

IMPROVISATIONAL WILDERNESS TECHNIQUES

Retrieval of Additional Epinephrine From Auto-Injectors

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Anaphylaxis is a challenging condition for any austere environment. It is unpredictable, has sudden onset and a high fatality rate, and is responsive only to epinephrine, a prescription medication. The Wilderness Medical Society has formally recommended that non-medical providers working in austere environments be trained to administer epinephrine. Medical providers frequently prescribe auto-injectors for this purpose due to their ease of use by nonmedical providers. However, auto-injectors have limitations in the wilderness environment, particularly due to their single-dose (or at most 2-dose) design. This paper describes an austere environment technique for obtaining multiple additional doses of epinephrine from auto-injectors that have already been used as designed.

Key words: anaphylaxis, epinephrine, auto-injector, wilderness, wilderness medicine

Introduction

Anaphylaxis, defined by the Second Symposium on the Definition and Management of Anaphylaxis as “a serious allergic reaction that is rapid in onset and may cause death,”¹ is one of the most dangerous conditions that can be encountered in the wilderness. Its onset is sudden, it may occur in patients without known allergies, it has a high fatality rate if not treated, and it is responsive to only one medication (epinephrine), which in the United States and many other countries is only available by prescription.

The Wilderness Medical Society has recommended that nonmedical providers whose work requires them to deliver emergency medical care be trained to administer epinephrine.² Many authorities and studies favor auto-injectors as the preferred device for administering epinephrine.^{3–5} However, available auto-injectors have some limitations for the wilderness environment: they are expensive, bulky, temperature labile, and are designed to provide only a single dose of epinephrine (or with a few devices, 2 doses).

This paper describes an austere environment technique that salvages as many as 4 additional doses of epinephrine from a single auto-injector after the unit has been used in standard fashion.

Review of Epinephrine and Administration Devices

The accepted treatment for all forms of anaphylaxis is epinephrine. A complete review of the pharmacology and indications for epinephrine is beyond the scope of this study, but is covered well elsewhere in the medical literature.^{1–3}

Current standards dictate that epinephrine only be injected intramuscularly or, in very severe cases of anaphylactic shock, intravenously; subcutaneous epinephrine is no longer considered appropriate for any variation of anaphylaxis.^{1,2}

The response of anaphylaxis patients who successfully respond to epinephrine can take 1 of 3 forms. In the uniphasic pattern, a single episode of anaphylaxis responds to a first dose of epinephrine. In the biphasic pattern, which occurs in about a third of episodes,⁶ the patient relapses back into anaphylaxis and requires a second dose of epinephrine. In approximately 5% of biphasic cases, a protracted pattern appears, with multiple or ongoing relapses.

The most frequent tool used by non-healthcare providers to administer epinephrine is an auto-injector. The most frequently utilized auto-injector in the United States is the EpiPen (Figure 1). In some states, even certain types of Emergency Medical Service healthcare providers are only permitted to administer epinephrine by an auto-injector.⁷

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Figure 1. Post-2010 EpiPen auto-injector demonstrating new body, blue safety cap, and orange needle end. Note that this specific auto-injector is an EpiPen Jr. Epinephrine salvage techniques are the same for both EpiPen and EpiPen Jr formulations. Also note that this EpiPen has not been used (the orange shield has not extended, compared with the extended orange shield illustrated in Figure 4). The salvage techniques in this article should never be tried on an unused EpiPen (one whose orange shield is not extended), such as the one illustrated here. Photograph courtesy F. Baty.

Importantly for wilderness applications, a single dose of epinephrine is frequently not enough to manage even a single episode of anaphylaxis, as many episodes are biphasic or protracted. Because most auto-injectors are single-dose tools, the capability for multiple dosing is extremely unlikely without carrying multiple injectors. Access to multiple injectors is often unfeasible in the wilderness setting because of cost, size, or lack of

preplanning. Planners of expeditions or trips need to make a difficult decision regarding how many auto-injectors to carry, or need to use vial-based epinephrine for additional doses. Field treatment of protracted anaphylaxis in the wilderness is extremely difficult and evacuation can be complex; larger supplies of epinephrine may be required to provide subsequent dosing of epinephrine for even a single patient.⁵

In light of the frequency of biphasic or protracted patterns of anaphylaxis, EpiPens are now generally sold as a 2-pack. Even with this retail decision, the 2-pack is often separated for convenience and to facilitate storing EpiPens in several locations. As a result, often only 1 is still available when needed.

In October 2010, Dey Pharmaceuticals introduced a new auto-injector device for the EpiPen product (Figure 1). This new auto-injector substantially changed its shell, included different coloring, added a sheath protecting the user from the exposed needle after drug administration, and altered its delivery system. It remains a single-dose device.

Although the earlier style auto-injectors are being replaced in the market by the updated model, it seems reasonable and prudent to assume wilderness medicine providers practicing in remote or resource-poor environments will continue to encounter examples of the original model for some time. That is especially true given the high cost of EpiPens and studies in the medical literature showing that EpiPen epinephrine maintains 63% of its original potency 10 years after its manufacture.⁸ In addition, it appears that other countries (such as the United Kingdom) utilize devices or variations that still market the pre-2010 Dey auto-injector body, even after the 2010 transition to the new body.⁹

For the last 20 years, Wilderness Medicine Outfitters (WMO) has been teaching a method for accessing additional doses of epinephrine from EpiPens. This technique has been expanded to include the new EpiPen devices introduced in 2010, as well as adaptations for Adrenaclick and Greenstone auto-injectors. A third dose from Twinject has been taught since 2006.

The authors recognize others may have developed similar techniques during this period. In addition, some institutions, such as Roane State, have more recently developed adaptations to the technique originally taught by WMO. The technique is potentially life-saving for patients who are having a biphasic or protracted anaphylactic reaction. The WMO has on record a case of a physician who reversed a biphasic anaphylactic reaction using this technique when no further auto-injectors or other sources of epinephrine were available after the first dose of an EpiPen auto-injector. In 2012, a WMO alumnus experiencing protracted anaphylaxis

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