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A SODIUM BICARBONATE-ACID POWERED BLOW-GUN SYRINGE FOR REMOTE INJECTION OF WILDLIFE

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ABSTRACT: An automatic blow-gun syringe which uses carbon dioxide gas as the injecting force is described. Upon striking the animal, carbon dioxide gas is released by the chemical combination of sodium bicarbonate (baking soda) and acid (vinegar), within the blow-gun syringe. The syringe has been used successfully with captive collared peccaries (*Dicotyles tajacu*). It has the advantages of longer stability, dependable gas expansion, reduction of drug loss, and consistent drug injection.

INTRODUCTION

When handling captive or trapped wild animals, it is always desirable to administer drugs intramuscularly for restraint or medication with a minimal amount of trauma or disturbance to the animal. The blow-gun syringe has been developed to serve this purpose and a number of commercial sets are now available (Wentges, 1975). Recently, several variations in the construction of blow-gun syringes from disposable polypropylene syringes have been described using compressed air (Bubenik and Bubenik, 1976; Warren et al., 1979), pressurized butane (Haigh and Hopf, 1976), or sliding brass weights (Brockelman and Kobayashi, 1971; Dewey and Rudnick, 1973) as the injecting force. Described herein is a modification of the basic blow-gun syringe which is capable of remotely injecting large or small volumes of solution using carbon dioxide gas as the injecting force.

MATERIALS AND METHODS

The following materials are required for the construction of a single blow-gun syringe:

(1) Two 10 ml polypropylene disposable syringes with Luer-lok tip (B-D No. 5640); Becton, Dickinson and Co., Rutherford, New Jersey 07070, USA.
(2) Sixteen-gauge disposable needle, 25 mm long, with plastic needle protector (B-D No. 5197).
(3) Two 20-gauge disposable needles, 38 mm long (B-D No. 5176).
(4) Lead fishing sinker or lead shavings.
(5) Size No. 4 cork stopper and yarn.
(6) Epoxy resin glue.
(7) Baking soda ($NaHCO_3$) and vinegar.

Preparation of the syringe

Remove the plastic handle from the withdrawn syringe plunger, leaving the rubber plunger (Fig. 1). This plunger will serve as the mobile piston for injecting the drug into the animal. Insert the mobile piston down the syringe tube. Cut off the finger-flange (Fig. 1) from the syringe body just anterior to the flange (more of the syringe tube may be removed to reduce its total weight when small amounts of drug are to be injected). Using a small razor knife, trim the inside lip of the syringe tube where the flange was removed, thus forming a slight funnel appearance (Fig. 2A). This will facilitate placement of the second rubber plunger. Obtain the plastic needle protector from the 16-gauge needle and cut at a point 18 to 20 mm posterior to the tip, leaving an elongated cup (Fig. 1). This cup will serve as the baking soda reservoir. Increase the weight of the cup by compacting small shavings of lead from a fishing sinker into the bottom of the cup, forming a layer 3 to 4 mm thick. Remove the rubber plunger from the second syringe as previously described. The plunger handle hole in this rubber plunger will serve to hold the cup containing baking soda. Using a 20-gauge needle, bore a perpendicular hole through the syringe approximately 5 mm anterior to the base so that the needle just protrudes out of the opposite wall of the syringe. Cut both ends of the fixing needle flush with the outer body of the syringe tube and file smooth (Fig. 2A). Remove this fixing needle and replace repeatedly until placement and removal becomes easy.

To prepare the needle, partially fill the bottom of the syringe Luer-lok tip with epoxy resin and screw on the 16-gauge needle. Add more epoxy resin around the base of the needle, if needed, so as to completely secure the needle. Smaller gauge needles may be used if needed. A tail-piece should be prepared from a size No. 4 cork stopper as described by Warren et al. (1979) with the following modifications. To prepare, remove the bottom one-half of a No. 4 cork stopper with a sharp razor and discard. Bore a 7 mm diameter hole (6 mm deep) in the top of the remaining cork stopper. Fill the hole with epoxy resin and stuff 30 to 40 strands (4 cm long) of yarn into the hole to form a "bushy" tail-piece. If required, cork can be trimmed from the tail-piece to accommodate the fixing needle. The tail-piece is not depicted in Figure 2A.

Operation of the syringe

Use the plastic plunger handle from one of the disposable syringes to position the mobile piston to the desired volume of drug to be injected. Fill the

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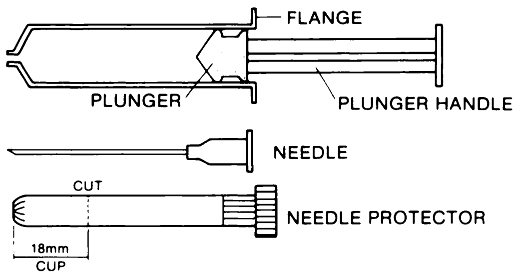

FIGURE 1. Required components of a disposable, Luer-lok tip, polypropylene syringe and needle for construction of a blow-gun syringe.

blow-gun syringe with a separate syringe containing the desired dosage using a 21-gauge needle or smaller diameter which can easily traverse the interior of the 16-gauge needle. To prevent the possibility of air embolism, advance the mobile piston slightly forward with the plastic plunger handle, removing all air remaining in the drug chamber. Invert the blow-gun syringe and place approximately 3 to 4 ml of vinegar behind the mobile piston. Fill the plastic cup with baking soda and place it 1 to 2 mm into the plunger handle hole of the second rubber plunger. Carefully place the inverted second plunger with attached cup inside the blow-gun syringe tube using a 20-gauge needle (or smaller diameter) alongside the plunger to allow for escape of compressed air during positioning (Fig. 2B). Remove the positioning needle, secure the inverted plunger with the fixing needle, and attach the tail-piece. A completed blow-gun syringe (without tail-piece) is depicted in Figure 2A.

The blow-gun syringe can be delivered using a 19 mm diameter (0.75 inch) polyvinyl chloride (PVC) water pipe or equivalent as a blow gun. Length can be varied from 1 to 2 m depending on the desired range and accuracy. Upon striking the animal, the cup containing baking soda will dislodge from the inverted rubber plunger and mix with the vinegar, producing a chemical reaction releasing carbon dioxide gas which serves as the injecting force. The gas produced pushes the mobile piston forward, forcing the drug into the animal. The reaction is fast (less than 2 sec), resulting in the quick injection of drug into the animal. Drug viscosity and volume will influ-

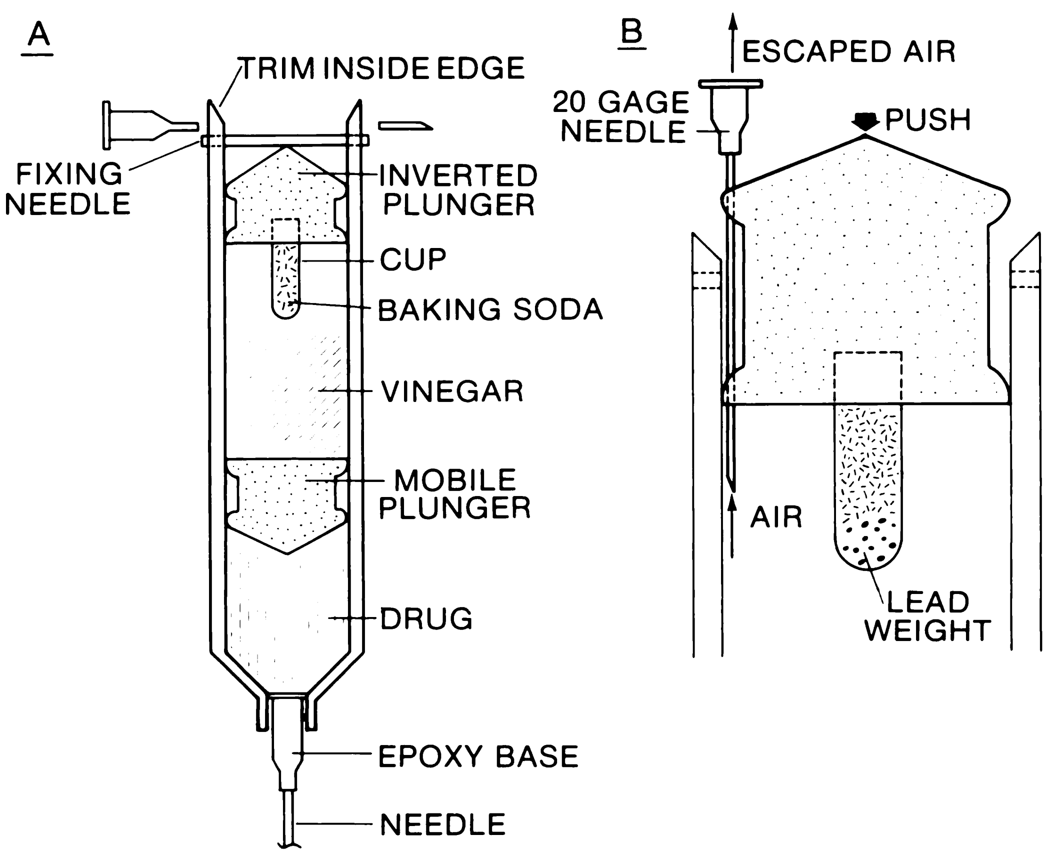

FIGURE 2. (A) Diagram of a completely assembled blow-gun syringe (without the tail-piece). (B) Diagram showing the proper procedure for positioning the inverted plunger into the syringe tube.

ence injection time. Disassembly of the dart is quick and easy. Re-insert the small gauge needle used to position the inverted plunger (Fig. 2B). This will release the pressurized gas in the syringe tube. Remove this needle and use it to push the fixing needle out (Fig. 2A). Shake the syringe tube vigorously to cause the remaining baking soda in the cup to react with the vinegar. Gas produced from this remaining reaction will force the inverted plunger out of the syringe tube. The dart will be ready for reuse after cleaning.

DISCUSSION

The modified version of the blow-gun syringe described herein possesses certain advantages over previously described syringes which use compressed air or butane as the injecting force. With compressed air or pressurized butane, it is difficult to determine exactly how much air to compress into the syringe without prematurely ejecting the drug due to overcompression, or failing to get complete injection due to undercompression. Another difficulty encountered with compressed air syringes (Bubenik and Bubenik, 1976; Warren et al., 1979) is a loss of pressurized gas from the compression chamber when removing the syringe used to inject the compressed air into the blow-gun syringe.

Prolonged delays in the delivery of prepared blow-gun syringes with compressed gas as the injecting force will often result in a slow leakage of drug from the occluded needle hole. This may result in inaccurate (partial dose) deliveries of drugs or necessitate the preparation of another syringe.

Unlike syringe designs which require that the needle tip be occluded and a lateral hole of a smaller diameter be drilled in the needle (Bubenik and Bubenik, 1976; Warren et al., 1979), this syringe uses an unmodified 16-gauge needle. This results in a lower resistance to flow and a faster injection of drug into the animal. Penetration into the animal's hide is also improved over those syringes requiring rubber needle sleeves to contain the compressed drug.

The small quantity of baking soda placed into the plastic cup in conjunction with 3 to 4 ml of vinegar results in the production of sufficient carbon dioxide gas to inject up to 6 ml of solution. However, when using larger volumes, drug injection is slowed and flight stability of the blow-gun syringe is reduced, making deliveries at long distances difficult. To insure complete injection of large amounts of drug (5–6 ml), a nylon filament embedded in epoxy resin can serve as a needle barb as described by Bubenik and Bubenik (1976). This will prevent the blowgun syringe from prematurely falling to the ground prior to complete drug injection. We have successfully delivered the syringe at distances up to 10 m with good flight stability. Under normal captive conditions, delivery distances will probably not exceed this range.

We recommend that the needle be permanently secured to the syringe tube using epoxy resin to avoid breakage during or after impact. Initial attempts at darting captive wild collared peccaries resulted in the breakage of many Luer-lok tip bases due to quick movements and thrashing by the peccaries following impact of the dart. After securing the needles to the syringe base with epoxy, the problem was eliminated. For those animals which are more sedentary after being struck with a dart, needles may not have to be secured with epoxy resin. This would lengthen the life expectancy of the blow-gun syringe, since needles could be changed when they become dull.

The syringe described in this paper can be easily assembled in under 1 min after construction of the individual parts. A number of blowgun syringes can also be prepared well in advance of delivery. The plastic cups which hold the baking soda can be reused indefinitely. The mobile piston and rubber cup holder can also be reused indefinitely; however, the life expectancy of the syringe tube will be dictated by the sharpness of the needle point and legibility of the graduated scale. Approximately 10 to 20 injections should be expected from each syringe tube before replacement becomes necessary. The blow-gun syringe provides enough versatility for use in a wide variety of experimental or treatment situations with wild animals under captive conditions. It will also perform nontraumatic remote injections with only minimal disturbance to most large animals.

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Journal of Wildlife Diseases, 19(1), 1983, p. 51

BOOK REVIEW . . .

The Coccidian Parasites (Protozoa, Apicomplexa) of Carnivores, by N. D. Levine and V. Ivens. University of Illinois Press, Champaign, Illinois, USA. 1981. 248 pp. $15.95 US.

This is a highly useful compilation of the coccidia of carnivores described up to 1978. Available information on taxonomy, life cycles, pathogenesis, immunity, cross-transmission, etc., is brought together. Because most coccidia studied are quite host-specific, it is practical to arrange the genera and species of coccidia according to their hosts. The authors aid naturalists and wildlife specialists by this and similar compendia of coccidia of rodents, ruminants, and bats. The glossary, extensive bibliography, and the 87 illustrations make this volume understandable even to the novice. In effect, there is more order and less chaos.

It is unfortunate that the introductory classification of the families, subfamilies, and genera of coccidia will be difficult to follow because it is not dichotomous and contains errors in fact. However, this has little effect on the classification of the species. The proper genus and some specific designations may be in dispute anyway (see Frenkel et al., 1979, Z. Parasitenkd. 58: 115–139). However, these questions are beyond the objectives of this highly practical volume. Most of the synonyms can be traced through the index.

The genus *Cryptosporidium* is mentioned only because of misinterpretations in the older literature; however, *C. felis* was described by M. Iseki in 1979 (Jpn. J. Parasitol. 28: 285–307). Much information is currently being developed on this potentially zoonotic genus.

Dr. Levine recently told me that he now considers the *Besnoitia* (?) sp. on page 50, described from the skin of a dog in Missouri, to be probably a *Caryospora*. This genus, with oocysts containing one sporocyst with eight sporozoites, was not defined in the book. R. S. Wacha and J. L. Christiansen described a novel feature for *Caryospora*, development of oocysts in both the gut of rattlesnakes and the connective tissue of mice serving as prey (1982, J. Protozool. 29: 272–278). The stages in mice resemble those found in the dog.

This useful volume should be available in all university libraries having natural science curricula, and it will be useful to many who deal with wildlife and diseases of carnivores.

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