Commentary

Earthquakes and the Office-Based Surgeon

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A major earthquake may strike while a surgeon is performing an operation in an office surgical facility. A sudden major fault disruption will lead to thousands of casualties and widespread destruction. Surgeons who operate in offices can help lessen havoc by careful preparation. These plans should coordinate with other disaster plans for effective triage, evacuation, and the treatment of casualties.

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The purpose of this article is to encourage and assist surgeons who operate in offices to prepare for a major earthquake of magnitude 7.0 or greater on the Richter scale. A brief review of the formidable nature of such an event may serve as a catalyst for this preparation.

Many unstable and treacherous seismically active fault zones and plate rifts have been mapped throughout the world. Examples of these areas located on the North American continent alone include the Alaskan archipelago; the Juan de Fuca plate along the Pacific Northwest coast; California's San Andreas fault; Utah's East Bench fault; and the extensive New Madrid, Missouri, fault zone (the scene of a series of the greatest earthquakes ever recorded in the continental United States, 1811 to 1812). Earthquakes have a capricious nature and will occur in long-dormant or unsuspected fault areas. Physicians and surgeons should become familiar with the location of their practices in reference to fault zones to evaluate their vulnerability and to develop earthquake preparedness programs.

California and the Western States

To bring the immensity of the earthquake problem in focus with increasing office-based surgical procedures, consider the following prime example of intense seismic activity.

California has experienced 5,000 earthquakes since 1769 of Richter scale magnitude 5 or greater. During the past 20 years, 19 earthquakes of magnitude 6 or greater were recorded in the Los Angeles area alone. It is highly probable that a great earthquake of a magnitude of 8 or larger will strike in the near future along the southern section of the San Andreas fault that runs east of San Bernardino and southward to the Salton Sea. Major earthquakes have occurred in this area about every 145 years; the last one occurred 135 years ago. About 3,000 deaths may occur if the "big one" strikes early in the morning, or as many as 14,000 deaths if it takes place in late afternoon; structural damages will amount to $17 billion.

Were the Newport Inglewood fault, adjacent to the San Andreas fault, to rupture again, far greater destruction would be expected than in a San Andreas quake, mostly because of the population density and unstable soil. The Federal Emergency Management Agency estimates a late afternoon major quake would result in 23,000 dead, 91,000 severely injured, and a property loss of $69 billion. Based on 1988 estimates, 34% of the available hospital beds in Los Angeles and Orange counties would be lost because of damage.

In northern California, the central section of the San Andreas fault, along with two parallel active branches, the Hayward and Calaveras faults, forms an intimidating ellipse that encloses the San Francisco Bay region and the immediate inland and southern land areas of high-density population as far south as the cities of Watsonville and Hollister. The great San Francisco quake of magnitude 8.2 on April 18, 1906, and the recent Loma Prieta quake of magnitude 7.1 on October 17, 1989, are two examples of the more devastating quake disasters in this area.

Geologists estimate that there is a 40% or more chance of a magnitude 7 earthquake on the Hayward fault in the next 30 years and more than a 67% chance for such an earthquake in the San Francisco Bay Area. The Loma Prieta quake, if anything, has increased the chances. Scientists are currently concerned about the seismic activity of the converging Hayward and Calaveras faults in the San Jose area and in the vicinity of Hollister to the south.

Two other areas covering Washington-Oregon and Utah have notable treacherous fault zones. The first and greater lies along the eastern edge of the Juan de Fuca tectonic plate just off the coastline of the Pacific Northwest. The fault runs 750 miles from Cape Mendocino, California, to Vancouver Island, British Columbia. The strain in the rocks of the fault is calculated to be so great that it could release at any time in a probable series of tremendous quakes of magnitude 9 or greater. The second dangerous unstable fault is the East Bench fault that runs directly through Salt Lake City, Utah. The Mississippi Valley, with widespread fault patterns, is another area of possible recurring devastation. Great earthquakes occurred in the New Madrid, Missouri, area in 1811 and in Charleston, South Carolina, in 1886.

Surgeons in these areas should take note and prepare accordingly, for there is no room for apathy, denial, or underestimating the risks. The disruption of communications, electric and water power, and transportation will be immediate. Chaos and confusion at every level of governmental and private sectors within the perimeter of the quake will likely ensue.

Earthquake Scenario for Office Surgeons

Some surgical procedures can be done in an office-based operating room. These surgical facilities are designed to meet the rigid standards of hospitals, emergency departments, and outpatient surgical units. They are sophisticated and efficient.

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Unlike their general surgery colleagues, whose work is done in settings with extensive emergency facilities and personnel for back-up, office-based surgeons are solely responsible for anticipating *all* emergencies in the surgical suite and in the office in general. This should include earthquake disasters, especially in high-probability areas.

The violent force of a magnitude 7.5 quake may come when a surgeon is performing an operative procedure in an office setting on the fifth floor of a medical building with the patient under heavy sedation or a general anesthetic. The shaking may continue for as long as one minute. Frequent aftershocks may occur; some may be greater than the first. Utilities, communication, and transportation will be instantly disrupted. A third of hospital beds and many medical personnel will be lost in moments. It may take 72 hours or more to sort out casualties and return utilities and transportation to a manageable level.

If surgeons have prepared for such an event, they and their staffs should respond with some sensibility. If there has been no planning, the surgical area will be in a deplorable state; surgeon, staff, and patient could become casualties.

Earthquake Preparedness of Office Surgical Facilities

In preparing an office to meet a major earthquake, the surgeon must consider the before, during, and immediate aftermath. All three phases must mesh with an office-building plan.

Before the Event

The surgeon must concede that a serious quake will happen sooner or later and be willing to do something about it *now.* The location of earthquake faults in relationship to the medical office building should be determined. The subsurface on which the office building rests should be defined. Buildings erected on soft alluvial or sandy landfill areas or over areas with high water tables will suffer the most structural damage. Seismic waves are amplified in these areas, causing liquefaction of the soil and weakening of foundations, leading to irreparable structural damage, a disruption of building contents, and loss of life. If the ground and building are structurally stable, the physician must realize that this does not assure stability of the building contents.

Important safety measures include using simple mechanical devices to secure and stabilize furniture, equipment, and supplies to prevent in-office casualties from falling and flying objects and to reduce the possibility of expensive losses. In addition, a written protocol should be provided for personnel response to the quake with an assurance for practice sessions and timely updating.

The "disaster response program" for the office building should provide a system for the safe evacuation of tenants and patients, efficient triage (using the START program), and treatment and holding stations for the evacuation of casualties to functioning hospital facilities. These facilities are to be supported by a communications team that is in contact with local emergency network systems by amateur radio. These positions can most likely be filled by soliciting and organizing volunteers from within the medical building.

Gurneys and wheelchairs will not be able to be used on elevators because of power loss. Fire, police, and ambulance services, limited at best, will be spread thin and may be unavailable for two or three days. Arrange for fire-fighting instruction, the use of litters for nonambulatory patients, and access to emergency medical supplies. Refer to the section, "Guidelines for Office Personnel."

During the Event

Operating surgeons will have at least two reactions during uncontrollable earth movements: to *survive* and to *protect* the patient. A dead surgeon and staff are useless. The outcome will largely depend on the surgical team being prepared and being as calm as the situation will allow. Rehearsing beforehand and recognizing the need for instant improvisation are most likely to lead to good judgment and sensible actions.

Open wounds and instruments must be covered. By leaning over the operating table, the surgeon and scrub nurse may be able to stabilize and protect the patient from falling debris. A face may be quickly shielded by a Mayo stand. Airway conduits and intravenous lines will have to be kept in place; anesthesia personnel and the circulating nurse can help with this. Intravenous poles will roll or topple unless they are attached to the operating table. Other suggestions are listed under the heading, "Safeguarding an Office Surgical Facility."

After the Event

After the initial shaking stops, further violent aftershocks may follow and dislodge already-weakened overhead fixtures. Consider moving the operating tables, along with the anesthesia unit, closer to an inside unencumbered wall. It may prove to be a safer, more sturdy supporting structure.

The operation should be completed as quickly as possible. Electrical units used for controlling small bleeding vessels will not function. This actually will be an asset, for an electric spark may cause an explosion due to possibly ruptured gas lines. Bleeding may be controlled by other measures.

By the time the patient can be safely evacuated from the office, the building preparedness measures should be in effect. A litter bearer team may have to be summoned through a floor leader for assisting in evacuating the patient. One member of the surgical team should accompany the patient to a safe holding station, well clear of the building, where ongoing "recovery" can be provided until the patient can be safely released. The patient's condition on discharge, the name of the person to whom care is transferred, and the destination should be carefully recorded. Written instructions for postoperative follow-up care should be given if possible. A packet of appropriate medication to cover the immediate postoperative period for up to three days should accompany the patient because local pharmacies and hospital supplies will be depleted or otherwise impossible to reach.

Generally speaking, the surgeons and physicians on the premises will either find their way to preassigned building preparedness stations, help as they see fit, or be assigned through the building's command or coordination center. Surgeons who have survived the crisis can also make their way to any preassigned station once immediate obligations to care for and evacuate surgical patient(s) and office personnel have been fulfilled.

The communications center will assist those who have committed their volunteer services elsewhere (schools, hospitals) to find out how practical it might be to get to those places in the event of citywide destruction, with bridges down and roads blocked, that may make it impossible to travel.

Surgeons should not be assigned to triage but rather to immediate or delayed-evacuation holding stations where their skills are required for diagnosis and supporting treatment before casualty evacuation to hospitals. Specially trained paramedic personnel are best used to do triage.

Safeguarding an Office Surgical Facility

The following suggestions may help an office surgical facility to prepare for a major earthquake. Surgeons may wish to modify, embellish, delete, or make innovative additions as deemed practicable.

- Ensure that the medical building has an earthquake preparedness plan.
- Provide an office emergency communication system because telephone lines will become overloaded or power lines will be down. Walkie-talkies, cellular telephones, or an employee designated as a "runner" can be used.
- Have an AM-FM battery-operated radio to monitor emergency broadcasting stations. Have a supply of extra batteries.
- Stabilize and tightly secure anesthesia equipment, operating table, monitors, supply bins, suction and cautery units, and defibrillators, with heavy-duty industrial-grade Velcro. Vital and expensive equipment may otherwise disconnect, fall, or crash and be rendered useless.
- Bolt large, free-standing equipment cabinets to wall studs with metal "L" brackets.
- Secure all cabinet doors and drawers with special hooks, catches, or latches to prevent spills.
- Secure large oxygen and nitrous oxide tanks by strapping them to special metal stands provided by the vendor on request.
- Have an extra-large oxygen tank on hand.
- Have available an E cylinder oxygen tank with regulator and Ambu bags to accompany patients on litters during evacuation and recovery.
- Have installed, in accordance with building codes, a small emergency generator as a backup system to provide electric power independent of the building power source. These small generators will activate the operating room light and necessary electrical equipment such as the monitors and suction unit needed to complete an operation. The generators should be tested regularly.
- A surgical head lamp powered with a belt-hinged battery pack will prove useful.
- Secure a wall-mounted, battery-powered, operating room clock with heavy-duty Velcro.
- Have more than one flashlight with extra batteries.
- Window glass may explode instantly; danger from flying glass can be reduced effectively by covering the inside of the glass panels with an acrylic safety film.

Guidelines for Office Personnel

- Assign an office "earthquake chief" and assistant chief to direct the office activities in case of a major disaster.
- Formulate a plan of action and discuss it with the office crew and floor leaders and then post it in a prominent place.
- Secure computers and typewriters with heavy-duty Velcro.
- Keep current an inventory of employees with names and telephone numbers and nearest relative. Have each employee carry a card in their wallet with the same information.
- Identify the cash box with physician's name and have a fireproof safe for accounts receivable and other important documents.
- Instruct office personnel to have a three-day supply of any medications they are taking to tide them over in a major disaster.
- Have a three-day supply of water, food, and first-aid supplies.
- Have a loud whistle or horn available in the office to signal for rescue, if necessary.
- At the instant of the earthquake, call for everyone to duck and cover for protection from flying glass and falling equipment and fixtures.
- Do not light candles; there may be a gas leak. Use flashlights instead, and keep a supply of flashlights along with extra batteries.
- Quickly and calmly inspect all rooms, including the waiting room. Have a clipboard and make appropriate notes. Calm the patients by telling them that there is an earthquake preparedness plan in action and that they will be safe by following your instructions.

When the floor leaders arrive, advise them of the following: office structural problems, serious casualties needing help, and fire. Indicate that the office is ready for evacuation and indicate to floor leaders the "all clear" when evacuation is complete.

- Do not use the telephone lines until authorized by the communications center.
- Be sure to wear shoes to protect feet from shattered glass.
- Quickly triage injured patients and employees. Tag them appropriately with standard color-coded triage tags for proper disposition. Render emergency treatment. Request a special rescue team, if necessary.
- Do not remove persons who have been killed. Properly identify them with triage tags. Report the location of victims to the floor leader and building director who, in turn, will notify the command or coordinating team. The coroner's office will arrange for removal of the body.
- Standard color-coded triage tags may be purchased from the fire department by the building preparedness leaders for distribution to the offices.

When the floor leaders indicate that your office is cleared for evacuation, be sure to lock your cash boxes (remove the keys and carry them with you), and take and guard the daily patient log book to assist the floor leaders and building director in determining the completeness of evacuation of the offices and to identify a patient who may have become an earthquake casualty.

- If there is fire and heavy smoke, crawl to the stairwell, being careful to avoid glass debris.
- Once clear of the building, do not reenter unless otherwise authorized by the command center team, as severe aftershocks may trigger additional falling debris and cause injury.
- Above all, remain calm. You think and act more clearly if you do not panic. Review the preparedness measures frequently with the entire staff, including front-office crew. Brief every new employee on the details of the office and building earthquake preparedness plans.

Conclusion

Earthquakes of major proportions are likely to strike in the foreseeable future in the western states, as well as other

densely populated, seismically high-risk areas throughout the country. Knowing the history and the potential of these devastating quakes and the capriciousness of earthquake faults should motivate everyone, including surgeons who operate in an office surgical facility, to prepare *now* to safeguard the lives and premises of their immediate concern and responsibility.

There will be little anyone can do during the shaking period, but preparation beforehand will make the during and after periods easier to cope with. Being unprepared will compound the disaster.

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* * *

ONLY HUMAN

i was glad
i had taken the time
to hold the dead man's head in my hands
and comb his hair
even though i am always afraid
combing the dead fibers
will make them fall out

and i was glad
i had rolled a towel
and placed it under his gaping jaw

and that i had arranged the crisp white sheet
smoothly and neatly
across his motionless chest

for when she asked through tear-filled eyes
if she could see him and say good-bye
all i could do was nod my head
and hope my eyes were communicating the words
wedged so snugly in my throat

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