

Review Article

The role of an anesthetist at the times of natural disasters

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Abstract

During disasters, anesthesiologists may play a main role. It is known that anesthesiologist is extremely effective and capable in the management emergency cases during disaster times. In times of disaster, the anesthetist should not get stuck in the operating room only, with his experiences of intensive care and emergency response. Anesthetic management of patients in disaster situations is full of challenges for the anesthetist. The role of anesthesiologist after disaster is important to handle a safe and ideal surgical condition. A limited number of anesthesiologists in developing countries work in disaster preparedness and disaster management. In this review, we aimed to discuss the role and choices of anesthetists during disasters with examples.

The Word of disaster is originated from dus (bad) and aster (star) in latin language. In italian; disastro, in French ; désastre. It means that some natural events can cause harmful outcomes. Lots of natural disasters happened during the history also before human beings. They have greatly influenced the lives of living creatures whatever their results. The first description of the disaster is thought to have started with “Noah’s Ark “ in human history. Later, it was widely reported in Greek, Mesopotamian and other cultures.

Disasters are divided into two groups as natural or man-made disasters. The natural group is examined under the name of disasters that develop slowly (severe cold, drought, famine) and develop suddenly (earthquake, flood, landslide, avalanche, storm, hose, volcano, fire) according to the time of their formation. Human disasters can be grouped as nuclear, biological, chemical attacks, terrorist attacks, transport accidents, industrial accidents, overcrowding accidents and migrants and displaced persons.

The most important natural disasters in the world history are summarized in Table 1. The mostly seen disasters are the earthquakes in Turkey. The most important earthquakes in Turkey are listed in Table 1.

During disasters, anesthesiologists may play a role in pre-hospital care, as an emergency trauma team leader or

member, in the operating room, post-operative and intensive care, and during transport. Anesthesia is an area of expertise trained to intervene in a wide range of patients, from a healthy to a medically complex case to pediatrics to geriatrics. Anesthesiologists have valuable skills in physical and toxic traumas before and during hospitalization. In some parts of the world, anesthesiologists are team leaders especially in

Table 1: The mostly seen disasters are the earthquakes.

Hurricane	The most deadly hurricane -1970 Bhola hurricane-west Pakistan, Bangladesh-500.000 dead The most powerful hurricane known - 1979 Pacific ocean- Tip typhoon
Snowstorm	The most deadly snowstorm- 1972-Iran- 4000 dead
Landslide	1920- China Gansu province- 200 000 dead
Fire	The most deadly fire-1871 U.S.A Wisconsin Peshtigo-1500 dead 1863- Chile Church Fire - 2500 dead
Tornado	1989- Daulatpur-Saturia Tornado -Bangladesh- 1300 dead 1925- Tristate Tornado Missouri-Illinois- Indiana
Tsunami	2004 Indian ocean Sumatra Island 1958 The most powerful Tsunami known Alaska-Lituya Gulf
Snowslide	1970-Peru Huascaran dağı yamacı
Volcanic Explosion	1815-Endonezya Sumbawa adası-Tambora volkanı
Earthquake	1556-Çin-Shaaxi, 1960- Şili, 1976-Çin-Tunghan, 1999-Marmara, 2010-Haiti



pre-hospital period [1]. In France, anesthesiologists have an important role in pre-hospital and emergency services during disasters [2]. In the 2005 London subway bombing, anesthetists in the helicopter emergency response team have actively worked for the injured, especially in the field amputations [3]. It is not difficult to see that these roles are very suitable for an anesthetist. Although the role of anesthesiologists in disaster management is clearly seen, there are certain challenges and questions to implement this model in practice: To clearly define this role beyond anesthetists' daily work routines, to arrange work and planning time, inadequacy in anesthesia education in these areas, Are field interventions covered by insurance? Should legal and other concerns prevent us from disaster preparedness and response? If we stop back in disaster preparedness and intervention, can we neglect as medical?

One of the most important disciplines that make up disaster medicine is anesthesia. Anesthesiologists can take data from the field during disasters, make decisions quickly and conduct a regular rescue operation through leadership. Disaster management is a key competence for anesthesia crisis managers. The role of anesthesiologist in providing quick and fast treatment to injured people is very important in disasters.

The most important part during disasters is the treatment within the first hour which is called as «GOLD CLOCK». It is important as a determinant of whether the patient will survive or not. Triage is one of the most important issues in this period. Resuscitation, establishing of vascular access, planning of suitable fluid treatments, stabilizing the patient, providing transport, and establishing communication between hospitals are the subjects to be considered during this period [4]. An effective triage system should be simple, time-efficient, reliable and with minimal error characteristics. Personnel and health professionals in the system should also receive continuous training on this subject [5]. In the literature, there are different classification and scales related to triage and scoring of the injured: Australasian Triage Scale (ATS), The Canadian Triage and Acuity Scale (CTAS), The Manchester Triage System (MTS), The Emergency Severity Index (ESI) [6]. However, the triage system used in the field is different and the color coding system is used. Red: First priority and immediate action, Yellow: Second priority (within 1 hour), Green: Third degree (up to 3 hours) priority, Black: Fourth degree and dead.

As soon as disaster news is received, elective cases in operating rooms should be postponed, beds in intensive care units should be emptied as much as possible, transportation of patients in need should be ensured, pain management must be taken into consideration in the postoperative period, internal and external communication of hospital should be established (blood bank, intensive care, emergency).

Deaths in disaster situations are mostly due to traumatic brain and spinal cord injury, hepatic and splenic laceration, and pelvic fractures [7]. According to previous earthquake experiences of ASA, the need for surgery during disasters was determined as 15% [8].

Anesthetic management of patients in disaster situations is full of challenges for the anesthetist. Patient knowledge is limited, previous medical history, medications used, allergy

status, genetic abnormalities and gastric fullness are unknown, the presence of multiple injuries (vertebrae, pneumothorax, cardiac tamponade.) may cause difficult airway problems [9]. When choosing anesthesia method, type of surgical procedure, vital signs of the patient, available resources (equipment, medicine, personnel ..), advantages and disadvantages of anesthesia technique, physical conditions of the environment (electricity, water ..), transportation facilities should be considered [10].

During disaster periods some problems like power cuts, inadequate gas supply and inadequate waste systems may limit the use of mechanical ventilators. If necessity happens 90% we prefer manual ventilation [11]. The patients in hemorrhagic shock in disasters we do not have an ideal intravenous anesthetic agent. The anesthetic management safety should be in small dose increments, no matter which drug is selected [12]. In disaster areas, the star of the field is ketamine according to literature and practical applications. Ketamine, which was started to be investigated in 1959, started to be used clinically in Vietnam war in 1970s [13]. The advantages of ketamine are the absence of respiratory depression, protection of airway reflexes, wide therapeutic range, maintaining hemodynamic stability, rapid onset effect and short half-life [14]. Mulvey, et al. Has well defined that ketamine can be a primary anesthetic in disaster situations due to its safety and effect [15]. Succinylcholine (cautions: Burn, Crush syndrome, intraocular and intracranial pressure increase) and high-dose (1mg/kg) rocuronium can be used in emergency trauma disaster patients who can usually have a full stomach [16]. Because of less side effects, compliance with deep analgesia, hemodynamic stability, high success rate and low electrical power requirement, regional anesthesia is recommended in disasters [14]. The regional techniques used are divided into two as neuroaxial blocks and peripheral nerve blocks. Epidural anesthesia: In disaster situations, this technique can be difficult to apply, not recommended. Spinal anesthesia is safe and effective if performed correctly. oxygen availability is not an absolute necessity. Means should be found to overcome resuscitation and possible side effects (eg Hypotension). However, fluid replacement is important before starting blocks [17].

Peripheral nerve blocks are frequently preferred because of good surgical environment, deep perioperative analgesia, stable hemodynamics, minimal side effects, and the need for simple portable material. Continuous catheter application for epidural or nerve block has been reported in very few publications. Buckenmaier, et al. Reported that catheter application can be used safely [14]. However, inadequate appropriate manpower in mass injuries may complicate follow-up and catheter care. The risk of infection due to environmental factors should not be ignored. Pain management, which is the basic human right, should be considered and evaluated by the team in the field. Effective pain control reduces patient discomfort and complications with early mobilization. The development of neuropathic pain also decreases and reintegration of individuals into society becomes rapid [18]. It is possible to provide a good analgesia, even with few resources. All pain treatment modes can be used. «Pain management planning »should not be forgotten when disaster planning is constructed.



Realworld examples

In a review of 33,410 patients in 31 articles, 2 surveys and reviews covering 15 major earthquakes between 1930 and 2010, traumatic extremity injury was reported as 68% (lower extremity was more than upper as 90%) and cranial, thoracic and abdominal injuries reported as less than 30%. In the studies, only 26% of the anesthesia techniques were reported and the anesthesia techniques were equally distributed. In all studies, perioperative mortality rate was 0–19%. In the studies, it is reported that regional anesthesia was used as the primary technique used intraoperatively for lower extremity injuries after earthquake. However, it has been shown that all types of anesthesia can be used safely and successfully in acute surgical procedures (if the infrastructure, materials and medication are sufficient). No correlation was found between the anesthetic technique used and the type and incidence of complications [17].

In 2008, an earthquake of 8 magnitude in a mountainous region of China in which 70,000 dead and 370,000 wounded, Faculty of Military Medicine was reached to the areas only 62 s after the earthquake. 2 large tents for the operating theater and 4 small tents for emergency and postoperative care have been established. Triage was performed in 2715 patients, the mean age of the patients was 28.3 ± 19.6 years (5 months–81) and 56.8% were male, and 111 of them underwent emergency surgery. Later they shared their experiences in articles and they reported 42.3% extremity fractures, 16% extremity rupture, 6.3% multiple trauma, 6.3% C-section (C / S), 3.6% acute abdomen, 2.7% abdominal trauma, 1.8% cervical vertebral fracture and 20.7% Crush syndrome. General anesthesia in 17.1% (ketamine, propofol, midazolam, fentanyl, atracurium, isoflurane), intrathecal anesthesia in %36 (0.75% bupivacaine), monitorized anesthesia care in %36,9 (ketamine, midazolam), brachial plexus block in % 10 of patients (8 interskalen, 3 axillary) were applied. They listed the most common complications as 33% hypotension, 58.6% oliguria, 38.7% tachycardia, 15.3% anemia and reported that 6 patients developed hemorrhagic shock [19].

They reported that they evaluated 468 patients in their article on the field experiences of the mobile surgical team of the military hospital during the 7.8 magnitude earthquake in Kashmir (Northern Pakistan) in 2005 and reported that 149 patients had surgical interventions, while all patients were using ketamine as an anesthetic agent. They carried out the operations with the basic sterilization conditions including 12 beds, 1 operating room and an unreliable generator. The mean age of the patients was 26.7 ± 15.5 (5 months–70) years, while 58.3% had male gender. While 89.2% of the patients had single anatomic injuries, 10.8% had multiple injuries. The most common injuries were 78% limb injuries, 8.2% head and 5.6% back injuries, respectively. 0.1 mg / kg IV diazepam and IV 1.5–2 mg / kg ketamine were used as anesthetic agents in all patients. Prior to surgery, patients were given Ringer Lactate and 2.5% dextrose / saline solution infusion. No patient required mechanical ventilator, hallucination and death were not observed [20].

Due to the tourism season, all the hotels were occupied in the Tsunami that occurred in Southeast Asian–Indian Ocean in 2004 and 214,000 deaths, 140,000 losses and 34,000 injuries were reported. In a hospital with 215 beds, 4 operating rooms and 8 intensive care beds, 56% hip–leg, 34% shoulder–arm, 13.1% head–neck, 8.4% vertebra and 7.5% abdominal–chest were identified as injuries respectively. While 87.8% of 107 patients who underwent surgery had ASA I characteristics, only 2 patients did not have fasting time. Halotan was used as the sole inhalation anesthetic. Only one patient was intubated and transferred to another hospital. While 69.2% general anesthesia was applied, 19.6% mask–general anesthesia, 4.7% TIVA 3.7% spinal anesthesia and 2.8% local anesthesia techniques were used. Aspiration, hypovolemia, sepsis, and lack of preoperative laboratory research were defined as the most common problems associated with anesthesia, while hypotension and oxygen desaturation were the most common intraoperative complications [21].

Although the teams came from other countries and despite the limited resources, many patients were successfully operated in the Haiti earthquake of 2010, oxygen beds, anesthesia machines, ventilators and monitors were not working in the 120–bed hospital. The anesthesia technique was USG–guided regional nerve blocks (from lumbar plexus block to... sciatic block). Only manual blood pressure and pulse oximetry were used as monitors. There were no problems in the postoperative period. In the article, it was emphasized that it should be kept in mind that general anesthesia may not be applied in many hospitals in disaster areas [22].

According to official sources, there were 1115 dead, 1214 serious and 1688 slightly injured in the 2009 Sumatra (Indonesia) earthquake. According to the statistics of a hospital with unreliable electrical system 1117 patients were treated, 614 musculoskeletal injuries were detected. Since the earthquake occurred early in the morning when people were asleep, proximal fractures were observed more frequently and debridement was the most common procedure. 63 patients underwent the necessary interventions under anesthesia. Conscious sedation, spinal anesthesia, peripheral nerve blocks and general anesthesia techniques with very few percent (2%) were used respectively [23].

In the 2005 Kashmir earthquake, another team reported that they intervened in 180 surgical patients and applied general anesthesia to 44% of the patients and also used ketamine at a rate of 41%. They stated that ketamine is a safe and sufficient agent for anesthesia of surgical procedures performed in the field due to the lack of complications and good surgeon satisfaction [24].

Sarfraz, et al. reported that 11,299 patients in their shared articles after the Sumatra tsunami used local anesthesia techniques at a rate of 90% since they did not even have an oxygen concentrator [25].

In the Haiti earthquake of 2010, because the nearby health centers were damaged, triage and attempts were made on the street, but after 2 weeks, the 120–bed hospital with 2 operating



rooms could be built in the school gymnasium. 333 orthopedic surgeries were performed in this hospital within 3 months. Lower extremity injuries were more frequent. Amputation was performed in 14.6% of the patients. Six patients died despite all intervention [26].

They reported that they used a high rate of general anesthesia technique and shared the experiences of the distant region hospital in the 1999 Marmara earthquake and that the surgical type was mostly fasciotomy, amputation, reduction and fixation of large bones and various debridement operations. They did not encounter intraoperative mortality [27].

In an article evaluating the role of anesthesiologists in the Lombok earthquake (564 dead, 1684 injured) in 2018, it was found that most of the injured needed orthopedic surgery due to trauma. Although it is not statistically significant, general anesthesia is used more than regional anesthesia. The youngest patients were 1 day old and the oldest patients were 95 years old. Intubation and laryngeal mask airway were used in general anesthesia. Spinal anesthesia was preferred most frequently from regional blocks [28].

As long as we continue to live on earth, it is a reality to encounter natural disasters. It is clear that our professional group needs to adapt and be prepared. The first step to being prepared for emergencies is to make a good risk assessment. This risk assessment is then included in the emergency plan.

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