9/15

n= Number, CT= Computerized tomography, ICU= Intensive care unit, GCS= Glasgow Coma Scale, B= Boy, G= Girl, fr= Fracture, EDH= Epidural hematoma, SDH= Acute subdural hematoma, tSAH= Traumatic subarachnoid hemorrhage, Px= Pneumothorax, V-P= Ventriculoperitoneal.

Table IV: Summary of Television Tip-Over Related Head Injuries as Reported Single Center Experience in the Literature

Study	Study Duration	Country	n	Patient Age	Gender Male/Female (%)	Fraction of Total Injuries Presenting in Head (%)	Neurosurgical Intervention (%)	LOS (days)	Mortality (%)
Bernard et al. (2), 1998	1995-1997	USA	5	Mean 20 mos	60/40	80	NR	NR	20
DiScala et al. (8), 2001	1988-1999	USA	183	76% 1-4 yrs	58/42	68.3	20.2	3.3	2.7
Scheidler et al. (23), 2002	1989-1999	USA	43	80% <6 yrs	60/40	58.1	11.6	NR	11.6
Ota et al. (19), 2006	2003-2004	USA	26	Median 40 mos	50/50	53.8	0	1	0
Dotchin & Gordon (9), 2007	1990-2002	Canada	104	65% 0-4 yrs	61/39	47.1	NR	NR	NR
Cho et al. (4), 2009	2000-2003	Australia	52	Median 2.5 yrs	45/55	42.3	NR	NR	1.9
Samson et al. (22), 2010	NR	India	8	Mean 12 mos	63/37	100	12.5	NR	12.5
Marnewick et al. (15), 2011	2006-2008	Australia	13	Median 30 mos	46/54	69.2	7.7	4.2	7.7
Rutkoski et al. (21), 2011	1999-2009	USA	52	Mean 36 mos	50/50	82.7	3.8	1	1.9
Guloglu et al. (12), 2012	2001-2010	Turkey	42	Mean 2.1 yrs	67/33	57.1	11.9	2.3	11.9
Mills et al. (16), 2012	1997-2011	Canada	179	Mean 41 mos	66/34	76	1.1	1.3	0
Befeler et al. (1), 2014	2009-2013	USA	26	Mean 3.3 yrs	73/27	77	19	NR	0
Kucuk & Tumturk (13), 2017	2007-2014	Turkey	36	Mean 3.6 yrs	50/50	100	11.1	3.7	8.3
Eren et al., 2018 (Present study)	2011-2016	Turkey	86	Mean 38.8 mos	55/45	100	5.8	2.1	1.2

n= Number, **LOS**= Length of stay, **NR**= Not reported, **mos**= Months, **yrs**= Years.

education level of the mother to be related to increased risk of TV tip-over, but no relationship with the education level of the father was found.

An average young child watches TV for approximately 4 h per day. Large screen TVs present in most houses weigh between 36 and 80 kg. As the center of gravity of CRT TVs lies toward the front of the appliance, the TV may easily tip over if it is not on a suitable and durable TV stand (8). We found that all the traumas in our patients resulted from CRT TV tip-over. Mills et al. reported that the preferred choice of TV for 75% of families was FP TVs (16), which were generally fixed on a TV stand or wall. CRT TVs that they had previously used tended to be on unsuitable stands in other rooms. Since the advent of FP TVs, these devices have become progressively lighter and thinner. Thus, they are believed to greatly reduce the risk of tipovers (7). Rutkoski et al. reported that the most common TV size implicated in these injuries was 27 inches (21), and there was no statistically significant relationship between the TV size and the severity of the injury. We observed the same results in our study. However, De Roo et al. reported that two-thirds of these injuries occurred because of screen sizes of ≤ 26 inches (6).

When a child pushes a TV, it most likely falls on the head and neck of the child because of the child's height in relation to the height of the TV (17). The TV is elevated off the ground 0.5-1.5 meters (5). Scheidler et al. reported that the average height of the fall was 1.12 meters (23), as in our cases. Dressers and other furniture not designed to support televisions were commonly involved in the TV-toppling injury (5). While most cases are not fatal, serious injuries may be inflicted. Soft tissue injuries and lacerations predominate, accounting for 36% of the injuries reported (6). This percentage was found to be 64% in our study. Ota et al. reported that head trauma frequently occurs with injuries to the extremities (19). Upper extremity injuries were more common in our study. However, in contrast to our study, this previous study found lower extremity injuries to occur more frequently. It has also been reported that the average GCS score on admission was 12 (1). Our patients demonstrated a mean GCS score of 13.9. Befeler et al. reported that neurosurgery was attempted in 19% of hospitalized patients, all of whom had CRT TV tip-over injuries (1). They also reported that the average length of ICU stay was 4.8 days. In our study, neurosurgery was attempted in 5.8% of patients, and 12 patients had an average ICU follow-up period of 15.2 days.

Mortality rates in large case studies have been reported to be 2%–11.9%, which are similar to those for traffic accidents (3,8,12). Head trauma is responsible for 96% of deaths (2,5). Platt et al. reported death of three patients in their study (ages, 11, 21, and 36 month), all of whom died because of head trauma after TV tip-over, and distinguished them from abusive head trauma (20). These three children were all injured by CRT TVs. One of the patients in our study died; this child had a GCS of 5/15 on arrival by ambulance to our hospital. Following cardiac arrest, resuscitation was performed by the emergency department. A thoracostomy tube was inserted because of bilateral pneumothorax. Cranial CT revealed epidural hemorrhage, subarachnoid hemorrhage, and diffuse

edema. Epidural hemorrhage was emergently drained. The patient was followed up in postoperative ICU but died on the ninth postoperative day.

This form of trauma, which can result in such serious consequences, is actually easily avoidable. The main problem is a lack of awareness by parents that such a trauma can occur and to take necessary precautions. A study verified that 85% of mothers and fathers whose children suffered TV tip-over injuries had been unaware of this risk (23). We observed that none of our patients had a TV fixed to a stand or wall. Therefore, we believe that this type of trauma represents child neglect.

In order to prevent this, training for families with young children should be provided before the toddler period. Training by TV and TV stand vendors would also be effective in reducing such injuries. CRT TVs should be placed in a rectangular wooden furniture with 4 fixed legs and the center of gravity should be designed to be located in the center of the furniture. FPTVs should be fixed to the wall or stand. Also, the height of the TVs should be at least 1.5 meters. Cables should be hidden as children can not reach them. In addition, manufacturers should be asked to add warnings to their brochures and to produce more stable devices.

■ CONCLUSION

TV tip-over causes physical injury that may result in serious neurological damage and death and is becoming more common. As it may be prevented by taking simple precautions, it can be considered as a particular form of child neglect. In addition to improving the designs of TV sets and TV stands, strategies should be implemented to educate the public.

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