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Brief communication

A 22-year history of treating intentional falls from the Golden Gate Bridge at Marin Health Medical Center☆,☆☆

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ABSTRACT

Background: The historical mortality rate after falling from the Golden Gate Bridge has been approximately 98%. We report on 14 recent survivors treated at Marin Health Medical Center.
Methods: We retrospectively reviewed the 22-year experience of treating patients after Golden Gate Bridge falls. Patients with signs of life when recovered by the Coast Guard were included.
Results: Marin General Hospital treated 26 patients with an average age of 28.2 years. The mortality rate was 46.2% with an increased survival over the past decade compared to the first 12 years, 61% vs 37%, $P =$ not significant. The average injury severity score was 29.3 and was significantly lower over the past decade (43.9 vs 22.8, $P = .004$). The leading injuries were hemothorax/pneumothorax (73%), spine fractures (65%), lung contusions (50%), rib fractures (50%), and solid organ injury (46%). Patients with major cardiovascular injuries were significantly more likely to expire, 88% vs 28%, $P = .009$.
Conclusion: The pattern of injury leading to death after an intentional fall from the Golden Gate Bridge has not changed significantly over the decades.

INTRODUCTION

Over the 85-year history of the Golden Gate Bridge (GGB), an estimated 1,700 victims have taken their lives through an intentional fall from the bridge walkway into the San Francisco Bay [1]. The mortality from the 220-ft fall has been estimated from longitudinal studies to be around 98% [2].

The coordinated response after a suicide attempt involves the key roles of retrieval, assessment, and transport by the Coast Guard, the California Highway Patrol, the Golden Gate Bridge Authority, and Marin Emergency Medical Services (EMS). For many years, victims were transported to Letterman Hospital, until the hospital's closure in 1991 [3]. After 1991, patients were transported to San Francisco General Hospital if they were recovered on the San Francisco side of the Bay or to Marin General Hospital (MGH) if they were retrieved on the Marin County side of the Bay. By 2013, a change in EMS triage policy resulted in all of the patients being transported to MGH. All of the patients reported herein were treated at MGH, which was renamed Marin Health Medical Center (MHMC) in 2019.

This study reviews the outcomes of all patients treated for falls from the GGB at MHMC after being designated as a Trauma Center in 2000.

PATIENTS AND METHODS

This study was approved by the MHMC IRB. The methodology consisted of a retrospective review of the MHMC Trauma Program registry database. Patients were identified from the EMS prehospital triage report, and chart abstraction was performed by the MHMC Trauma Program staff to obtain demographic data, categorize the site and type of injury for both survivors and fatalities, and calculate the Injury Severity Score (ISS). The cohort of 26 patients was also divided into 2 time periods: those treated before the ACS Level III trauma verification in 2009 (the early cohort, group 1) and in the period afterward from

Abbreviations: GGB, Golden Gate Bridge.

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Table 1
Patients treated at Marin Health Medical Center after leaping from the Golden Gate Bridge and having signs of life when recovered from the water

Number	*Year*	*Age*	*Sex*	*Outcome*	*ISS*
1	2000	19	Male	Survived	19
2	2000	24	Male	Survived	34
3	2001	40	Male	Survived	35
4	2002	20	Male	Expired	38
5	2005	19	Female	Expired	33
6	2005	85	Male	Expired	75
7	2007	Unknown	Male	Expired	42
8	2008	38	Male	Expired	75
9	2010	61	Female	Expired	30
10	2010	24	Male	Expired	17
11	2011	16	Female	Survived	22
12	2012	25	Male	Survived	59
13	2013	17	Female	Expired	26
14	2013	32	Male	Expired	9
15	2013	31	Male	Survived	22
16	2015	22	Male	Expired	17
17	2016	22	Male	Expired	10
18	2017	26	Male	Survived	5
19	2017	29	Male	Expired	36
20	2017	36	Male	Survived	29
21	2017	24	Female	Survived	24
22	2018	19	Female	Survived	17
23	2018	19	Male	Survived	17
24	2018	20	Female	Survived	12
25	2021	18	Female	Survived	17
26	2021	19	Female	Survived	41

No patients with intentional falls from the GGB were transported to MHMC in 2003, 2004, 2006, 2009, 2014, 2019, or 2020.

2010 to present (the late cohort, group 2). Patients prior to 2000 were not included because MHMC had not maintained a Trauma Registry prior to that time. As of 2010, the Marin County Coroner stopped routinely performing autopsies on deceased patients after falls from the GGB. Thus, the coding of deceased patient injuries (and ISS score) after 2010 is not based upon additional gross and anatomic pathology information that was previously routinely collected.

Differences were compared using the unpaired Student *t* test for categorical variables, χ^2 for nominal variables, and Fisher exact test for nominal variables with a small sample size.

RESULTS

Over the 22-year period of study, MHMC cared for 26 patients (17 men and 9 women) after intentional falls from the GGB, of whom 14 survived and 12 expired (Table 1). There were 7 consecutive deaths from 2000 to 2010, whereas 8 of the 9 most recently treated patients survived. The average age of all 26 patients was 28.2 ± 15.4 years old (age unknown in 1 patient), and the average ISS was 29.3 ± 18.1.

Among the 14 survivors compared to the 12 fatalities, there were 8 men and 6 women vs 9 men and 3 women, respectively. The average age of the 14 survivors versus fatalities was 24 ± 7.8 vs 33.5 ± 21.1 years, respectively (P = NS), and the average ISS of the survivors versus fatalities was 25.2 ± 13.7 vs 34.0 ± 22.0 (P = NS). All survivors were discharged from the inpatient ward to psychiatry. Five patients required transport to a higher level (ACS Level I) of care for treatment of either unstable pelvic fractures or advanced orthopedic injuries.

The injury pattern of all patients and mortality by type of injury are summarized in Table 2. All patients had multiple injuries. Major cardiovascular injuries were associated with an 87.5% mortality and intracranial injury with a 66.7% mortality. Patients with cardiovascular injuries were significantly more likely to expire than those without, 88% (7/8) vs 28% (5/18), P = .009.

Table 3
Demographic and outcome data comparing patients with intentional falls from the Golden Gate Bridge that had signs of life at the time of recovery from the water between group 1 (early cohort 2000–2009) versus group 2 (later cohort 2010–2022).

	Group 1 (n = *8*)	*Group 2* (n = *18*)	P *value*
Age (y)	35.0 + 23.8	25.6 + 10.4	NS
ISS	43.9 + 20.3	22.8 + 13.0	.004
Fatalities	63%	39%	NS

Comparing group 1 and group 2, there were 7 men and 1 woman vs 10 men and 8 women, respectively. The average age in group 1 versus group 2 was 35.0 ± 23.8 vs 25.6 ± 10.4 years, respectively (P = NS), Table 3. The average ISS (group 1 vs 2) was 43.9 ± 20.3 vs 22.8 ± 13.0, respectively (P = .004). The mortality rate in group 1 was 63% (5/8) compared to 39% (7/18) in group 2 (P = NS).

DISCUSSION

Our study represents the comprehensive list of patients treated at our institution after being designated as a Trauma Center in 2000. This report comprises the second largest series of survivors in the literature, accounting for nearly one third of the known survivors. Our survivors tended to be younger; had a lower ISS; and were more likely to have injuries confined to the ribs, vertebral spine, and pelvis. Massive intra-abdominal or intrathoracic hemorrhage, cardiac injury or disruption of the great vessels, tension pneumothorax, flail chest, and intracranial injury are less likely to be survivable. We witnessed an increased survival in the past decade likely due to a less severe pattern of injury and a younger patient population. The increased survival we observed after 2010 coincided with ACS Level III verification of our institution. It does not appear that the actual injuries sustained after a fall from the GGB have likely changed over the decades.

In the literature, 3 previous studies have focused on the injuries sustained after a fall from the GGB [3–5]. The first was published in 1967 in Aerospace Medicine as commercial air travel was increasing to study the injury pattern after striking water from a height [3]. The authors reviewed 169 GGB suicide autopsy cases from the SF Coroner's office from 1937 to 1966. They noted that 85.2% of the patients sustained crush injuries to the thoracic cage with bilateral rib fractures and penetration of the vital organs.

The second study was a 1981 review from the SF Coroner's office and hospitals across SF, including Letterman Army Medical Center and San Francisco General Hospital [5]. This review of 100 consecutive autopsies also showed that lacerations or perforations of the heart, great vessels, or lungs by displaced ribs were the causes of immediate death.

The third study was a 15-year institutional history published in 1995 by Letterman Army Medical Center [4]. Their series of 16 survivors is the largest reported in the literature. After comparing survivors to fatalities (n = 281), they observed that major cardiovascular and intracranial injuries were uniformly lethal. Similar to the other series, cardiovascular injuries were the primary injury associated with mortality. In our series, there were 1 patient with an intracranial injury and 1 with a cardiovascular injury that survived. We were able to show a statistical increase in

Table 2
Injury pattern and mortality for the 26 patients that were recovered from the water after intentional falls from the Golden Gate Bridge; all patients had multiple injuries

	Pneumothorax/hemothorax	Spine fracture	Pulmonary contusion	Rib fracture	Solid organ	Major cardiovascular	Intracranial	Pelvic fracture
All patients	73%	65%	50%	50%	46%	31%	11.5%	19.2%
Overall	47.4%	23.5%	46.2%	38.4%	50%	87.5%	66.7%	0%
Mortality	(9/19)	(4/17)	(6/13)	(5/13)	(6/12)	(7/8)	(2/3)	(0/5)

survival in patients recovered with signs of life without associated cardiovascular injuries.

A 2013 report noted a total of 34 survivors after leaping from the GGB [6]. Our study adds 8 additional survivors since 2013, bringing the estimated total of survivors to 42 in 2022 (assuming that all survivors since 2013 were transported to MHMC). In the first 26 years of the bridge's history, there were only 2 survivors after nearly 303 deaths for a mortality rate of 99.3%. The majority of survivors have been seen after 1968, and the modern reported survival rate of around 2% likely reflects the improvements in emergency medical response and the capabilities of modern medicine, including Advanced Trauma Life Support, care coordination, and the advances of interventional radiology, trauma surgery, critical care/anesthesia, and emergency medical services. The mortality rate is calculated based on the number of recovered bodies and is likely higher as the bodies of some victims are likely never recovered (particularly those who fall unwitnessed and/or at night).

Data from the Marin County Coroner's Office and reported by the media highlight the number of suicides at the Bridge since 2000 [1]. An average of 26 people a year have taken their lives since 2000 at the GGB, and there has not been any significant change in the number of suicides from the Bridge over the past decade. A suicide deterrent barrier consisting of steel-cable safety nets below the Bridge is currently under construction and scheduled to be completed in 2023. Hopefully, these types of severe traumatic injuries will no longer be witnessed at our institution after that time.

The limitations of our study include the small numbers of patients treated in both time periods and the inability to determine whether changes in EMS response, Coast Guard Search and Rescue, or other prehospital trauma care may have impacted overall survival. The change in autopsy practice at the Marin County Coroner's office impacted our calculation of the injury severity score in the later cohort.

In conclusion, the pattern of injury leading to death after an intentional fall from the GGB has not changed significantly over the decades. This paper summarizes the experience of nearly 30% of the known survivors in the 85-year history of the Golden Gate Bridge.

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Author Contribution

John Maa: Conceptualization, Methodology, Validation, Formal analysis, Investigation, Writing – original draft, Writing – review & editing, Visualization, Supervision. Jon Levin: Conceptualization, Methodology, Writing – review & editing. James Minnis: Conceptualization, Writing – review & editing. Ben Stahl: Writing – review & editing. Meaghan Carroll: Data curation, Software, Methodology, Writing – original draft. Laura Pajari: Data curation, Software, Writing – review & editing. Ed Alfrey: Conceptualization, Methodology, Validation, Formal analysis, Investigation, Writing – original draft, Writing – review & editing, Visualization, Supervision, Project administration.

Conflict of Interest

The authors have no financial conflicts of interest to disclose.

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Ethics Approval

This study was consistent with the MHMC IRB for a retrospective case review.

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