Comparison of Different self-defense Sprays in the Hands of paramedics – simulation Study

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Abstract:

Pepper spray is a self-defense tool used to prevent or stop aggressive behavior by quick and temporary incapacitation of the aggressor. The main aim of this study is to compare the effect of 2 different tools – Flashlight spray (Tool 1) and a gun shaped pepper spray (Tool 2) for paramedics in Prague. We performed a simulated test of the use of the tools with 10 paramedics (5 men, 5 women; the average age was 28 years) – nobody had been educated in using the mentioned self-defense tools. Using pepper spray (Tool 1) is faster and safer than using a pepper gun (Tool 2). There were discovered a lot of negative factors

for recommendation for both of these tools: long time period for using against possible perpetrators; impossibility of the using in the space of ambulance. We found that neither tool is appropriate for paramedics.

Objective

The rate of occupational injuries among paramedics and other Emergency Medical Services (EMS) professionals is 8 times higher than the national average for all workers and twice as high as the rate for police officers (1). It seems that there is no occupational group with a higher injury or fatality rate than paramedics and EMS providers (2). The basic theories of violence include: frustration; social learning; a general pattern of violence; violence vs. non-violence; inequality; subcultural and ecological theory. Theories of violence, include: the state of "remaining marked for life"; "direct correlation between organizational effects and creating a safe environment"; EMS managers' self-awareness; and other contributing factors toward moderating violence must also be considered (3).

Although some safety measures are designed to reduce violence in emergency departments, few studies have focused on the pre-hospital setting, with its unpredictable and unstructured environment. Violence toward prehospital emergency professionals is an often-neglected topic (4). There is no complete understanding of the incidence of violence in the Czech Republic, nor are there recommendations for specific professional communities regarding the problem of violence and how to resolve it in the pre-hospital emergency care.

Pre-hospital and EMS providers are the first to respond to medical emergencies. A high prevalence of violence has been reported in a few studies, indicating the extent of the problem. It also seems that one factor contributing to inappropriate patient behavior may be the non-professional conduct of some cases was managed by Emergency Medical Services (5). The Prague Emergency Medical Services (PEMS) is an organization funded by the City of Prague (Czech Republic). Rescue teams respond to emergency calls from 20 stations that are strategically situated in various parts of Prague to ensure the availability of pre-hospital care within 20 minutes. According to long-term statistics, response times vary between 7 to 8 minutes and amount to less than 7 minutes in the most serious emergencies. 330–350 patients are attended every day, which translates into more than 111,000 cases per year. All activities are managed by the EMS Dispatch Center, where medical operators receive over 900 emergency calls per day. Specialized pre-hospital emergency care is provided by 5 rapid response vehicles (RRV – emergency vehicles carrying a physician) and 32 advanced life support vehicles (ALS – large ambulance vehicles with a paramedic and a driver – Emergency Medical Technician) and 1 helicopter. They operate in the rendezvous system, where a physician works together with an ALS crew in situations when a patient's life or health is in serious danger. This approach not only reduces the response time to a patient, but it also allows deploying physicians in an optimal manner because in the vast majority of cases (approximately 85%), patients are transported to a medical facility without the need for a physician assistance during the transport. This way, doctors are not unnecessarily tied up and can be dispatched to assist other patients. Currently there are only 6 physicians' crews for whole City of Prague (1.5 million inhabitants) (6).

In general, we can state that the paramedics and ambulances drivers of Prague EMS are most exposed to verbal violence (15% / week, 80% / month). 80% employees are exposed to the physical violence per year but only a few cases need any care in hospital after the incident. Most attackers are men and most violent incidents are happened during the night shifts. The documentation of hard physical violence is 90%, only 10% are an "easy" violent incident.

Management of Prague EMS devotes maximal support to employees in communication as a tool for de-escalation conflicts - except of pepper spray the paramedics in Prague EMS are trained in effective communication, self-protection with contact of violence people and perfect collaboration with state and municipal Police exists (7).

Pepper spray is a self-defense tool used to prevent or stop aggressive behavior by quick and temporary incapacitation of the aggressor. To

date, few studies have investigated pepper spray operational usefulness and its limitations (6). Paramedics of the PEMS have this product in gear for personal self-defense in critical situations without the presence of Police (only in cases of immediate danger) when there is physical violence from patients, relatives or bystanders.

The main aim of this study is to compare the effect of 2 different tools – Spray Flashlight TORNADO® (Tool 1) and a new self-defense tool for paramedics Pepper Defense Gun Piexon Guardian Angel® (Tool 2).

Spray Flashlight TORNADO® (Tool 1) with a flashlight takes the form of a special stream that acts more strongly and more stable than conventional sprays. It is not as sensitive to external conditions as wind or rain, which minimize the possibility of directing the liquid flow at the user. The alkaloid content of capsaicin (obtained from cayenne pepper) is up to 15%, which is not the case with other models. The effect of stream of liquid is 4 meters. This pepper spray is also equipped with a system that enhances protection in the form of a very powerful LED flashlight, which blinds the attacker, this utility gives the user more time to react or escape. The safety cap switches on the diodes and at the same time creates perfect protection against unexpected dispersion (8).

Pepper Defence Gun Piexon Guardian Angel® II (Tool 2) is a compact defense product that contains 2 cartridges with an effective tear-forming substance 10% OC PIEXOL. Thanks to its gun like shape, it allows quick pulling out and helps for intuitive use in risky situations where there is no risk of bad application, as can be the case, for example, with pepper spray (turning the nozzle against the defender itself). The range is up to 4 meters with a scatter of about 30 cm. The active substance is in the form of a liquid, which prevents excessive contamination in the area of use (there is no risk of hitting the defender himself). In use, the affected aggressor will be exposed to severe irritation of the respiratory tract, eyes and skin. The effects do not cause permanent damage to health and disappear within 45 minutes (9).

Design

Simulation pilot study.

Methods

We performed a test of the use of both tools with 10 new paramedics who were in adaptation process, as they did not have any special training in the use of self-defense sprays. We have measured several aspects:

a) The time it took to pull out Tool 1 & Tool 2 and aim at a target (and the difference in pulling the tool from the belt and from the pocket);
b) The time it took to pull out Tool 1 & 2 and to fire at the target (an actor started running towards the paramedics beside an obstacle without warning);
c) The distance needed to hit the aggressor;
d) The view of paramedics. We aimed the tools at paramedics and we evaluate their feelings if they felt: (a) comfortable (b) uncomfortable (c) fear (d) panic.

All the tests were video-recorded. The results were verified by paired T-test ($p < 0.05$).

Participants

Our sample was represented by 10 paramedics (5 men, 5 women; the average age was 28 years). Nobody had been educated in using the mentioned self-defense tools.

Results

The median time of pulling the Tool 1 from the belt was 2.54 seconds (IQR 1/3 – 2.46/2.79); from the pocket 3.49 seconds (IQR 1/3 – 2.85/4.35). The average time of pulling the Tool 2 from the belt was 3.04 seconds (IQR1/3 – 2.78/3.63); from the pocket 3.65 seconds (IQR1/3 – 2.96/4.12). Pulling the Tool 1 (pepper spray with flashlight) from belt and pocket was faster than using the Tool 2 (pepper gun) (paired T-test, $p = 0.0005$). The average time of pulling out the self-defense pepper spray (Tool 1) and firing at the target was 3.15 seconds (IQR1/3 – 2.78/3.46); The average time of pulling out the self-defense pepper gun (Tool 2) and firing at the target was 4.28 seconds (IQR1/3 – 4.05/4.63). Pulling and firing at target using Tool 1 was faster than using the Tool 2 (paired T-test, $p = 0.030$).

We tested the distance when the paramedics manage to hit running aggressors (actors) against them – nobody managed to hit running aggressors (actors) from the starting distance of 4 meters - respondents did not manage to react with the spray nor the gun. When we prolonged testing distance to 8 meters, 4 paramedics managed to hit crossing aggressors (2 men and 2 women and only by pepper gun – Tool 2); the distance when paramedics hit the crossing aggressors was 3 meters (5 meters took the reaching the Tool 2). The times to reach the Tool 1 and 2 strongly exceeded the times from first measurement.

From the view of qualitative aspects nobody from our testing group (paramedics) felt comfortable when we aimed tools against the paramedics. When we aimed Tool 1 against paramedics, 6 paramedics felt uncomfortable and 4 felt fear. When we aimed Tool 2 against paramedics 5 paramedics felt fear and 5 felt panic.

Discussion

Management of Prague EMS support their paramedics in prevention of violence in general – staff have regularly trainings in communication and self-defense as a tool for de-escalating conflicts, there are definable causes which are running only in strict collaboration with police, we analyze every conflict between crew and patients/their relatives – the pepper spray is used only as a protect product for critical situations without the presence of Police (only in cases of immediate danger) when there is physical violence from patients, relatives or bystanders.

After the offer to try also for this purposes a pepper gun we decided to compare these 2 tools at first by our study. The main aim of this study was to compare the effect of 2 different tools – Spray Flashlight TORNADO® (Tool 1) and a new self-defense tool for paramedics Pepper Defense Gun Piexon Guardian Angel® (Tool 2). After our measurement we can state that from the point of view of comparison of different Self-defense sprays in the hands of paramedics the Spray Flashlight TORNADO® (Tool 1) has unequivocally better usage – in this study a pepper spray was faster than a gun (time of pulling the from the belt and from the pocket).

According the aiming against aggressors the pepper gun has an advantage over peppers spray. When we tested the distance when the paramedics manage to hit running aggressors (actors) against them – we had to prolong testing distance to 8 meters (the range of both tools is up to 4 meters, but nobody from our respondents could react to crossing aggressor in an attack from 4 meters). After this reparation 4 paramedics managed to hit crossing aggressors (2 men and 2 women and only by pepper gun – tool 2); the distance when paramedics hit the crossing aggressors was 3 meters (5 meters took the reaching the Tool 2). But the times to reach the tool 1 and 2 strongly exceeded the times from first measurement. It was described that in a real scenario will ability to react on attack the same or longer than our measurement (10). The distance to hit against attacker of both tools is 4 meters, main difference is in the application – pepper spray makes a liquid shot as a "stream" and the pepper gun is the possibility of attack from a bigger distance, but it only shoots in one direction and the paramedic has only 2 projectiles (attempts). The pepper spray has also advantage of attack from a short distance, which can be used e.g. in the ambulance car. The Police Tornado pepper spray (Tool 1) was also equipped with a system that enhances protection in the form of a very powerful LED flashlight, which blinds the attacker that gives more time to react or escape.

The main disadvantage for both tools is risk injuries for paramedics when they don't strike the aggressors and there is risk when used in an ambulance space – risk of eye injuries. (11) Contact of the eye with OC causes redness, swelling, severe burning pain, tingling, lacrimation, and involuntary or reflex closing of the eyelids. Symptoms usually resolved within 1.5 to 2 hours of decontamination although mild chemises, corneal edema, or hyphemia could persist. (12)

We had also interest how patients could react they would see paramedics with a pepper gun. Nobody from our testing group (paramedics) felt comfortable when we aimed tools against the paramedics. When we aimed Tool 1 against paramedics, 6 paramedics felt uncomfortable and 4 felt fear. When we aimed Tool 2 against paramedics 5 paramedics felt fear and 5 felt panic. Our findings could be connected with conclusions of research aimed to find out that the high prevalence of guns is the primary driver of gun-related death and disability and that having fewer guns would undoubtedly result in fewer such adverse consequences (13).

In this test we confirmed that the using pepper spray from pocket or from the belt is faster than the pulling of pepper gun. None of our respondents managed to hit running aggressors (actors) from the starting distance of 4 meters and when distance was extendedd to 8 meters, only 4 paramedics managed to hit running aggressors (2 men and 2 women and only by pepper gun – Tool 2). The times to reach Tools 1 and 2 strongly exceeded the times from first measurement and in case of the distance 4 meters our paramedics did not manage to react neither with the spray gun. These results showed that even when the use of self-defense sprays is announced as easy with no special training needed the paramedics require more training to use it effectively. Our findings showed that pepper guns or spray are not suitable self-defense tools to resolve conflict with violent people. Thus the main effort might be placed in the area of communication, self-defense training for paramedics and steps for prevention the conflict, f.e. using the Brøset Violence Checklist (14).

Conclusion

We found that using pepper spray (Tool 1) is faster than using a pepper gun (Tool 2) in our simulation study about comparison of self-defense tools. The pepper gun is advantageous for a bigger distance, but only shoots in one direction with limitation to 2 shots. On the other hand, we also find that using these types of self-defense tools is connected with negative feelings on the side of potential aggressors, which always comes with pros and cons. More research and qualitative research on the use of different self-defense tools and the effect on aggressors will be needed to understand a whole process, effectiveness and safety of the use in pre-hospital care. Accordingly, after our findings it seems that the staff from Prague Emergency Medical Service cannot use effectively this self-protection equipment in case of physical attack (for personal self-defense in critical situations without the presence of Police such as physical violence from patients, relatives or bystanders).

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