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Case report

Optimizing mass casualty: an incident report of centralizing patient transport and its impact on triage efficiency

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Abstract

In mass casualty incidents, effective triage, treatment, and transport are critical for efficient management but often deviate from practices and ethical standards. In terms of resource allocation, decentralized transport is the predominant transport method; however, it is not standardized. This report retrospectively analyzed the response to a mass casualty incident at a university emergency center. By centralizing patient transport from the scene, the time to patient transport could be shortened, the burden on the scene related to transport could be reduced, and undertriage at the scene could be avoided. No trauma-related deaths occurred. This case provides a valuable contribution to the understanding of situations in which critical patients may concentrate in emergency centers during future mass-casualty incidents.

Key words: disaster medicine, mass casualty incident, transport, triage

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Introduction

Mass casualty incidents necessitate a unique approach to assessment and care, significantly diverging from normal practices and ethical norms[1]. Essential components for efficient management in such crises include triage, treatment, and transport[2]. However, the complexities of patient transportation logistics vary widely and lack standardized policies. Rapid and effective on-site triage, combined with the strategic selection of transport sites, is crucial, but presents challenges.

Our hospital, located in Shizuoka Prefecture, serves the eastern region of Japan, which is an area with limited medical facilities and human resources. Transport to alternative emergency centers can exceed two hours by ambulance in specific locations[3–5]. In the past, hospitals have encountered head-on collisions involving minivans and passenger cars. Decentralized transport was implemented, but there were instances of undertriage in which patients initially assessed to be in a mild condition were later found to be in a serious condition. This resulted in delays in transportation to the emergency medical center and admission to the Intensive Care Unit. In response, the hospital and Emergency Medical Services (EMS) mutually approved a policy of the centralized transport of moderately and severely ill patients to our hospital in the event of a mass casualty incident in the vicinity. This report provides a retrospective account of our hospital's experience in effectively responding to mass-casualty incidents by consolidating the transportation of moderately and severely ill patients to our emergency center. This report was approved by our institutional review board and examinations were conducted in accordance with the standards of good clinical practice and the Declaration of Helsinki. The approval number is 431. This report is a retrospective analysis of the prehospital and in-hospital responses of one emergency center. Data on injuries, outcomes, triage, patient flow, and resource utilization were obtained by reviewing the EMS and hospital records.

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Case Report

On November 3, 2023, at around 8:35 a.m., an autumn festival float overturned on a road in Izunokuni City (Figure 1), Shizuoka Prefecture, under the jurisdiction of the Sunto Izu Fire Department (SIFD)[6]. Half of the 30–40 pullers were inexperienced. Normally, when a festival float goes downhill, its speed is adjusted from behind using a tug line. When the float started to move downhill, the tug-rope operation was omitted and the float proceeded. During descent, the float was braked with a lever stick; however, the float, which weighed more than one ton, did not stop or overturn. The SIFD dispatched a command team, ambulance, rescue team, and fire brigade. Additionally, the SIFD requested that our hospital dispatch an on-scene triage and a physician-staffed ambulance (doctor car)[7]. The hospital dispatched a doctor and two nurses.

The site was approximately 3 km away from the hospital's emergency center, and despite the need to cross the north-south railroad tracks, it was only a 10-minute car ride. The closest alternative emergency center was a 40-minute drive away. To streamline triage and the choice of transport destination, it was decided that all moderately and severely ill patients would be temporarily accommodated at the hospital. A physician would also be sent to the scene to provide advanced medical care and join EMS commands. If the hospital was unable to cope with the situation, the plan was to use helicopters or other means of decentralized transport.

The time courses of the SIFD and doctor car activities are shown (Table 1). Patients were triaged according to a Simple Triage and Rapid Treatment (START) protocol. Initially, the EMS classified 1 patient who was compressed by the float as black, 2 patients who had direct contact with the float or fell as red due to a non-palpable radial artery, 3 patients who were unable to walk as yellow, and 13 patients as green. The dispatched physicians arrived at the scene and re-triaged the patients based on anatomical evaluation and portable echocardiographic assessment. As a result, two patients initially categorized as red were reclassified as yellow upon confirmation of palpable radial arteries, and one patient initially in the yellow category was upgraded to red owing to worsening respiratory status. Patients were transported in rescue order because the site was in the vicinity of the hospital and there were sufficient transport vehicles available. Only the patients classified as red were transported by a physician. By dispatching a physician, a critically ill patient was identified, and coordination and communication with the EMS were ensured. Our hospital's patient intake system has been enhanced. In addition to the usual two, the number of emergency physicians increased to two and the number of residents increased from three to six. One nurse joined seven typical nurses. Normal emergency care con-

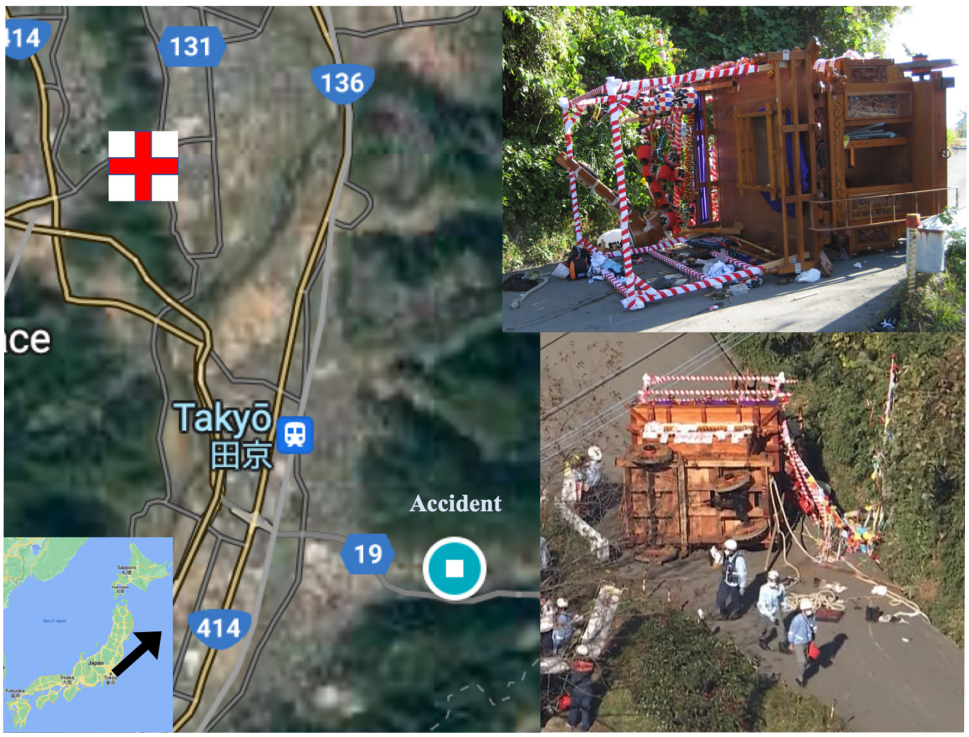

Figure 1 Location and scene of an accident.
On November 3, 2023, at approximately 8:35 a.m., an autumn festival float overturned a road in Takyo, Izunokuni City, Shizuoka Prefecture.

tinued during the mass casualty response. Of the 19 injured patients, the hospital received 6 moderately and 6 severely ill patients (1 black, 1 red, and 4 yellow). Patients who were already in cardiac arrest when rescued at the scene underwent resuscitative emergency surgery upon arrival at the hospital but did not survive. Other patients presented with hemopneumothorax, fractures of the extremities requiring standby surgery, and other symptoms requiring follow-up in a specialized department. However, a transfer to another hospital is unnecessary. Finally, no preventable trauma deaths occurred (Table 2).

Discussion

In this report, patients whose triage category was yellow or higher, indicating that they were moderately or severely ill, were transported centrally. Although decentralized transport may be considered for resource allocation during mass-casualty events, consolidating transport to emergency centers has proven promising in areas with limited resources, as shown in our case.

The scarcity of medical resources during contingencies necessitates patient distribution across hospitals to prevent

Table 1 Time course

Time	Event
8:35	Occurrence of the accident
8:42	Awareness
8:48	Request for on-site triage
8:50	Arrival of the first responding firefighting team at the scene
9:03	Request for patient admission No. 1 [black]
9:06	Departure of the doctor's car
9:13	Arrival of the doctor's car at the scene
9:15	Arrival at Hospital No. 1 [black, final diagnosis: aortic injury, hemothorax, open pelvic fracture]
9:34	Arrival at Hospital No. 2 [Initial red, final yellow, final diagnosis: left optic canal fracture, multiple craniofacial fractures]
9:34	Arrival at Hospital No. 3 [Initial red, final yellow, final diagnosis: humerus shaft fracture]
9:35	Completion of on-site triage
9:44	Arrival at Hospital No. 4 [Initial yellow, final red, final diagnosis: pneumothorax, acetabular fracture], with Triage Doctor
9:44	Arrival at Hospital No. 5 [yellow, final diagnosis: olecranon comminuted fracture, thumb metacarpal fracture]
9:48	Arrival at Hospital No. 6 [yellow, final diagnosis: gluteal muscle strain]

Table 2 Patient list

No.	Age (years)	Sex	START triage	Final	Destination	Diagnosis	Outcome
1	72	Male	Black	Black	JUSH	Aortic injury, hemothorax, open pelvic fracture	Death
2	55	Male	Red	Yellow	JUSH	Left optic canal fracture, concussion, multiple craniofacial fractures	Admission
3	45	Male	Red	Yellow	JUSH	Humerus shaft fracture	Admission
4	47	Male	Yellow	Red	JUSH	Pneumothorax, acetabular fracture	Admission
5	36	Male	Yellow	Yellow	JUSH	Comminuted fracture of the olecranon, fracture of the thumb metacarpal	Admission
6	31	Male	Yellow	Yellow	JUSH	Gluteal muscle strain	Returning home
7	75	Male	Green	Green	Hospital A	Contusion to the extremities	n/a
8	43	Male	Green	Green	Hospital A	Contusion to the extremities and back	n/a
9	39	Male	Green	Green	Hospital A	Contusion to the extremities	n/a
10	38	Male	Green	Green	Hospital A	Contusion to the back	n/a
11	29	Male	Green	Green	Hospital A	Contusion to the extremities	n/a
12	28	Male	Green	Green	Hospital A	Contusion to the extremities	n/a
13	28	Male	Green	Green	Hospital A	Contusion to the head	n/a
14	6	Male	Green	Green	Hospital A	Contusion to the extremities	n/a
15	48	Male	Green	Green	Hospital B	Contusion to the back	n/a
16	40	Male	Green	Green	Hospital B	Cervical sprain	n/a
17	36	Male	Green	Green	Hospital B	Cervical sprain	n/a
18	39	Male	Green	Green	Hospital B	Acute lower back pain	n/a
19	24	Male	Green	Green	Hospital B	Cervical sprain	n/a

START: Simple triage and rapid treatment; JUSH: Juntendo University Shizuoka Hospital; n/a: not available.

overwhelming a single facility. However, triage and medical facility selection pose challenges such as accuracy and time constraints[1]. These factors may worsen the outcomes of decentralized transportation. Mortality is reduced by prompt and sophisticated management, and over triage is acceptable because it does not increase mortality[8]. In addition, to find lethal traumatic lesions, obtain a definitive diagnosis, evaluate the severity of trauma, and decide the priority of management of polytrauma, an early computed tomography examination performed by the hospital is essential[9, 10]. Therefore, prompt consolidation of transport to the emergency center may be advantageous.

However, there are additional transportation challenges in rural areas. First, it is generally noted that field and transport times are longer in rural areas than in urban areas[11]. Second, there are fewer medical facilities and human and material resources, and geographic remoteness and topography can be problematic for transport. Furthermore, in contingent situations, undertriage is more likely to occur in rural areas than in urban areas because of inadequate assessments by medical staff and the possibility that EMS may prioritize hospital proximity over the need for a trauma center, which has been reportedly associated with higher mortality rates[12].

Our experience provides valuable insights into patient transport in mass-casualty incidents without a uniform policy. It has been noted that prehospital intervention by a physician may decrease mortality[13, 14], and a physician's presence during scene triage may have improved the situation. The consolidation and acceptance of moderately and severely ill patients may have reduced the triage time and simplified destination selection. Retrospective verification by the EMS team indicated a reduction in the task of selecting destination hospitals. Additionally, it is possible that undertriage of patients whose conditions could have worsened significantly was avoided.

Repeated effective triage and rapid transfer of patients to definitive care maintain the hospital's surge capacity[8], and we managed this situation while maintaining normal medical care. We assumed that if patients could not be treated at our hospital, a helicopter would be used for dispersed transport; however, this was unnecessary. This experience will be valuable in the future when more injured and sick patients are present, and we are forced to consolidate critically ill patients without any choice.

This report has several limitations. First, the findings may be specific to the context and characteristics of the emergency centers and regions under investigation, thereby limiting their generalizability to other settings. Second, focusing on a single emergency center may restrict the broader applicability of the results to healthcare systems with different structures or capabilities. Third, the absence of a direct comparison with decentralized transport makes it challenging to draw definitive conclusions regarding the superiority of centralized transport. Finally, the report is limited by its focus on specific outcome measures, such as preventable traumatic death, undertriage, and the burden on the EMS in selecting a transport hospital, without considering other potential measures of system efficiency and patient outcomes.

Conclusion

In mass-casualty incidents, centralized patient transport to emergency centers shows promise, especially in resource-limited areas. This approach may reduce transport time and minimize transport undertriage conditions. Our case provides valuable insights for understanding mass-casualty incidents. Moving forward, these findings underscore the importance of implementing centralized transport systems for more efficient emergency medical responses.

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