Remote damage control during the attacks on Paris: Lessons learned by the Paris Fire Brigade and evolutions in the rescue system

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ABSTRACT: On November 13, 2015, in 40 minutes, Paris suffered four suicide bombers attacks; shootings at three different restaurant terraces; and an attack on the Bataclan concert hall, resulting in 130 dead and 495 wounded. How did the Parisian rescue system respond and how did it evolve since? We proved we could deploy quickly wide prehospital and hospital resources and teams' equipment and preparedness is being further developed. To secure a swifter initial response, we need a better integration of the operators of the rescue chain with a simpler and more robust organization as well as improved communications channels. We must continue to anticipate and prepare for possible future attacks. (*J Trauma Acute Care Surg.* 2017;82: S107–S113. Copyright © 2017 Wolters Kluwer Health, Inc. All rights reserved.)

KEY WORDS: Terrorist attacks; disaster medecine; massive casualties; rescue organisation; remote damage control; advanced and basic life support.

On November 13, 2015, Paris suffered an unprecedented series of terrorist attacks which led to the first activation of our planned response to multiple attacks. In 40 minutes, four suicide bombers blew themselves up near the national stadium—the Stade de France in Saint-Denis and in a restaurant in the east of Paris. One person died as well as the four attackers. There were 10 absolute (immediate) and 65 relative (delayed or minimal) emergencies (Figs. 1 and 3).

In the meantime, a team drove through eastern Paris. They stopped at three sites near each other and opened fire on crowded restaurant terraces killing 37 people. They also left at least 30 absolute and 37 relative emergencies.

Finally, another team attacked the Bataclan concert hall, in the same vicinity, taking lives and hostages before being engaged by the police and special forces. It ended with a death toll of 82, as well as the three terrorists and at least 188 wounded: 84 absolute and 104 relative emergencies.[1–3] The final toll will be 495 wounded, 130 dead plus the seven terrorists.

The shock of these atrocities must stimulate us to scrutinize how our rescue system responded, to learn from this major stress test and adjust accordingly. We will browse through the operations pointing out the factors of success, the improvements made, and those remaining to be carried out (Fig. 1).

THE PARISIAN RESCUE SYSTEM

The Paris Fire Brigade is a military corps created in 1811 by Napoleon. It covers the city of Paris and the three nearest administrative areas called *la petite couronne*— the small crown. This bloc numbers 7 million inhabitants over 657 km^2. In addition to firefighting, the Paris Fire Brigade provides and dispatches most basic life support (BLS) ambulances. Some are also run by nonprofit associations.

Advanced life support (ALS) ambulances—staffed with a physician, a nurse, and a driver—are run by the Paris Fire Brigade as well as four hospitals' ambulances services called *Service d'Aide Médicale d'Urgence* - Urgent Medical Aid Service. Each SAMU as well as the Fire Brigade is equipped with its own call and dispatch center.

About 40 hospitals can accept emergencies. Six are Level I trauma centers. Each hospital has a mix of technical facilities or specialties which are not spread homogeneously across the map. Two military hospitals are staffed with physicians and nurses with training and experience in treating war casualties and damage control surgery acquired in deployment abroad. The complexity of this network makes the orientation of patients towards the hospitals likely to receive them a difficult task. It is called "regulation," and it is supervised by dedicated physicians from the Paris Firefighters call center for the BLS teams and by physicians from each SAMU for the ALS ambulances.

It usually allows the ALS ambulances to transport their patients directly to the proper department (ICU, catheterization laboratory) after the SAMU has checked the possibility to accommodate the patient. Hence, most unstable patients shortcut the emergency departments which are not staffed to receive unstable patients in numbers in addition to the daily flow.

The Alpha Red Plan was designed in 2005 after the attacks on London and Madrid[4] to cope with multiple terrorist attacks including one chemical, biological, nuclear, or radiological (CBNR) attack. Its principles are:

1. Swift automatic dispatch of three groups of vehicles: extraction from the danger zone (firefighting engines), medical stabilization of victims in a safer regrouping zone, evacuation towards hospitals.
2. Dispatching vehicles in limited numbers to keep reserves for additional sites.
3. Minimizing time on site to reduce the risks of secondary attacks.
4. Each site is run by a Rescue and a Medical Operations Commander in cooperation with the Police Operations Commander.

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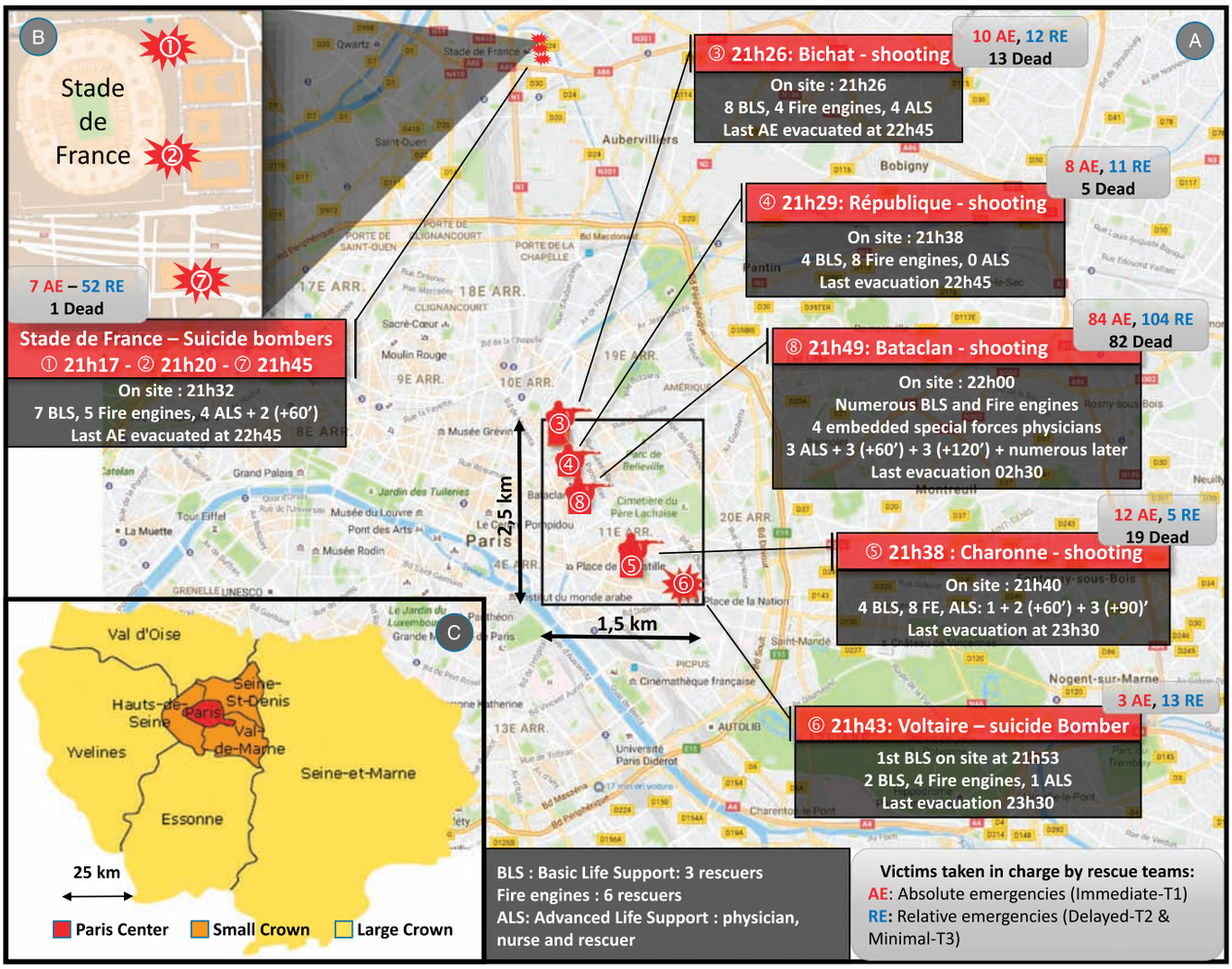

Figure 1. Map of November attacks. (*A*) Time line of the attacks and rescue operations. (*B*) Stade France bombings. (*C*) Ile de France Region.

5. Patients' destinations are regulated by the SAMU. In theory, immediate emergencies are transported to the closest hospitals with severe trauma capabilities, whereas delayed emergencies are sent to more remote hospitals.
6. The four peripheral administrative areas of the "Île de France" region, la grande couronne–the big crown, and the surrounding regions provide additional rescue resources if needed.

DAMAGE CONTROL CAPABILITIES

Teams are to implement remote damage control with possibilities of delayed evacuation.[5]

BLS teams apply tourniquets, simple, compressive and hemostatic dressings, three-sided dressings, waiting position, oxygen, hypothermia prevention, limbs and body immobilizations, and cardiopulmonary resuscitation (Fig. 2).

ALS teams can drain pneumothorax or hemothorax, manage airways, place intravenous or intraosseous lines, administrate crystalloid, colloid or vasopressors, analgesia or sedation, tranexamic acid or autotransfusion. They may use FAST echography. Triage (Fig. 4) done by physicians is expected to be more accurate which is crucial when the hospital grid is complex and resources under major strain (Fig. 3).

FACTORS OF SUCCESS

BLS Dispatch

One resounding success was the swift dispatch of numerous BLS teams to all sites. A BLS vehicle happened to be on site near Rue Bichat when the attack occurred there. It was shot at without damage and could give the alert immediately. Two physicians from the Fire Brigade and the local SAMU were positioned at the Stade de France and could confirm the initial reports of victims and demand BLS and ALS support. It took between 5 minutes and 9 minutes for the first teams to reach the sites.

Resources

Around 1,800 firefighters are on duty every night. Many of the 7,900 firefighters are accommodated in some of the 80 fire stations which reduce delays of mobilization. Some 840 of them

Figure 2. BLS teams.

were involved in the November 13 operations on the ground or at the headquarters. The others were kept in reserve or dealing with daily operations—about 1,300 everyday. What was revealed was that if we are provided with reliable information and support from civilian organizations and firefighters from nearby administrative areas, we can respond to more sites without delays.

Team's Autonomy

Firefighters are seasoned operators used to dealing with risks in a disciplined manner. They implemented efficient, basic damage control and gathered intelligence through radio. They revealed enough autonomy to organize evacuations without waiting for ALS teams when they were delayed.

The ALS teams proved particularly useful when the evacuations were delayed due to a suspected threat or a lack of transport. They supported patients' hemodynamic with fluids and vasopressors, fostered clot formation with tranexamic acid, drained tension pneumothorax, managed airways, successfully resuscitated at least two cardiac arrests and sorted and evacuated most urgent patients[1,3] (Fig. 4).

Dealing With the Information

In case of a major event, we double call operators in a few minutes and staff the crisis room with 30 people in less than 30 minutes reaching a total of more than 80 people. We received 459 calls in 30 minutes at peak time with 25% of lost calls and a maximum waiting time of 1 minute and 55 seconds while staying on line with the callers from the Bataclan to calm them down. Intelligence could be treated efficiently, avoiding dispatches on several false alerts and helping to dissipate the fog of the situation more quickly.

Having physicians on the ground was useful to sort out the casualties. It helped us to know where the extra teams were most urgently needed. We also have embedded physicians in the special forces to treat the casualties in the platoon. On the night of the killings, they were the first and only responders in position to treat the victims inside the Bataclan. Connected to our radio, they were useful in guiding extraction teams in the exclusion zone and in delivering critical information on the scale of the casualties.[6,7]

A key decision that night—based on the intelligence gathered—was to keep 72,000 spectators inside the Stade de France during the game. Had we evacuated them, the third bomber could have blown himself up in the crowd and triggered a potentially lethal wave of panic (Fig. 5).

Mobilization of Hospitals

Saint-Louis, Saint-Antoine, Lariboisière, are nontrauma hospitals located close to the sites of the shootings. They received most of their victims within the first hour of the attacks.[8,9] Apart from these, no hospital reported that it was overwhelmed or understaffed.[10–12] This is probably due to the huge hospital resources in Paris, the availability of operation rooms at that time of the day and the spontaneous return of personnel to their hospitals that allowed them to absorb the arrival of patients in the emergency departments and intensive care units. The flow of ordinary patients traditionally recedes when a major football game is on (France was playing Germany at the Stade de France), and it dropped drastically once the attacks became known to the public. Furthermore, the casualties arrived at the hospitals between 9:30 pm and 2:30 am when the evacuation from the Bataclan ended.

In total 124 people died before reaching a hospital and out of the 495 casualties, six died in the hospital. Among the casualties reported as admitted to hospital, 54% were admitted in a trauma center and 78% among the absolute emergencies. This emphasizes the need to teach casualty care to every medical

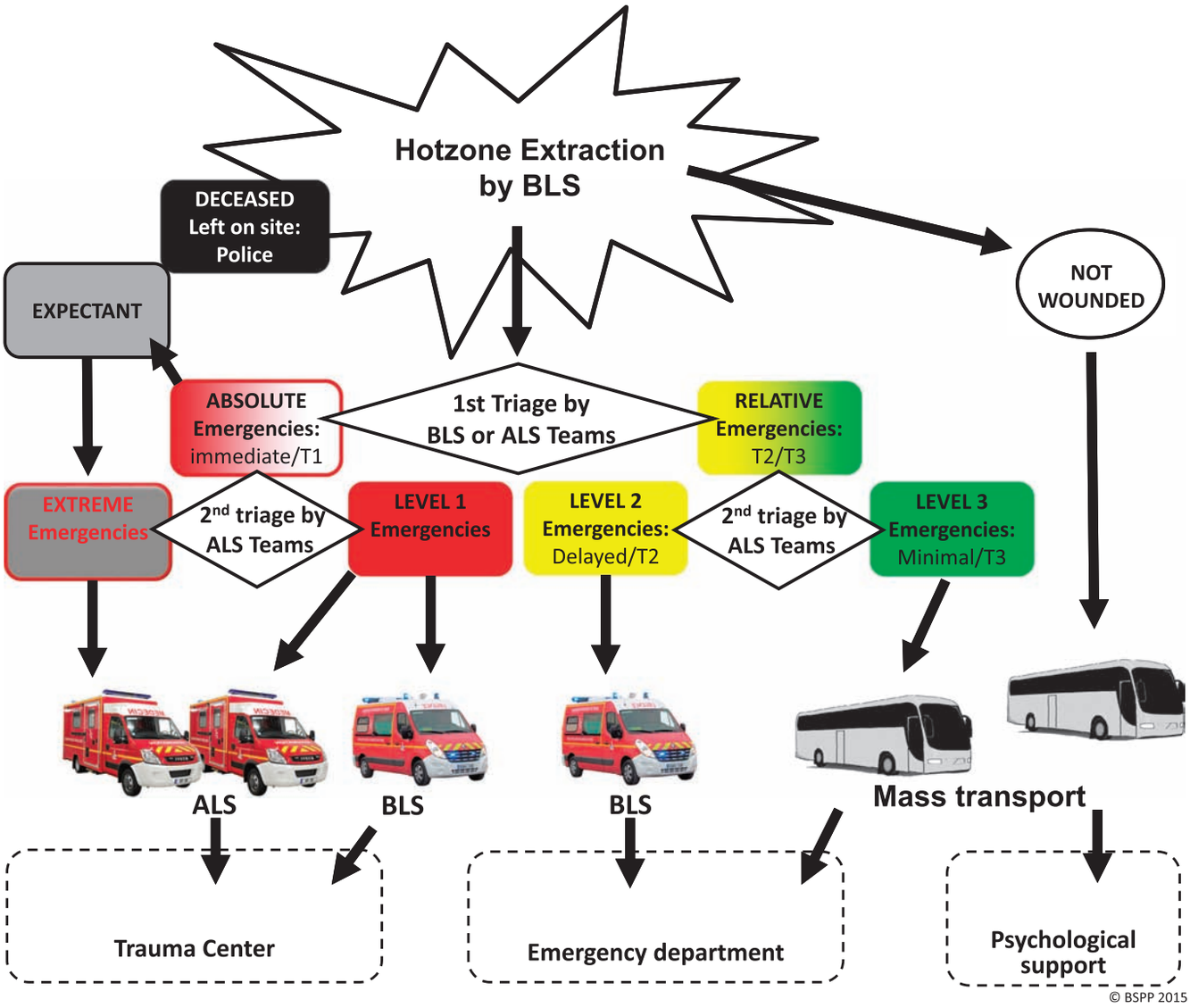

Figure 3. French Triage System.

treatment facility. Since then, the Army Medical Department has been assigned to train civilian physicians in combat casualty care and damage control surgery.

Resilience of the System

The operations ended around 5:00 am. By 8:00 am, stocks were replenished, and all vehicles fully armed and functional. Analysis of our weaknesses and possible improvements started immediately. Within a month, 840 firefighters had a psychological check-up. One third underwent a control check-up 3 months later, and all underwent repeated PTSD screening.

IMPROVEMENTS MADE AND STILL NEEDED

Equipment Dispatch

Since the attacks on Charlie Hebdo magazine and the Hyper Cacher Store in January 2015, all BLS, ALS, and fire engines were being equipped with additional and improved damage control kits (tactical tourniquets, quick clot dressing, sealed dressing for blowing chest wounds). The November 13 attacks revealed that we needed to further improve stocks and dispatch of equipment to avoid shortages and give autonomy to each team member. We doubled the damage control kits in the ALS ambulances, added junctional tourniquets, quadrupled our support vehicles from 1 to 4 to accelerate dispatch of additional damage control equipment, soft extraction and rigid stretchers, intravenous fluid, CBNR equipment. Deportable trunks for 15 victims are positioned all over the *petite couronne* to be transported in any vehicle. Spare medical bags have been made available to equip additional physicians and nurses. Our staff is being trained to use their equipment in realistic sessions with simulated secondary attacks.

Many victims die during the initial 10 minutes when there is no rescue team on site. To bridge that gap, we have launched

Figure 4. ALS teams.

a first aid training program for the population. Since January 2016, there has been a monthly attendance of 1000 people at the free weekly sessions.

Securing Communications to Improve ALS Initial Dispatch

The events revealed a good ALS mobilization capacity. In an hour, the firefighters added 18 ALS teams to the 7 on duty. The SAMUs positioned 40 ALS teams ready for intervention. But we need to improve our very early ALS dispatch to act on preventable deaths. Some of the attack sites were close to each other. It resulted in confusion of addresses and vehicles stopping on their way when confronted with multiple victims—thereby leaving their initial destination unattended. To prevent a similar occurrence, localization of all ALS vehicles with GPS is now being developed.

The first 60 minutes are critical when communication channels are saturated by phone calls. There are rumors and false alerts. Site locations are blurred by the variety of the addresses given by the callers. ALS dispatch—which is not automated—was sometimes delayed by the communication difficulties with our partners. Hence, additional dedicated radio channels, controlled daily, and crisis phone lines have been set up with each SAMU allowing audio conferences between the five call centers. Liaison officers are to be dispatched between the SAMU and the Fire Brigade and we acquired the capability to establish our own satellite phone network in case of a blackout.

We are still far from the ideal unique call and crisis center like the ones operating in Madrid and Boston. Yet since the November 13 attacks in Paris, the call centers for the Paris Fire Brigade and the police have been merged for two of the four administrative areas of the *petite couronne*. The other two will follow soon.

Improve Security of the Personnel and CBNR Detection

On November 13, two of our vehicles were shot at. Luckily, none of the team members were hit. Acknowledging the risk as well as the need to support the special forces in the extraction processes of mass casualties, we set up three experienced extraction groups supported by one ALS team each. They are all equipped with "class 4" bullet proof vests and helmets. Their role is to extract casualties from the exclusion zone following a corridor protected by the special forces as soon as a window in the operations allows it.

Although part of the procedure, checks for toxic gas and radiation were not performed. This loophole needs correction

Figure 5. Crisis room.

in case of a future attack. In addition to the detection tools already used by our officers on site, our CBNR specialists are now automatically dispatched in case of suspicious explosions.

Make Swift Evacuation a Priority

In the French prehospital model, the hospital comes to the patient with a physician to "stay and play" to treat the patient. This model has been adjusted to try and incorporate swift evacuation particularly when it comes to severe trauma for which fast damage control surgery may be the only lifesaving treatment or when security is at stake. However, we struggle to match the pace of Anglo-Saxon, Israeli, or military models. These are fully driven toward minimizing time to hospital. We are hindered by the complexity of the hospital network, the unbalanced distribution of trauma centers in the Paris region, the urban density of Paris (21,000 inhabitants/km^2) as well as the regulation lags.

Several factors now help us to accelerate the movement. The assessment by a real stress test of the hospitals' response capabilities brings into play the concept of a default distribution key between the hospitals.[13] It could be used to orientate patients towards the hospitals especially when communications are difficult or down.

There is concern that secondary attacks might be the next step in the terrorists' arsenal, and it is now widely accepted that communication difficulties cannot delay evacuations that will be decided at the highest level reachable: SAMU, Paris Fire Brigade call center or on the ground in case of blackout. The entire chain of rescue is now focusing on evacuation with additional evacuation vehicles in the automatic dispatches and closer monitoring of the evacuation rate.

The orientation rules are also evolving. Instead of orientating slightly injured patients to remote hospitals and keeping the nearby facilities for the severely injured patients, each hospital received a mix of both. Indeed, some simply turned up at the hospital and grouped evacuation mixed them up in one vehicle. And this turned out to be a sensible solution: the severely injured were treated by intensive care units, whereas those with less life-threatening wounds were received by the emergency department. It allowed each hospital to make the best of its resources without overloading any of the teams. Similarly, spreading victims around as many hospitals as possible, avoids flooding them with waves of patients over a short period.

A better up-to-date view on the load on each hospital is needed as well as additional communications channels other than phones—that is, radio—to make those hospitals aware of a major incident and to know how many patients they can handle. This is all the more important as swifter evacuation will mean more pressure on the hospitals.

Identification of Patients

Système d'Information Numérique Standardisé (SINUS) is a nationwide system for the identification of victims. It comprises a bracelet of stickers with a unique number and bar code as well as a sheet resisting CBNR decontamination. It identifies the victim and treatments given (Fig. 6). Without delaying evacuation once resources and safety are secured, data are entered in a centralized system providing information to all the institutions involved.

SINUS is supposed to be used by the entire rescue chain but only the Paris firefighters use it on a regular basis (once a

Figure 6. Standardized digital identification system.

day on average when confronted by more than five victims). This and the shortage of SINUS kits resulted in incomplete initial data and delays in identification (Fig. 6).

Perspectives and Discussions

Repeated attacks remind us that we must continue to improve our processes, acknowledge our weaknesses to address them, continue to train together with our partners and learn from how terrorists attacked elsewhere and how the rescue systems responded. This leads us to adjust our CBNR plan to make it more operational, train our teams for pediatric damage control,[14] prepare for secondary attacks on the rescue forces, spot potential targets, and establish possible circulation axes for each of them.

However prepared we may be, we must expect to be surprised and organize to function in moments of fluidity. War is an art of dealing with that kind of uncertainty. It teaches us to gather intelligence and secure communications to dissipate the "fog of war." We should not expect a clear vision. Thus, to stay operational in that unavoidable fog, we must develop the autonomy and versatility of our teams which are likely to have relevant information. They must be prepared to improvise. We must feed them with key information on risks and resources they can count on, and we must keep processes simple and decisions decentralized in order not to paralyze them.[15]

Our article focuses on the tactical and logistical aspects of a remote damage control strategy as implemented by a mature rescue chain in a civilian setting. However, for lack of a prehospital trauma registry and because the results of the autopsies have not been released by the legal authorities, we are not able to produce reliable data on injury patterns, treatments given and causes of death. A collective work has been undertaken to gather and analyze the data available from the hospitals. This limits the scope of our article.

CONCLUSION

On November 13, we were able to take advantage of our enormous rescue and medical resources and to mobilize them despite certain complexities in our organization that could have resulted in a higher death toll. We must continue to correct these flaws to simplify our processes, to secure our communication channels, and better integrate the institutions taking part in the rescue chain. Hopefully, this will help us respond to the best of our capabilities in case of future attacks.

AUTHORSHIP

X.L. participated in data collection, analysis and interpretation, literature search, and writing. J.-P.T. participated in data collection, analysis and interpretation, literature search, critical revision. Y.V. participated in data collection, analysis and interpretation, literature search, critical revision. B.F. participated in data collection, analysis and interpretation, literature search, critical revision. C.R. participated in data collection, analysis and interpretation, literature search, critical revision. O.S. participated in data collection, analysis and interpretation, literature search, critical revision. F.F. participated in data collection, analysis and interpretation, literature search, critical revision. A.G. participated in data collection, analysis and interpretation, literature search, critical revision. J.-C.G. participated in data collection, analysis and interpretation, literature search, critical revision. S.A. participated in data collection, analysis and interpretation, literature search, critical revision.

DISCLOSURE

The authors declare no conflicts of interest.

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