The Three Rivers Regatta Accident:
An EMS Perspective

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The Three Rivers Regatta accident occurred on August 7, 1988 when a Formula I racing craft collided with shore, injuring 24 spectators. The authors retrospectively examined the prehospital-based response for this multiple-casualty incident that used emergency medical service (EMS) physicians and 32 paramedics stationed at water and land-based posts to triage and evacuate 24 patients in 32 minutes. Patients were transported to 5 hospitals including 4 Level I trauma centers; this was accomplished in 53 minutes. The EMS response was unique in a number of respects. This was a prehospital-based rescue with the entire triage and stabilization phase accomplished by River Rescue units that transported paramedic divers, EMS physicians, and trauma supplies for 30 patients. Also of significance was the inordinate proportion of pediatric patients that accounted for 50% (12/24) of the cases. Successful medical care was the result of planning based on "Daily Routine Doctrine" or escalation of existing treatment protocol; adequate supplies, personnel and transport adapted to local geography and patient population; communications, including all services—EMS, police, and fire; and prehospital physician input to ensure correct triage order and patient disposition. (Am J Emerg Med 1991;9:64-71. Copyright © 1991 by W.B. Saunders Company)

A disaster has been defined as a situation where "destructive effects of natural or manmade forces overwhelm the ability of a given area or community to meet the demand for health care."[1] Multiple-casualty incident (MCI) is a more accurate description for most disasters occurring on national and global scales, usually involving 15 to 20 casualties.[2] Thus, disaster and MCI are on a continuum differentiated by both operational and logistic aspects. An MCI features a smaller number of patients, higher incidence, less emotional connotation to the descriptive term, and the capability of the health system to provide adequate care.

This MCI occurred at the 1988 Pittsburgh Three Rivers Regatta, an 11th annual event showcasing the city's waterfront activities. The location was Point State Park, a triangular land mass formed by the junction of the Allegheny, Monongahela, and Ohio Rivers. The crowd, estimated at 440,000 for the 3-day event and 135,000 on the day of the accident, was the largest ever assembled in the city. The race was the third leg of the 1988 Formula I Grand Prix series held since 1982 without incident on a 50 lap, 1.2 mile course. The racing craft were formidable with V8 engines generating 500 horsepower, weighing 1,100 pounds, 16 feet in length, and capable of speeds of 140 mph with gravitational (G) forces of 4 to 5.

The accident occurred when "Second Effort," piloted by Robert Wood, veered from the course between the Fort Duquesne Bridge and the Point State Park turning buoy (Figures 1 and 2). The course change was attributed to loss of steering ability due to the wind forcing the right sponson below the water, or as the result of the skeg or rudder striking a submerged object. The craft veered into a crowd of approximately 800 spectators along the North Shore Vietnam War Memorial at 45 mph (Figures 3 and 4).

The discussion will focus on the prehospital evaluation, stabilization, and transport of the 24 injured patients along with analysis and review of the triage process. It is emphasized that this was an MCI as opposed to a disaster, and that the medical operations of the EMS system, including municipal and medical tent service, continued without interruption. The accident was managed by escalation of routine prehospital care involving the City of Pittsburgh EMS physicians and by paramedics using preexisting evaluation and treatment protocol. EMS planning for such an event should emphasize expansion of routine medical operations until resources are exceeded, before institution of more formalized but less facile disaster plans. Finally, the unique aspects of this prehospital based MCI, including the first reported civilian amphibious rescue and the large number of pediatric patients involved, will be reviewed.

METHODS

Retrospective analysis of prehospital and hospital medical records, EMS and police radio transmissions, personal observations, and participant interviews were used for data collection. Descriptive technique including mean, range, and standard deviation represented numerical data.

Triage analysis classified patients into 3 groups based on injury severity and type: high severity (Class I) with cardiorespiratory instability or open surgical and orthopedic trauma; moderate severity (Class II) with closed orthopedic trauma; and low severity (Class III) who were ambulatory with minor orthopedic trauma. Triage order (TO) assessed the sequence of transport from 1 to 15, in light of multiple patients in some units. The transport time (TT) was measured from the time on scene to hospital arrival in minutes.

The City of Pittsburgh EMS system, comprised of 186 paramedics, is composed of 14 medical and 2 rescue units staffed by 2 paramedics per unit. Specialty services feature River Rescue, an independent unit staffed by paramedic divers with multiple craft capable of response to all waterways. Its annual call volume is 325 responses.[3] Routine and special event medical care is provided under a protocol system with on-line physician input and field response by second- and third-year residents at the University of Pittsburgh

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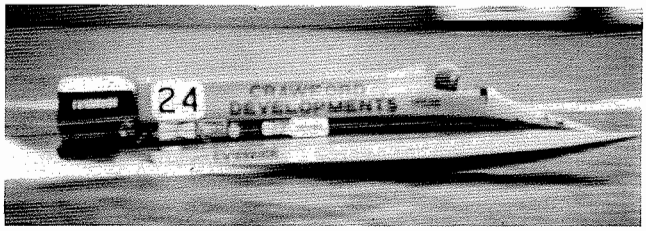

FIGURE 1. Formula I craft ("2nd Effort").

Affiliated Residency in Emergency Medicine with attending physician support 24 hours per day. Its annual call volume is 68,500 patients, 16.6% of whom require ALS intervention.[4]

Medical care for the Regatta was based at the medical tent located at the base of the Point State Park triangle (Figure 3-1). This post was staffed by 2 paramedics, 1 supervisor, and 1 EMS physician with 4 additional paramedics and 2 mobile units to respond to park activities. The Regatta Command Post, a mobile communication center and supply depot, was staffed with 2 paramedics and 1 supervisor (Figure 3-2). The fountain post was a mobile unit with 3 paramedics located at the park apex (Figure 3-3). Race activities provided 2 additional paramedic units with a physician based on the north and south shores of the Allegheny River at the race preparation point and the Coast Guard cutter "Osage" (Figure 3-4). River rescue operations included 4 Achilles inflatable power boats with 3 paramedics respectively and 2 Boston Whaler craft with 2 paramedics, 1 police, and 1 fire personnel (Figure 3-5). Regatta staffing at the time of the accident included 7 EMS physicians, 32 paramedics, the medical director, the chief of paramedic service, and officials, in addition to normal citywide staffing. Communication was provided by integrated VHF transceiver (EMS, police, and fire) and secondary cellular phone system coordinated by the public safety dispatch and medic command service. The city is served by dual aeromedical systems with three rotocraft available within 3 miles. Medical facilities featured seven hospitals including four Level I trauma centers within 5 miles.

RESULTS

Analysis of medical care began with the triage process that involved the evaluation of 24 patients, 12 adult and 12 pediatric, with a mean age of 20.9 (range 2 to 61 years) (Table 1). The initial responder team consisted of 2 paramedics, stationed near the accident site, who furnished the first medical report indicating 20 patients involved (Table 2). Their visual assessment suggested 6 patients (EA, HJ, HJ, BD, HA, EJ) of critical status suffering predominantly from musculoskeletal injury, gross lacerations and open fractures approaching amputation. Initial triage was provided by two EMS physicians who discovered a pediatric patient (HJ) with head trauma and agonal respirations for whom airway control and transport was initiated to the nearest facility (TO, 1; TT, 12 minutes). Retrospective review revealed a patient (EE) with moderate severity injuries who was transported allegedly by an unauthorized police unit (TO, 0; TT, 7 minutes).

Formal triage was accomplished by the medical director, author, and remaining EMS physicians utilizing multiple physical examinations with verbal communication while paramedic service chief assumed scene stabilization and transport roles. Triage priority was assigned by ATLS criteria for traumatic injury with focus on respiratory, hemodynamic, and neurologic function along with vital signs and patient age.[5] A triage tag system was available but not implemented. Geographic triage was utilized, however, with grouping of high, moderate, and low severity patients in the transport staging area. Physician intervention revised the initial paramedic triage assessment to include two patients (MM and SJ) with previously undetected respiratory insufficiency due to pneumothoraces in both, as well as hypotension in the former patient. Patient care included cervical collar, cervical immobilization device (CID), and long board immobilization in 45.6% (11/24) of patients; IVs established in 41.6% (10/24); and military antishock trousers (MAST) suit inflation in 16.6% (4/24). Transport was accomplished by ground, using nine vehicles to three adult (AGH, MH, PUH) and one pediatric (CHP) Level I trauma centers along with the nearest nontrauma designated facility (DP) located within a 5-mile radius. Aeromedical evacuation was not used because of the inability to secure a safe landing zone in this congested urban setting, the presence of adequately trained personnel on scene and the accessibility of local hospitals. Hospital choices for patients were determined by need balanced with space availability to accommodate an estimated number of casualties, as well as specialty consideration, eg, adult or pediatric facility.

Final triage and transport assessment of 24 patients assigned 33.8% (8/24) to the high severity group (I) (Table 3). Their TOs were 1 to 5 with a mean TT of 12.9 (range 10 to 24) minutes. EMS physicians accompanied 75% (6/8) of these patients, while the remaining 2 cases were accompanied by paramedic officials. The moderate severity group (II) consisted of 41.7% (10/24) patients with TOs from 6 to 12 and a TT of 25 (range, 18 to 41) minutes. The low severity group (III) consisted of 25% (6/24) patients with TOs from 13 to 15 and a mean TT of 49.7% (range 46 to 53) minutes. The mean TT was 22.4 (range 10 to 53) minutes for all patients involved. The hospitals used, AGH (1.3 miles), MH (2.1 miles), CHP (4.8 miles), PUH (4.9 miles), and DP (1.1 mile), received 6, 2, 8, 5, and 3 patients respectively (Table 4).

Ten (41.6%) of the 24 patients admitted were determined to be in critical (4), serious (3), or fair (3) condition. One

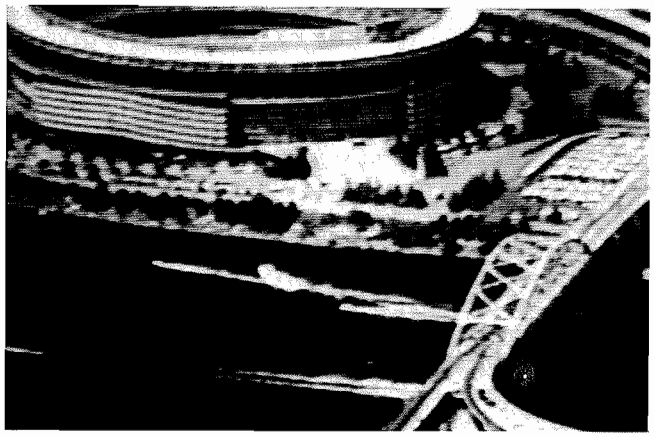

FIGURE 2. "2nd Effort" veers to shore.

TABLE 1. Patient Triage and Transport

TO	Triage Classification	Patient	Age/Sex	GCS/TS	Trauma Protocol	TT (min)	Diagnosis	OR	ICU	Condition	Disposition	Pt. Stay
0	II	EE	11/F	15/16	–	7	Pelvic herniation, left gastrocnemious laceration			Serious	A	5
1	I	HJ	7/M	4/8	+	12	Subdural hematoma, right lower extremity compartment syndrome	+	+	Critical	A	8
1	I	BD	9/M	15/16	+	12	Pancreas transection Grade IV, splenic laceration, evisceration	+	+	Critical	A	18
2	I	EA	15/M	15/16	+	10	Bilateral intra-articular knee laceration	+		Fair	A	3
3	I	HA	3/F	15/16	+	13	Left and right tibula/fibula open fracture, left radial/ulnar fracture	+	+	Serious	A	13
3	I	EJ	6/M	15/16	+	13	Hematuria, leg laceration		+	Fair	A	
4	I	SJ	19/F	15/16	+	14	Right pneumothorax hemoperitoneum	+	+	Serious	A	10
4	I	HJ	29/M	15/16	+	14	L2,3,4 fracture, right acetabular fracture, right Grade IV foot fx.	+	+	Critical	A	21
5	I	MM	39/F	15/16	+	15	C2,3 C3,4 subluxation pneumothorax		+	Critical	A	29
6	II	WJ	10/M	15/16	+	18	Left thoracic contusion					
7	II	WD	34/M	15/16	+	20	Multiple abrasions and contusions				D	
8	II	BE	32/F	15/16	+	21	Multiple abrasions and contusions				D	
9	II	BL	5/M	15/16	+	24	Right inguinal hematoma			Fair	A	2
10	II	SA	61/M	15/16	–	25	Right hip contusion				D	
10	II	CP	38/M	15/16	–	25	Right rotator cuff tear				D	
11	II	BR	11/M	15/16	–	38	Multiple abrasions				D	
11	II	CC	9/M	15/16	–	38	Left lower extremity abrasion				D	
12	II	HW	26/M	15/16	–	41	Left lower extremity sprain				D	
13	III	SN	9/M	15/16	–	46	Thoracoabdominal abrasion				D	
13	III	ST	2/M	15/16	–	46	Closed head injury				D	
14	III	DN	39/F	15/16	–	50	Right lower extremity contusion				D	
15	III	WR	23/M	15/16	–	53	Anxiety reaction				D	
15	III	CA	24/F	15/16	–	53	Anxiety reaction				D	

often dictates the mode of medical care including patient access and transport. The geography of this event, a crowd situated on three land masses separated by two rivers, required adequate prior planning for provision of medical care, essentially an amphibious EMS response.

Staffing should be adequate and include initial responders providing triage, treatment, and transport teams, ideally a continuum. Guidelines for personnel required can be extrapolated from recommendations for mass gatherings to include one physician for every 12,500 to 15,000; 2 paramedics for every 10,000; and 1 EMT for every 5,000 to 12,500 spectators.[14,15,16] Medical staffing at the Regatta was sufficient to provide each patient with 2 paramedic responders, physician triage, and separate paramedic transport personnel.

Medical teams should have adequate supplies adapted to

TABLE 4. Transport Hospitals

Hospital	Trauma Designation	Distance (Miles)	Patients (No.)	Severity			Age (Adult/Peds)
				I	II	III	
AGH	I	1.3 miles	6	4	1	1	3/3
MH	I	2.1 miles	2	2	0	0	2/0
CHP	I (Ped)	4.8 miles	8	2	4	2	0/8
PUH	I	4.9 miles	5	0	3	2	3/0
DP	III	1.1 miles	3	0	2	1	5/0

only 43.6% of cases in the latter.[28,29] Triage tags were available but not used for this event as ample patient care resources and rapid transport were available. Geographic triage is patient classification according to location, by design, or naturally where the most severely injured are located at the area of impact while less severely injured are located peripherally; it has been suggested as an alternative approach, if scene safety is ensured.[26] The advantage of this approach is that patients are categorized to some extent by the incident itself as was the case in this event with high-severity patients localized to the impact site. We hope to stress as other authors have that the "Daily Routine Doctrine" or keeping as close as possible to standard EMS operations is the most effective approach to the MCI until resources become the limiting factor.[30]

Finally, more elaborate mass casualty triage schemes have been suggested, using 2, 3, 4, and 5 tier systems.[8,31-33] Most MCIs, however, are not limited by resources, and medical care can be afforded to all patients, negating the deceased or unsalvageable categories of the more elaborate systems. The two-category system delineating major and minor injury is the most simplistic. A three-tier system described classifies patients into those with cardiorespiratory dysfunction in 10% of patients requiring immediate care and ICU stay; general medical and surgical in 30% requiring hospital admission; and orthopedic in 60% suffering from wounds and fractures suitable for hospital discharge.[31]

Patients encountered at the Regatta had more extensive injury than suggested by the prior analysis or the GCS or TS assessment with 33.3% Class I, 47.7% Class II, and 25% Class III. Comparison of triage category and outcome finds that 100% of the high severity patients required ICU admission or operative intervention, while there were no cases of undertriage, where low severity patients required aggressive intervention. The moderate severity group consisted of the 2 additional patients hospitalized while 8 others were discharged after therapy. Several patients in this group may have been overtriaged, a common difficulty encountered with physician assessment at the accident scene.[34] The low severity group included 6 patients, all of whom were subsequently discharged with minor injury. This group was free of under- or overtriage bias.

Two cases warrant identification and explanation. Patient EE with lower extremity laceration was assigned to the moderate severity group but was the first patient to arrive at the hospital (7 minutes). This occurred because of an unauthorized nonmedical transport allegedly by a city police unit or spectator. Patients HJ (subdural hematoma) and BD (abdominal evisceration) were transported by first unit from the scene to the closest Level I facility (AGH) in 12 minutes. However, the second patient transported, EA (intraarticular knee lacerations), arrived at MH in 10 minutes.There was no extrication required, but the former unit encountered traffic delay before access routes were secure.

We feel that patient care rendered at the Regatta substantiates the need for an EMS physician at the accident scene. Standard treatment protocols included airway support, intravenous lines, MAST, and spinal immobilization utilizing the CID, cervical collar, and long board placement for 50% (12/24) of those evaluated, including 100% (8/8) patients requiring ICU admission or surgical intervention.

Also of significance was the large number of pediatric patients encountered, 50% (12/24), which included 75% (6/8) of the high severity group. Their care was provided by EMS physicians with residency training in pediatrics (5 of 36 months), responsible for pediatric trauma aeromedical transport on a daily basis. The paramedics also received pediatric inservice including pediatric intubation as a routine curriculum. This is significant in that little has been reported concerning pediatric care in disasters. The sole reference described experience with the 1,000 bed field hospital established for the air lift of 1,600 Vietnamese orphans suggesting that 20 pediatric patients exceeds the resources of most pediatric facilities.[35]

Retrospective analysis of the Regatta demonstrated that physician triage allowed patients with the highest injury severity to be transported to trauma centers while patients with lower injury severity were transported to adjacent nontrauma facilities or underwent secondary transport to trauma facilities. This avoided the common disaster triage difficulty of transporting a large number of casualties to the nearest hospital, leaving the most severely injured requiring longer extrication times to be sent to more distant facilities.[36]

Ground transport was used exclusively for this event, although aeromedical service was available. The geography, including a hillside accident site and congested adjacent parking facilities, offered no landing zone, requiring 100 × 100 ft ground space without aerial obstruction. Proponents of aeromedical evacuation suggest that a higher level of expertise is delivered to the accident scene, transport speeds 2 to 3 times faster are obtained, and access to geographically isolated patients unreachable by ground are provided.[37] These advantages were clearly not an issue in this case, and the addition of helicopter transport might have compromised scene safety. It is suggested in one study that because of logistic considerations, longer transport times are associated with aeromedical (58 minutes) than ground (35 minutes) transport.[37] The benefits of aeromedical care are sound, but are best suited for rural areas with prolonged ground transport time and low level scene expertise.

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