CAN TASERS® DIRECTLY CAUSE VENTRICULAR FIBRILLATION?

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ABSTRACT (Updated):

Tasers® are battery powered electrical devices used by law enforcement personnel to temporarily incapacitate suspects.1 This study is part of a larger study to determine the probability of a Taser (X26 and M26) causing ventricular fibrillation (VF) in humans. We determined the distance between a Taser dart and the ventricle (dart-to-heart distance) necessary to trigger VF in an in-vivo porcine model, using 10 anesthetized pigs. All experiments were approved by the appropriate IUCUC and adhere to all applicable laws and standards of the NIH and USDA as well as the policies of the APS.

To more accurately represent the dart-to-heart distances found in a human, we reflected the skin, subcutaneous fat and muscle over the sternum and placed a thoracic dart into the third intercostal space over the right ventricle. Current flowed to a second dart 54 cm away on the abdomen. We determined that the distance between the darts makes no significant difference in the current. We confirmed dart location post mortem.

In 10 pigs, VF was triggered at a mean dart-to-heart distance of ~17 mm (0–20). We will combine these data with echocardiographic human anatomic data, police provided dart landing distribution data, and a finite element method (FEM) model of current density in the human torso to yield a probability of a Taser causing VF in a human.

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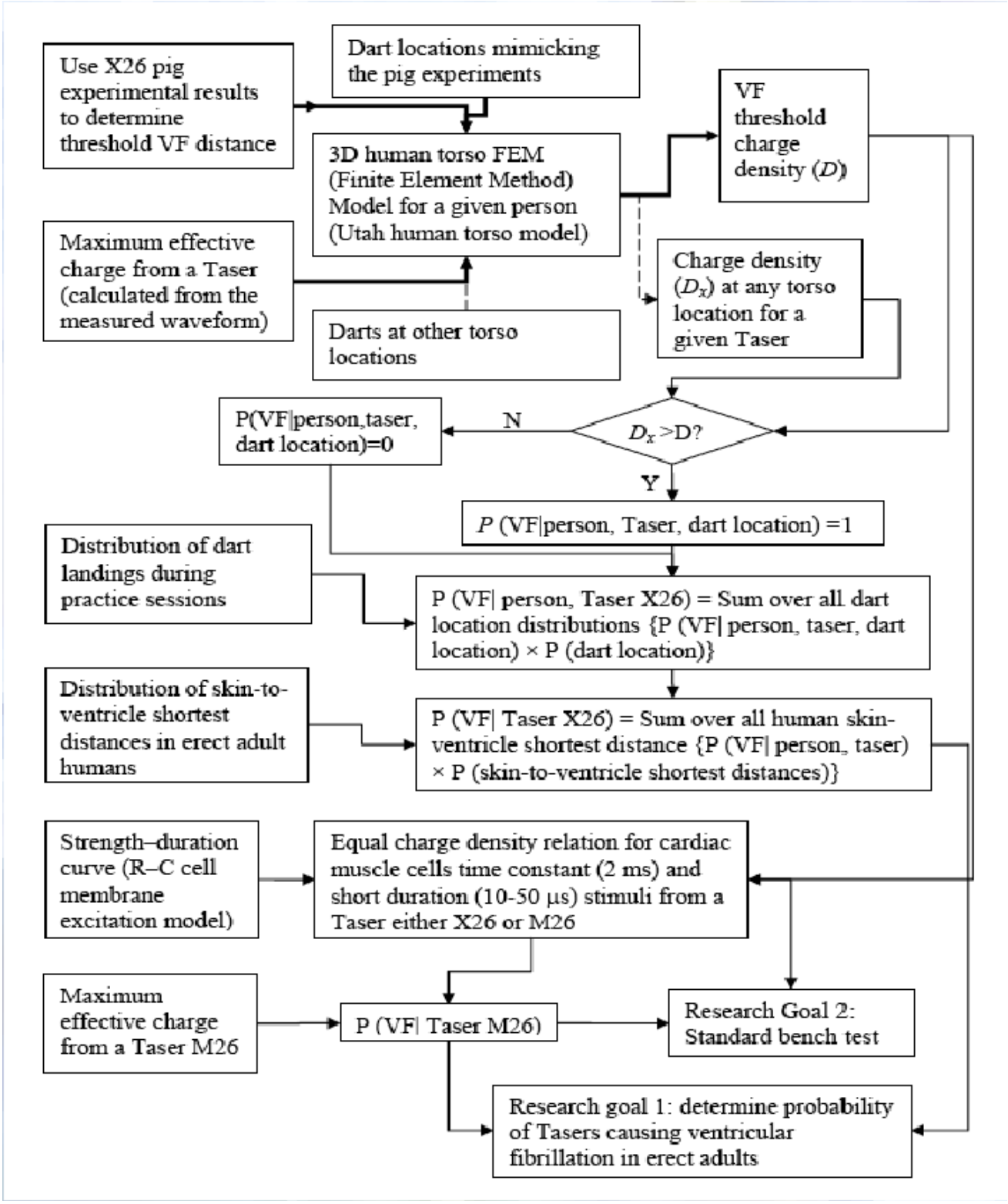


Figure 1. A flow diagram of research plan.

INTRODUCTION

Some reports suggest that electro-muscular disruption (EMDs) devices can kill. It has been postulated that EMDs may cause cardiac ventricular fibrillation (VF) leading to death. If VF occurs, the heart will stop pumping, leading to collapse and death unless medical help is provided immediately.2 There are no data from individuals who have died after being Tasered to unequivocally support or reject the hypothesis that Tasers can directly cause VF in otherwise normal persons.

To determine the probability Tasers cause VF in a human, our research has several aims:

1) Determine the dart-to-heart distance in anesthetized pigs that can cause VF.

2) Determine measurements of distribution of skin (dart) to human ventricle (heart) distances from echocardiography.

3) Determine the probability for VF from a dart landing in any area of the thorax.

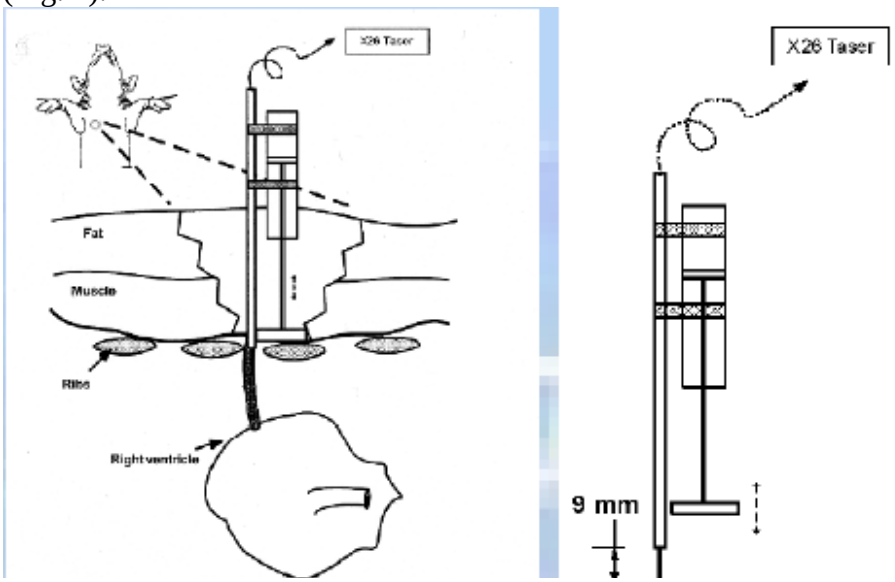
4) Make estimations of electrode dart landing distributions from provided police data.

5) Create anisotropic 3D finite element method (FEM) models for determination of sites that correspond to likelihood for causing VF. 3

This poster presents data to complete aim #1.

METHODS:

Ten 50-71 kg pigs were pre-anesthetized with Telazol®. Maintenance anesthesia was provided with isoflurane by ventilation with a Harvard fixed volume ventilator at levels to maintain a normal end-tidal CO2. An incision was made over the sternum and the skin and underlying tissues were reflected to allow direct access to the ribs and intercostal musculature. A bluntly created "virtual tunnel" was between the 3rd and 4th ribs at their junction with the sternum. A Taser dart was affixed to a piece of catheter tubing and then to a 6 cc plastic syringe used to maintain the proper dart-to-heart distance (Fig. 2).



Figures 2 & 2A.

These figures show the dart setup and how a "virtual tunnel" was created through which the stimulating electrode was placed at varying distances from the heart.

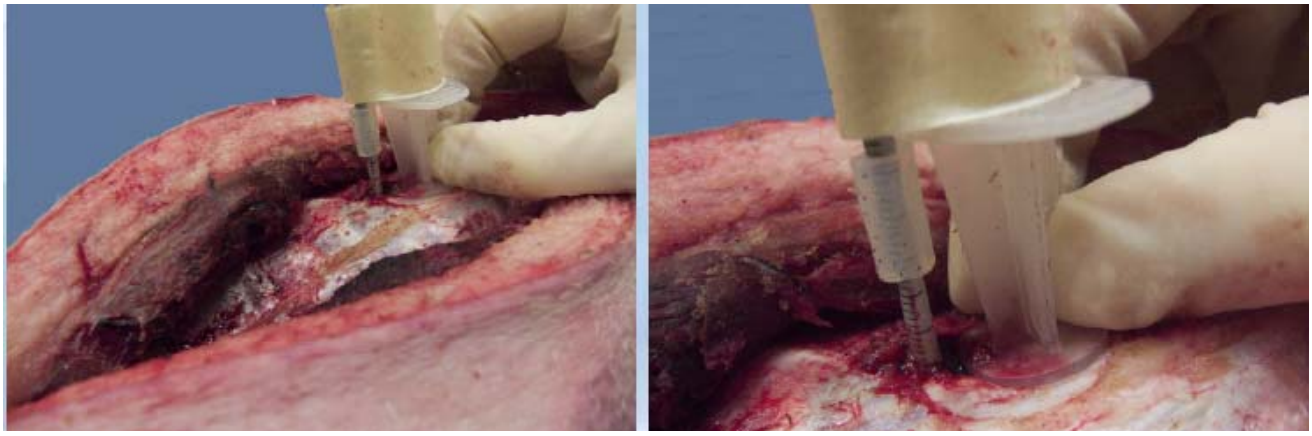


Figure 3 and 3A.
The dart apparatus is shown in the 3-4 intercostal space over the "virtual tunnel". The air gap created by the tunnel was filled with a muscle-impedance matching gel made from agar and saline.

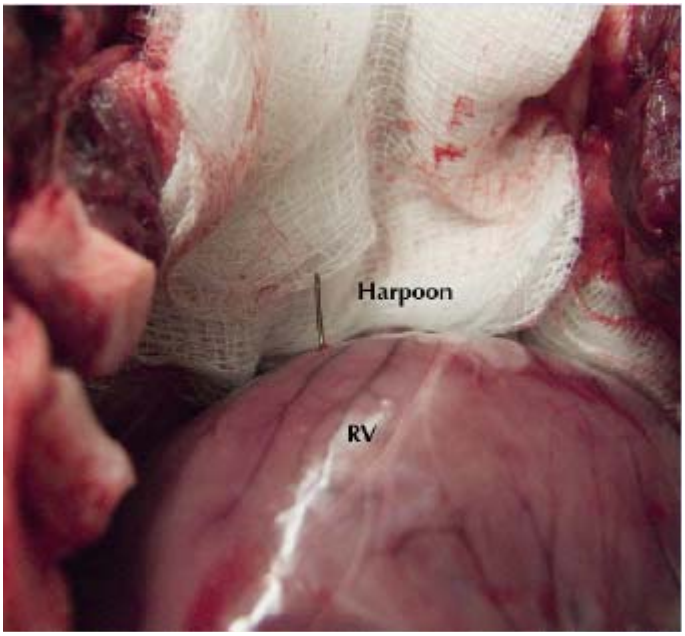


Figure 4.
At necropsy, we validated the ventricular placement of the dart with a "harpoon", a Taser dart inserted in the same tract used to determine the dartto-heart distances causing ventricular fibrillation.

Pig	First VF distance (mm)
1	18
2	0
3	14
4	20
5	18
6	20
7	18
8	18
9	20
10	24
Average	17 ± 6.48 (SD)

RESULTS

In 10 pigs, we were able to cause VF in all animals. The dart-to-heart distances for each animal are shown in Table 1. The mean dart-to heart distance for VF was 17 mm ± 6.48 (SD). The median was 18 mm.4

Table 1.
Distribution of dart-to-heart distances resulting in VF in 10 anesthetized pigs.

DISCUSSION

Previous pig studies placed the dart on the intact chest wall and the heart was then separated from the heart by a fat and muscle layer which is not as thick in the human.5 Our model will more closely provide a basis to correlate studies in the 2 species.

CONCLUSIONS

It is possible to cause ventricular fibrillation in pigs using a Taser EMD device.
From these data we can now proceed to investigate the probability of Taser induced VF in humans.

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