Anaphylaxis Simulation Session

Seeing Is Believing

Mark D. Hellaby,
BSc (Hons), RODP, FHEA

Introduction: Massive anaphylactic reactions are rare but potentially life-threatening events. It is recognized that there are concerns in both the immediate management and recognition of the condition. The report describes an innovative approach to develop a simple, low-cost device to simulate a rash on a mannequin as part of an education session.
Methods: A system was developed to allow a plastic sheet with surface-mounted light-emitting diodes to be placed under the mannequin's chest skin. The light-emitting diodes presence and intensity could be controlled remotely via a potentiometer.
Results: Staff were initially surprised by the presence of a rash on the mannequin but very quickly used the presence of the rash to support a diagnosis of severe anaphylaxis. Participants appeared to have responded positively to these simulation-reinforced courses on acute anaphylaxis.
Conclusions: The development of a method to visually demonstrate a rash on a mannequin facilitated some of the educational goals of the course: the importance of skin changes in aiding the diagnosis of acute anaphylaxis and the importance of exposure of the skin of the patient.
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Key Words: Anaphylaxis, Anaphylactic, Simulation, Rash.

Anaphylaxis is a rare but potentially life-threatening event.[1] Previous studies have suggested that simulation-based education offers potential advantages for courses dealing with immediate management and recognition of anaphylaxis.[2,3] The majority of currently available mannequins do not possess a method of simulating a rash. The report explains the steps taken in designing a simple, low-cost method to simulate a rash on a mannequin as part of an anaphylaxis educational session at a National Health Service hospital in the United Kingdom.

Following a request to provide anaphylaxis training for ward nursing staff, a needs analysis was undertaken. Evidence shows that 80% of patients with anaphylaxis present with a rash.[1,4] It was obviously necessary for the mannequin used to develop a rash during the scenario to add to the realism. Such visual realism helps to promote learner buy-in to the scenario.[5] Also, the finding of the rash further reinforced the importance of the exposure step in the systematic Airway, Breathing, Circulation, Disability, and Exposure assessment.

From the Education and Research Division, Warrington and Halton Hospitals NHS Foundation Trust, Warrington, Cheshire, England.

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Reprints: Mark D. Hellaby, BSc (Hons), RODP, FHEA, Warrington and Halton Hospitals NHS Foundation Trust, Clinical Education Unit, Ward A4, Halton Hospital, Hospital Way, Rucorn, Cheshire, WA7 2DA. (e-mail: mark.hellaby@whh.nhs.uk).

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The aim of the session was to improve staff understanding, recognition, and initial management of massive anaphylaxis. It has been widely recognized that there is a lack of recognition, management, and follow-up of the patient experiencing a severe anaphylactic reaction.[1,6] Furthermore, it has been shown that the use of epinephrine is infrequent, and a significant delay in administration often occurs.[1,7]

This may occur because of the rarity of severe anaphylaxis, the rapid speed of onset, the confusing range of symptoms, and the lack of education at both undergraduate[8] and postgraduate[7] medical level. The session was run for a variety of medical, nursing, and dental staff over 2 hours for a maximum of ten candidates, although the normal session size was around six.

METHODS

The author experimented with various techniques for providing a visual indication of a rash on the mannequin to assist in the realism of the scenarios. The first thought was to simply mark the skin of the mannequin with a pen. It was quickly appreciated that this would limit the change round between scenarios, as well as having no ability to alter the visibility of the rash or make the rash appear after exposure to a trigger agent.

The next possibility that was considered was to use individual red light-emitting diodes (LEDs) drilled into the substructure of the mannequin beneath the mannequin's skin. It was recognized that this would restrict scenarios to the adapted mannequins, as well as the potential for damage to the mannequins.

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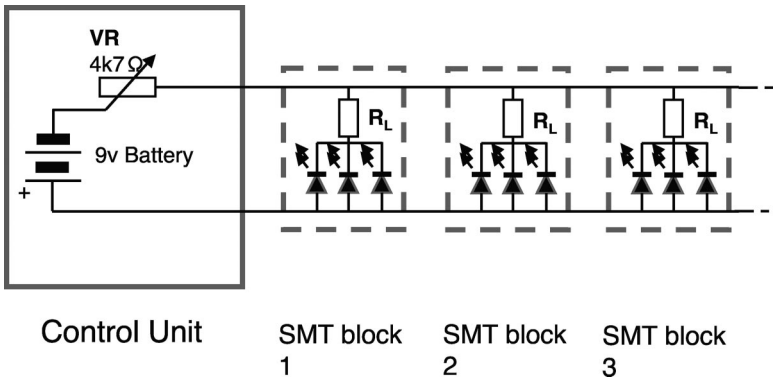


Figure 1. Circuit diagram.

Several strips of red, surface-mounted technology LEDs were purchased online at low cost. These strips are a thin tape that can be cut into smaller units with three low-profile LEDs and an integral-limiting resistor to drop the supply voltage (9–12 V) on each unit. These are in effect very low-profile red light sources with groups of three surface-mounted technology LEDs connected in parallel. The LEDs were powered from a 9-V battery, via a potentiometer, that allowed the intensity of the LEDs to be controlled and hence the visibility of the rash. Using the battery to power the LEDs also removed the safety concerns and testing requirements of using an AC electrical power supply. This also meant that the system could be used remote from electrical supplies.

A wiring diagram and a list of equipments are shown in Table 1 along with a suggested supplier (Fig. 1). Cheaper alternatives can be found online from other suppliers.

Initially, the LED strips were placed directly on the mannequin's structure beneath the skin; however, the resulting pattern was unsatisfactory. It also limited the use of the adapted mannequin only.

The final evolution of the rash was to cut the strips into the three LED units and connect them together with a small length of wire between them. The LED units were then attached to a thin flexible plastic sheet. The plastic sheet was originally a small document wallet. The plastic was flexible enough to conform to the shape of the mannequin's chest and firm enough to provide a secure anchoring point for the strips. Ten units were connected together. The units were mounted onto the thin plastic sheet, and some of the LEDs were masked to present a more random pattern.

The thin plastic sheet was cut to fit beneath the chest skin of a Laerdal ALS Simulator mannequin (Laerdal Medical Ltd., Stavanger, Norway). The shape of the sheet allowed it to fit in a position between the mannequin's defibrillation and electrocardiogram connections. The sheet was also successfully used in several other Laerdal mannequins including their MegaCode Kelly, SimMan, and Little Anne range, so in effect the rash could be used on any of the department's mannequins. Being further down the chest meant that the rash was less obvious until the patient's chest was significantly exposed (Figs. 2, 3).

Initially, the variable resistor on the control unit could be turned to a point where the rash was not visible and this could be adjusted during the scenario. Thus, the mannequin could be prepared at the beginning of the session and used on other scenarios before an anaphylaxis scenario. The rash could become more obvious if required during the progression of the scenario. The plastic sheet could be easily inserted beneath the skin of the mannequin, thus any of the adult and pediatric mannequins could be used for training.

Typically, during the scenario, the staff would respond to a patient with a pronounced massive anaphylaxis with signs of stridor, wheeze, deteriorating oxygen saturations, and circulatory collapse. As the scenario was repeated on more than one occasion, a range of presentations could be demonstrated (Figs. 2, 3).

RESULTS

The training session has been run, over a 1-year period, for over a hundred of the hospitals' medical, nursing, and allied health professional staff and specific sessions for the newly qualified doctors. In addition, regular open sessions have been held, attracting participation from general nurses, physiotherapists, dental nurses, dentists, and doctors. The medical staff who attended the sessions ranged from newly qualified staff to consultants.

The majority of training sessions used one of the Laerdal ALS Simulator mannequins. However, on one occasion in an outlying area, a session was run with a standard Laerdal Little Anne with the insert beneath the chest skin. Candidates in

Table 1. List of Components, Example Supplier, and Cost

Items	Suggested Manufacturer	Cost
DC 12v LED strip × 10 N84CZ	Maplin Electronics	£15.90 ($24.46, €19.22)
Small plastic box 50 × 25 × 17 mm N78BQ	Maplin Electronics	£1.69 ($2.60, €2.04)
Miniature potentiometer 4k7 Ohms FWO1B	Maplin Electronics	£1.41 ($2.17, €1.70)
Rigid PP3 (9 V) battery clip	Maplin Electronics	£0.89 ($1.37, €1.08)
Misc solder, wire thin plastic sheet, and 9-V battery		Negligible
Total		£19.89 ($30.60, €24.04)

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Figure 2. Final design.

this session appeared to achieve the same level of confidence in recognizing and managing a simulated patient with anaphylaxis.

It was decided that routinely the sheet would not be used on cardiac arrest scenarios (partly to preserve the life expectancy of the plastic LED sheet), as the plastic insert was in a position that the candidates would be performing chest compressions on. None of the planned scenarios included cardiac arrest, as the scenarios were all based on the recognition and management and hence did not deteriorate to a cardiac arrest. It would be possible to further adjust the position of the LEDs away from the sternal area to improve resilience when using a cardiac arrest scenario.

Other functions of the mannequins appeared to be unaffected. Students could still auscultate the chest and heart sounds with no appreciable lack of audible clarity. The sheet was flexible enough not to interfere with other mannequin functions such as respiration. On one occasion, a cardiac arrest scenario was undertaken with the LED sheet in situ. The sheet did not interfere or affect chest compressions and continued to work effectively subsequently.

DISCUSSION

Various reactions were observed when the candidates exposed the chest of the mannequin. There was often an initial surprise that the mannequin had developed a rash—this was partly because in the initial scenario the rash was not used. Although a small minority of the candidates did question what the lights represented, other participants in the group always pointed out that it was a rash. The presence of the rash did stimulate the learners into recognizing the anaphylaxis and hence initiating treatment.



Figure 3. Final design—skin half exposed.

It would be ideal to be able to operate the LED lights from the mannequin's controller. However, as there was limited facilitator operation, the LEDs were turned on before the scenario was started, and it was not a major issue.

Care needs to be taken to avoid overstandardization of the condition, for example staff being drilled to respond to a "simulated" emergency and failing to recognize a real one because of subtle clinical differences in the presentation. Hopefully, this was avoided by having several different presentations to let the learners witness a range of presentations, for example a different range of trigger agents and the speed of onset of anaphylaxis.

In addition to being used on the anaphylaxis session, the adapted mannequin has also been used on various other simulation events, including as part of a human factor introduction. A scenario was devised to demonstrate fixation errors whereby the history was given that the learners were called down to reassess a patient who they had recently treated for an acute asthma attack. The majority of learners failed to perform a complete Airway, Breathing, Circulation, Disability, and Exposure assessment and proceeded to treat the underlying wheeze, and there was a delay in recognizing massive anaphylaxis caused by antibiotic administration for a chest infection.

It is recognized that the study was performed on a group of learners who were attending an anaphylaxis session, thus expecting an anaphylaxis scenario. Further research could be undertaken to explore whether such a visual method affected long-term retention of anaphylaxis diagnosis and management confidence and competence, as well as more formally quantifying the intervention.

CONCLUSIONS

This report shows that a simple, low-cost method for simulating a rash on a mannequin can be easily manufactured. The LED sheet proved to be a simple and inexpensive adaption that could be used in a variety of situations and sessions to provide realism for an anaphylaxis scenario.

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