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# Hemostatic dressings in civil prehospital practice: 30 uses of QuikClot Combat Gauze

Stéphane Travers, Hugues Lefort, Eric Ramdani, Sabine Lemoine, Daniel Jost, Michel Bignand and Jean-Pierre Tourtier

To report the use and describe the interest of hemostatic dressings in a civilian setting, we provided medical prehospital teams with QuikClot Combat Gauze (QCG) and asked physicians to complete a specific questionnaire after each use. Thirty uses were prospectively reported. The wounds were mostly caused by cold steel ( $n = 15$ ) and were primarily cervicocephalic ( $n = 16$ ), with 19/30 active arterial bleedings. For 26/30 uses, hemostatic dressing was justified by the inefficiency of other hemostasis techniques. Those 30 applications were associated with 22 complete cessations of bleeding, six decreases of bleeding, and ineffectiveness in two cases. The application of QCG permitted the removal of an effective tourniquet that was applied initially for three patients. No side-effects were reported. The provision of hemostatic dressings in civilian

resuscitation ambulances was useful by providing an additional tool to limit bleeding while rapidly transporting the injured patient to a surgical facility. *European Journal of Emergency Medicine* 00:000–000 Copyright © 2015 Wolters Kluwer Health, Inc. All rights reserved.

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## Introduction

Prehospital medical rescuers can face difficulties with controlling external bleeding by conventional means (e.g. standard gauze field dressing, elastic bandages, direct pressure, tourniquet), and uncontrolled external hemorrhaging remains a leading cause of preventable death in trauma [1].

During the 2000s, several types of topical hemostatic agents were developed to better deal with these situations. Among these, QuikClot Combat Gauze (QCG) is a flexible, non-woven (50-50 rayon/polyester) gauze impregnated with kaolin, an aluminum silicate with a hemostatic effect caused by the activation of the intrinsic clotting pathway [2].

These devices have been studied and used widely by Western armies in Iraq and Afghanistan [2,3]. However, their use has seldom been described in a civilian setting.

## Aims of this study

To report the use of hemostatic dressings such as QCG and to describe their potential interest in civilian prehospital emergency medicine.

## Materials and methods

This was a prospective observational study carried out from 1 June 2011 to 30 May 2014 by the medical department of the Paris Fire Brigade. After specific training for physicians and nurses, QuikClot Combat Gauze (Z-MEDICA, LLC, Wallingford, Connecticut, USA) were made available in our nine medical ambulances. Local guidelines recommended

using them only in cases of failure of the usual hemorrhage-control measures (e.g. direct pressure with standard gauze field dressing, elastic bandages, tourniquet).

A specific questionnaire was completed by the physicians or nurses after each prehospital use (Table 1). Data were collected on patients (age, sex, previous use of anti-coagulant therapy), clinical status (type of wound, hemodynamics), management of bleeding (previous hemostasis gestures; interest in prescribing hemostatic dressing; effectiveness of QCG, in terms of complete stopping or decrease of the bleeding; side-effects; difficulty of use), hospital data (clinical status, difficulties encountered when removing the hemostatic dressing, surgical and medical treatments, duration of hospitalization), and patient outcome.

The study was approved by the ethical committee of our institution.

## Results

Hemostatic dressings were used 30 times by the prehospital medical team during the study period (Table 1). The different contexts of use were aggression ( $n = 11$ ), accident ( $n = 15$ ), or suicide ( $n = 4$ ). The median (IQR) age of the patients was 38 years (29.3–55.4) with 86.7% men ( $n = 26$ ). For all patients treated, at least one of the lesions was a hemorrhagic open wound. The most common wounding agent was cold steel ( $n = 15$ ) and the location of the wound was most often cervicocephalic ( $n = 16$ ). Active arterial bleeding was described 19 times.

**Table 1 Uses of QCG by medical teams of the fire brigade of Paris from 06/01/2011 to 05/03/2014**

| N° | Age | Sex | Cause           | Cause/<br>weapon | Wound<br>localization | Anticoagulant | Shock | Bleeding | Actions<br>before QCG | Interest of QCG<br>(according to the<br>physician of the<br>prehospital team) | Complete stop of the<br>bleeding after<br>introduction of QCG | Difficulties of<br>using QCG | Perfusion (ml) | Vasopressive drugs | Hospital<br>department | Transfusion | Surgery | Duration of<br>hospitalization<br>(days) | Outcome     |
|----|-----|-----|-----------------|------------------|-----------------------|---------------|-------|----------|-----------------------|-------------------------------------------------------------------------------|---------------------------------------------------------------|------------------------------|----------------|--------------------|------------------------|-------------|---------|------------------------------------------|-------------|
| 1  | 26  | M   | Suicide attempt | Razor            | Upper limb            | No            | No    | Arterial | Bandage               | Avoid tourniquet or pressure point                                            | Complete stop                                                 | No                           | < 500          | No                 | ICU                    | No          | Yes     | 1                                        | Return home |
| 2  | 30  | M   | Suicide attempt | Subway           | Lower limb            | No            | No    | Venous   | None                  | Avoid tourniquet or pressure point                                            | Complete stop                                                 | No                           | 700            | No                 | ICU                    | No          | Yes     | 78                                       | Return home |
| 3  | 49  | F   | Suicide attempt | Fall             | Head                  | No            | Yes   | Arterial | Bandage               | Spare time (scalp)                                                            | Complete stop                                                 | Yes                          | 1500           | Yes                | ICU                    | Yes         | Yes     | 7                                        | Dead        |
| 4  | 74  | M   | Accident        | Car              | Neck                  | No            | No    | Arterial | Bandage               | Other actions were ineffective                                                | Complete stop                                                 | No                           | 1900           | Yes                | ICU                    | Yes         | Yes     | 1                                        | Dead        |
| 5  | 22  | M   | Aggression      | Knife            | Upper limb            | No            | Yes   | Arterial | Pressure point        | Other actions were ineffective                                                | Incomplete stop                                               | No                           | 2500           | Yes                | ICU                    | Yes         | Yes     | 7                                        | Return home |
| 6  | 36  | M   | Aggression      | Glass            | Neck                  | No            | Yes   | Arterial | Bandage               | Other actions were ineffective                                                | Complete stop                                                 | No                           | 1500           | No                 | ICU                    | No          | Yes     | 3                                        | Return home |
| 7  | 21  | M   | Aggression      | Knife            | Neck                  | No            | No    | Venous   | Bandage               | Other actions were ineffective                                                | Complete stop                                                 | No                           | 0              | No                 | Surgery                | No          | Yes     | 4                                        | Return home |
| 8  | 45  | M   | Aggression      | Knife            | Head                  | No            | No    | Unknown  | Bandage               | Other actions were ineffective                                                | Incomplete stop                                               | No                           | < 500          | No                 | ED                     | No          | Yes     | 2                                        | Return home |
| 9  | 35  | M   | Accident        | Knife            | Perineum              | No            | No    | Unknown  | Bandage               | Other actions were ineffective                                                | Incomplete stop                                               | Yes                          | < 500          | No                 | ED                     | No          | Yes     | 2                                        | Return home |
| 10 | 27  | M   | Aggression      | Fire arm         | Lower limb            | No            | No    | Arterial | Pressure point        | Avoid tourniquet                                                              | Complete stop                                                 | No                           | < 500          | No                 | ICU                    | No          | Yes     | 12                                       | Return home |
| 11 | 34  | M   | Aggression      | Knife            | Neck                  | No            | No    | Arterial | Bandage               | Other actions were ineffective                                                | Complete stop                                                 | No                           | 650            | No                 | Surgery                | No          | Yes     | 1                                        | Return home |
| 12 | 50  | M   | Accident        | Car              | Perineum              | No            | Yes   | Arterial | Bandage               | Other actions were ineffective                                                | Incomplete stop                                               | No                           | 2000           | Yes                | ICU                    | Yes         | Yes     | 14                                       | Dead        |
| 13 | 72  | M   | Accident        | Saw              | Lower limb            | VKA           | No    | Venous   | Bandage               | Avoid tourniquet or pressure point                                            | Complete stop                                                 | No                           | < 500          | No                 | ICU                    | No          | Yes     | 2                                        | Return home |
| 14 | 34  | M   | Aggression      | Knife            | Lower limb            | No            | No    | Arterial | Tourniquet            | Tourniquet removed after QCG                                                  | Complete stop                                                 | No                           | 1000           | No                 | ICU                    | No          | Yes     | 3                                        | Return home |
| 15 | 46  | M   | Accident        | Car              | Head                  | No            | No    | Arterial | None                  | Spare time (scalp)                                                            | Complete stop                                                 | No                           | < 500          | No                 | ICU                    | No          | Yes     | 1                                        | Return home |
| 16 | 76  | F   | Accident        | Fall             | Head                  | ASA           | No    | Arterial | Bandage               | Spare time (scalp)                                                            | Complete stop                                                 | No                           | < 500          | No                 | ED                     | No          | Yes     | 12                                       | Return home |
| 17 | 24  | M   | Aggression      | Knife            | Upper limb            | No            | No    | Arterial | Bandage               | Other actions were ineffective                                                | Complete stop                                                 | No                           | < 500          | No                 | ICU                    | No          | Yes     | 2                                        | Return home |
| 18 | 36  | M   | Aggression      | Knife            | Neck                  | No            | No    | Arterial | Bandage               | Other actions were ineffective                                                | Incomplete stop                                               | No                           | 750            | No                 | ICU                    | No          | Yes     | 3                                        | Return home |
| 19 | 32  | F   | Accident        | Glass            | Upper limb            | No            | No    | Arterial | Bandage               | Avoid tourniquet or pressure point                                            | Complete stop                                                 | No                           | < 500          | No                 | ICU                    | No          | Yes     | 2                                        | Return home |
| 20 | 75  | F   | Accident        | Knife            | Neck                  | No            | Yes   | Venous   | None                  | Other actions were ineffective                                                | Complete stop                                                 | No                           | 1000           | Yes                | ICU                    | No          | No      | 1                                        | Dead        |
| 21 | 27  | M   | Aggression      | Knife            | Head                  | No            | Yes   | Arterial | Bandage               | Spare time (scalp)                                                            | Complete stop                                                 | Yes                          | 1000           | No                 | ICU                    | No          | Yes     | 3                                        | Return home |
| 22 | 41  | M   | Accident        | Fall             | Head                  | No            | No    | Arterial | Bandage               | Spare time (scalp)                                                            | Complete stop                                                 | No                           | < 500          | No                 | ED                     | No          | Yes     | 2                                        | Return home |
| 23 | 50  | M   | Accident        | Saw              | Upper limb            | No            | No    | Venous   | Tourniquet            | Tourniquet removed after QCG                                                  | Complete stop                                                 | No                           | < 500          | No                 | Surgery                | No          | Yes     | 3                                        | Return home |
| 24 | 25  | M   | Accident        | Knife            | Upper limb            | No            | Yes   | Venous   | Tourniquet            | Tourniquet removed after QCG                                                  | Complete stop                                                 | No                           | 500            | No                 | ED                     | No          | Yes     | 3                                        | Return home |
| 25 | 37  | M   | Accident        | Glass            | Aead                  | No            | No    | Arterial | Bandage               | Spare time (scalp)                                                            | Complete stop                                                 | No                           | < 500          | No                 | ED                     | No          | Yes     | 1                                        | Return home |
| 26 | 49  | M   | Suicide attempt | Knife            | Abdomen               | No            | Yes   | unknown  | None                  | Other actions were ineffective                                                | No stop                                                       | No                           | 4000           | Yes                | Dead                   | No          | No      | 0                                        | Dead        |
| 27 | 92  | M   | Accident        | Knife            | Head                  | No            | Yes   | Arterial | Bandage               | Other actions were ineffective                                                | Complete stop                                                 | No                           | 1500           | Yes                | ICU                    | Yes         | Yes     | 4                                        | Return home |
| 28 | 82  | M   | Accident        | Fall             | Head                  | VKA           | No    | Arterial | Bandage               | Spare time (scalp)                                                            | Incomplete stop                                               | No                           | 0              | No                 | ED                     | No          | Yes     | 8                                        | Return home |
| 29 | 78  | M   | Aggression      | Knife            | Neck                  | No            | Yes   | Unknown  | Bandage               | Other actions were ineffective                                                | No stop                                                       | Yes                          | > 2500         | Yes                | ICU                    | Yes         | Yes     | 2                                        | Dead        |
| 30 | 39  | M   | Accident        | Glass            | Lower limb            | No            | No    | Unknown  | Bandage               | Avoid tourniquet or pressure point                                            | Complete stop                                                 | No                           | 500            | No                 | Surgery                | No          | Yes     | 2                                        | Return home |

ASA, acetylsalicylic acid; ED, emergency department; F, female; M, male; QCG, QuikClot Combat Gauze; VKA, vitamin K antagonist.

The use of QCG was justified by the ineffectiveness of other hemostasis techniques (e.g. direct pressure or pressure with a standard gauze field dressing and elastic bandages) in 26 of 30 cases and involved an inaccessible area for pressure or tourniquet in 14 cases. In seven patients, the hemostatic dressing was used for a scalp wound during the initial phase of patient management. QCG application was associated with the complete cessation of bleeding in 22 cases, the decrease of the bleeding in six cases, and ineffectiveness in two cases. In three patients, the use of a hemostatic dressing permitted the removal of an effective tourniquet initially applied by a witness while maintaining hemorrhage control.

No complications or side-effects were reported during the prehospital phase or during hemostatic dressing removal after arrival at the hospital. Difficulties in QCG application have been reported by the operator in four cases, including two cases in which the thin and narrow nature of the wound made it difficult to introduce the hemostatic dressing closer to the vascular breach, and two cases where the operator had difficulty maintaining the bandage during transportation.

## Discussion

Hemostatic dressings have been shown to be more efficient than standard dressings in terms of reduction of bleeding and survival in animal models with hemorrhagic lesions with high and low pressure, probably because the topical hemostatic agent (kaolin, in the case of QCG) improves the creation of a thrombus in the vascular breach when used in association with the compression [3,4].

Their utilization has been advocated by several authors, including the PHTLS Executive Council, on the basis of numerous animal studies [4–6], and hemostatic dressings were used widely by several Western armies during conflicts in Iraq, Afghanistan, and Gaza [3,6–8].

However, other authors point out the difficulties with analyzing data accumulated during combat situations and emphasize that the use of these devices has seldom been described for civilian injuries [3,9].

This case series of 30 uses is, to our knowledge, the first to describe the prehospital utilization of QCG in a civilian context.

We chose QCG among numerous available hemostatic dressings because this device is still recommended as the first-line hemostatic agent by the Tactical Combat Casualty Care Committee and was also selected by the French Military Health Service. According to several practitioners who had experience with its use in Afghanistan, one of its interesting specificities is its roll form, which enables the realization of a packing in the wound.

Doctors and nurses who used QCG in our department described complete cessations of bleeding after its

application in two-thirds of the cases, whereas other measures to control a hemorrhage were ineffective or impossible to use.

In several previous studies [4,7], the interest in hemostatic dressings was related to their effectiveness in open wounds located in inaccessible areas for pressure or a tourniquet, such as the groin or perineum, and their effectiveness in certain situations where other techniques have failed, including cervical injuries.

The physicians in our study reported the efficiency of QCGs in the above-mentioned situations but also described two more original uses that are likely to be interesting.

- (1) The possibility of stopping scalp bleeding, leaving time for the physician to perform other urgent procedures (e.g. rescue, perfusion, and intubation) before achieving the final hemostasis suturing.
- (2) The opportunity to remove a tourniquet after the effective application of a hemostatic dressing. This point confirms the results observed in swine with the possibility to reduce tourniquet time through the use of this type of dressing [10].

No side-effects have been described in our series, either at the time of hemostatic dressing application in a pre-hospital setting or during removal in the hospital. This result confirms the fact that QCGs in their current form (rolled gauze impregnated with kaolin) produce no exothermic reaction and do not have any side-effects. Conversely, injury by heating and the risk of granule dispersion into the tissue were described with first generations of QuikClot devices that were composed of zeolite granules [3].

It was not possible to introduce hemostatic dressing into the wound in two cases and effectiveness in these cases was affected. Indeed, for the dressing to be effective, it must be in contact with the vascular breach and then associated with manual compression for at least 3–5 min [3]. This has not been completely possible for these two patients as the wounds were deep and punctiform.

Finally, it may seem surprising that QCG has been used only 30 times during the study period. This low usage is related to the procedure of our department that planned, during the study period, to use hemostatic dressing only in case of failure or an inability to perform other hemostasis gestures. The results of our study have since led us to expand the use of these devices.

## Limitations of the study

The self-evaluation of a hemostatic dressing's efficiency by the user has multiple biases [3]. The observation of decreased bleeding remains subjective and is difficult to quantify. The absence of a control group makes it

impossible to measure the efficiency of QCG, in terms of immediate or late prognosis, and a comparison with other devices such as standard gauze or elastic bandages.

However, carrying out a randomized clinical study to assess the effectiveness of these dressings in the context of human uncontrolled bleeding would be difficult and has not been achieved by other teams. Despite these limitations, certain benefits could be observed more objectively, such as the removal of tourniquets after hemostatic dressing application.

### Conclusion

In civil practice, standard gauze field dressings, direct pressure, and tourniquets appear occasionally inadequate for the control of a hemorrhage. The provision of hemostatic dressings in resuscitation ambulances helps physicians and nurses to face these situations by providing them with an additional tool to limit bleeding while rapidly transporting the injured individual to a surgical facility.

The absence of major side-effects and the level of interest noted among physicians who used QCGs for 3 years in our department confirmed our intention to equip our Basic Life Support teams with hemostatic dressings.

## Acknowledgements

### Conflicts of interest

There are no conflicts of interest.

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