Epinephrine: The silver bullet for anaphylaxis

by

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Epinephrine also known as adrenaline was first synthesized by Friedrich Stolz in 1904 (Bennett, 1999). It is basically a hormone produced in our body by the medulla of the adrenal glands. It is the hormone which aids our muscles while we execute strenuous actions. It ignites the sympathetic nervous system which is responsible for the fight-or-flight response, which includes widening the pupils of the eye, mobilizing energy, ad diverting blood flow from non-essential organs to skeletal muscle (Delaware, 2006). When it is re-injected into our system it causes increase in heart rate, muscle strength, blood pressure and sugar metabolism. It’s abilities of diverting blood to tissues under stress makes it one of the most dynamically used drugs. It is used in the treatment of asthma, cardiac arrests, superficial bleeding, croup and in local anesthetics. Even though it is used in these various facets of medicine, its most important role is played in the treatment of anaphylactic shocks and hyper-allergic reactions. This paper will focus on how epinephrine helps in the treatment of anaphylaxis and review the advantages and disadvantages of different methods in which it is administered.

Anaphylaxis

Although allergies have seen a common rise in recent times, the case of anaphylactic shocks has not been under the limelight as much. “Anaphylaxis is a severe, potentially fatal, systemic allergic reaction that occurs suddenly after contact with an allergy-causing substance.” (Hugh A.
Sampson, 2006). A typical anaphylactic shock “results in smooth-muscle spasm, an increase in vascular permeability, vasodilation, myocardial depression, and reflex activation of vagal effector pathways, leading to the classic features of anaphylaxis, which include some combination of flushing, urticarial and angioedema; wheezing, hypotension, nausea, vomiting and diarrhea.” (Ellis, 2003). In layman’s language it is a condition in which a person experiences extreme body spasms and is rendered immobile after some duration of spasms. It mostly begins within seconds of the intake of an allergen. “About 25 percent of patients have a second wave of symptoms one to several hours after their initial symptoms subsided” (Education, 2013). It is one of the most common reactions for food and drug allergies. According to the Food Allergy, Research and Education website, “The U.S. Centers for Disease Control reported that food allergies result in more than 300,000 ambulatory-care visits a year among children under the age of 18. Food allergy is the leading cause of anaphylaxis outside the hospital setting.” (Education, 2013). In non-life threatening conditions, where the shock will just cause the patient to faint or have a panic attack, the treatment can be as simple as lying the patients flat or providing them with an oxygen mask. But in extreme cases where there is airway swelling, wheezing or change in skin color due to inadequate oxygenation of blood, the treatment is adrenal drugs like epinephrine (Ford, 2012).

**Epinephrine for anaphylaxis**

Epinephrine is considered the first choice of treatment for anaphylactic shocks. Most consensus guidelines for the past 30 years have held that epinephrine is the drug of choice and the first drug that should be administered in acute anaphylaxis. Some state that properly administered
epinephrine has no absolute contraindication in this clinical setting (Kemp SF, 2008). Allergy patients undergoing immunotherapy may receive an adrenaline rinse before the allergen extract is administered, thus reducing the immune response to the administered allergen (Sicherer, 2006). Anaphylactic shock is caused whenever the heart is unable to pump enough blood throughout the body due to an allergic reaction, weakening of the heart muscle, or shrinking of the veins (vasodilation). Patients who are found severely allergic are usually given proper training for situations where external help might be unavailable. The use of the auto-injector is the first option of treatment should there be an exposure to allergens in unexpected circumstances. Injection of epinephrine into the blood stream will cause an increase of blood flow throughout the body, direct blood to the tissues which are under stress and open up constricted airways. Although the relief is temporary, it keeps a severe shock under control until hospitalization is possible. In most cases, as soon as the patient realizes that they are going into anaphylactic shock, an epinephrine auto-injector is used to self-inject epinephrine intramuscularly.

**Routes of administration of epinephrine for anaphylaxis**

Although the most common method of administering epinephrine is through the auto injectors available in the market for allergic patients, there are various other ways in which it can be administered. The injector uses the intramuscular way of administration. During severe anaphylactic shocks, the Intravenous opening is preferred as the IM takes longer to reach the central circulation. Many authors caution that intravenous epinephrine is hazardous as it can produce potentially fatal complications such as intra-cerebral hemorrhage that is internal
bleedings (Ellis, 2003). There is also a possibility of administering it subcutaneously that is injecting it under the skin. But, “Subcutaneous absorption of medication, however, is highly dependent on cutaneous blood flow, which is already compromised in anaphylaxis, and can be aggravated further by epinephrine administration, given its known potent vasoconstrictor activity that is the constriction of blood vessels.” (Ellis, 2003)

There are other ways of administering which are considered unconventional. The most popular of those ways is the oral inhalation method. In this method epinephrine is taken by nebulization. There has been research going on for years regarding the use of inhalers of epinephrine during anaphylaxis. In a report during the initial stages of research, it states that epinephrine given by an inhaler has a more immediate effect on the laryngeal edema (the accumulation of fluid in cavities in the body) and the respiratory distress associated with anaphylaxis. It also states that it’s more effective than epinephrine given by any form of injection, and that an inhaler can have up to three times the shelf life of a self-injector (Ewan, 1991). But more recent studies show that inhalers might not be as effective as the injectors even though there are efforts being taken to develop the inhalers used for asthma treatment to be used for anaphylaxis treatment. It is particularly proving difficult for the epinephrine to be effective through inhalation because a number of “puffs” through the inhaler is required in order for the right dose of the drug to be administered.

Also during an anaphylactic shock it’s easier to inject the person in shock. In an experiment where epinephrine inhalers were used on allergic children, most of the children could not be given a sufficient dosage to increase their plasma epinephrine due to the “bad taste” of the drug. "Do not depend on an epinephrine metered-dose inhaler for the first aid treatment of
anaphylaxis," stresses F. Estelle R. Simons, MD. "A few puffs of epinephrine inhaled from a metered-dose inhaler might give some relief of airway obstruction; however, the amount of epinephrine absorbed into the body as a whole after inhalation is not enough to turn off the anaphylactic reaction and restore the blood pressure to normal. This is true even when the children are “coached to take a full dose [of] 10 to 20 puffs," (Simons FER, 2000). Also in the report by Anne Ellis, MD she states that “the clinical effect was less pronounced and shorter lasting than after SC administration” (Ellis, 2003).

It can be inferred from these reports that even though the inhalation method appears convenient and useful in the treatment of children, in the present stage of research, injections are prescribed for emergency and out of hospital treatment of anaphylaxis.

**Conclusion**

Research has shown that so far in the management of anaphylactic shocks epinephrine injections have been the most effective line of treatment (Kemp SF, 2008). Though majorly administered intramuscularly, intravenous administration is prescribed in the presence of resources and skills (Ellis, 2003; Placeholder1). The use of inhalers in the immediate treatment of an anaphylactic shock is not suggested until further research indicates that it is an effective method. According to Stephen Kemp in the World Allergy Journal, “Fatalities during anaphylaxis which occur outside of a medical facility usually result from delayed administration of epinephrine”. (Kemp SF, 2008). Therefore it is imperative for allergic patients to be prepared at all times and be trained in self-administration of epinephrine through auto-injectors. “Based on
available evidence, the benefit of using appropriate doses of intramuscular epinephrine in anaphylaxis far exceeds the risks” (Kemp SF, 2008)
References


   http://www.udel.edu/chem/C465/senior/fall00/Performance1/epinephrine.htm.html.


