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An evaluation of stress responses, simplicity and cost of pinhole castration as an alternative technique for male dog sterilization

J. Okwee-Acai, B. Akunu, B. Agwai, E. Ekakoro, P. Sajjakambwe and J. Acon

Small Animal Clinic, Department of Veterinary Pharmacy, Clinical and Comparative Medicine, School of Veterinary Medicine, P. O Box 7062, Makerere University, Kampala

Abstract

Pinhole castration is a novel minimally invasive procedure for calf or kid castration. We evaluated stress, simplicity and costs of the technique in mongrel puppies (N=15). The puppies were divided into three groups: control i.e. not treated; second surgical castration and third pinhole castration. Stress was monitored by daily recording of rectal temperatures and assay of plasma cortisol concentration. Testicular histopathology was used to evaluate effectiveness of the method. Material requirements, costs and length of pinhole or surgical castration cases were compared. Surgery provoked higher febrile and cortisol responses than pinhole castration, however, the responses took longer to resolve in the pinhole treated animals. Each pinhole procedure required: xylazine 2% (0.2ml), syringe, needle and suture (10cm). Surgery meanwhile, required: xylazine 2% (0.2ml), 2 syringes, suture (15cm), razor, surgical blade, antibiotics, antiseptics, cotton and 1 ml ketamine (50mg/ml). Material cost for a surgery case was about thrice a pinhole case. Average time for pinhole was 14 minutes while surgery took about 35 minutes. We concluded that, compared to standard surgical castration, the pinhole technique is, less stressful, quicker, simpler and is a cheaper alternative for male dog sterilization. The technique should, therefore, be popularized in veterinary schools and practices for wider application.

Keywords: Pinhole Castration, Stress, Simplicity, Costs, Puppies

Introduction

Castration is the commonest operative procedure routinely performed on food and companion animals (Ames, 1988; Wu, 1988). To date, castration is almost the sole method for control of pet overpopulation globally (Brenda, 2002). Surgical removal of the testes is conventionally, the method of choice for castration in dogs (Brenda, 2002). Unfortunately, surgical castration is associated with appreciable postoperative pain and sometimes life threatening complications (Stafford et al., 2002). Surgery is also generally considered very expensive to an average animal owner (Brenda, 2002; Leyland and Catley, 2002).

To minimize pain, postoperative complications and cost associated with conventional surgical castration, other less invasive approaches have been tried with varying degrees of success. These include immunocastration, chemical castration and more recently, *in situ* spermatic cord ligation (Dube et al., 1987; Fordyce et al., 1989; Jana et al., 2005; Ponvijay, 2007).

In situ spermatic cord ligation (pinhole castration) has been described as a novel minimally invasive technique for calf and kid goat sterilization (Ponvijay, 2007, Okwee-Acai et al., 2008a). Because the spermatic cord is ligated without cutting or involving the scrotum, intergumentary sensory nerves are avoided. The technique hence, provokes less pain or stress to the animal compared to conventional castration techniques such as the burdizzo, elastrator or the standard knife castration (Okwee-Acai et al., 2008a). Though previously applied in dogs, there is no published systematic report about application of the method, the clinical responses and cost implications in dogs of any age. We hence, evaluated the stress

Corresponding author: J. Okwee-Acai, Small Animal Clinic, Department of Veterinary Pharmacy, Clinical and Comparative Medicine, School of Veterinary Medicine, P. O Box 7062, Makerere University, Kampala

responses, effectiveness and associated costs of the method in mongrel puppies.

Materials and Methods

Healthy Mongrel puppies (N=15, aged 3-5 months) were used in the experiment. These were homeless puppies rescued from the streets of Kampala. The puppies were housed individually in a kennel at the School of Veterinary Medicine, Makerere University. Every morning, each puppy was fed a liter of fresh cow milk mixed in boiled corn flour. In the evening, each puppy received half a kilogram of boiled beef in corn flour. Water was provided *ad libitum*. The puppies were treated with a pyrentel embonate (143mg)-praziquantel (50mg)-oxantel (543mg) combination (Canex 4®, Pfizer Laboratories (Pty) Ltd., South Africa) *per os* as a broad prophylactic measure against worms two weeks prior to the experiments. Ecto-parasites were controlled using Fipronil (FRONTLINR®, Merial, South Africa) spray. The puppies underwent pre-operative clinical examination including careful palpation of the scrotum to confirm presence of two well descended testes.

The puppies were randomly divided into three groups (5 puppies per group) and subjected to the following experimental treatments: (1) no treatment (control); (2) pinhole castration and (3) standard surgical/knife castration. Pinhole castration was performed in accordance with the procedure described by Ponvijay (2007). The puppies were sedated using xylazine (Bomazine®, BOMAC Laboratories, New Zealand) at a dose rate of 0.5mg/kg body weight before the pinhole procedure. Puppies in group three were subjected to the conventional knife castration through a pre-scrotal midline incision (Anderson and Smith, 2003). All consumable materials used in each pinhole and knife castration case were listed and average cost in US dollars computed. The length of time spent on each case was also noted.

Rectal temperatures of puppies in all groups were taken twice daily for 7 days after treatments. About 2ml of blood was collected from each puppy every 5 days for assay of plasma cortisol. Cortisol concentration (nmol/ml) was determined using electrochemilumine-scence immuno-assay (ECLIA). An automated ECLIA analyser (Cobas e411®, Roche, USA) was used in accordance with manufacturer instructions. After 21 days following treatments, the testes were recovered from each puppy using the standard knife/surgical castration (Anderson and Smith, 2003) for histopathology (Bradbury and Rae, 1996).

Statistical analysis

Data was validated and entered into Excel spreadsheets. Descriptive (summary) statistics on the data were generated using the frequency procedures of Excel.

Results

Each case of pinhole castration required only xylazine, an 18 gauge hypodermic needle and a strand of suture material. Meanwhile, consumable materials needed for the standard knife castration were xylazine, ketamine, antibiotic, antiseptic, razor blade, surgical blade, syringe, cotton and suture (Fig. 1). The average cost (5.76 US dollars) of each standard surgical case was nearly four times higher than pinhole (1.5 US dollars).

The average time to undertake a case of standard knife castration (35 minutes) was thrice longer than for pinhole castration (14 minutes). This is illustrated in Table 1.

Relative to the control group, puppies that underwent pinhole and surgical castration showed a marked rise in mean rectal temperature (from 38.5 to 39.6^{o}C) by day 2 after treatment (Fig. 2). For the surgery group, mean rectal temperature sharply dropped to near pre-treatment values (38.5^{o}C) by the 4th day. Mean rectal temperature for the pinhole group however, remained high, returning to pre-treatment values after the 6th day following treatment.

Throughout the experiment, cortisol concentration remained relatively constant (about 4.52 nmol/ml) in the control puppies. By day 5 after treatments, mean

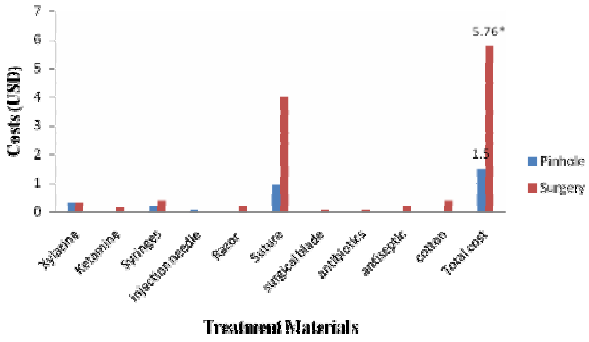

Fig. 1: Material costs for pinhole and surgical castration cases

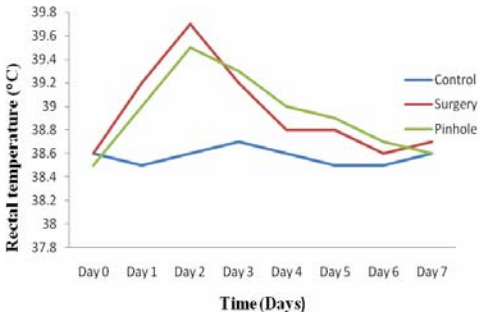

Fig. 2: Changes in rectal temperatures following surgery and pinhole treatments

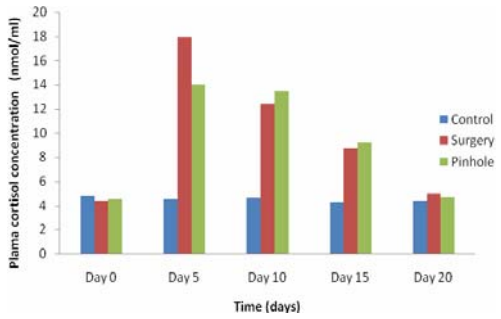

Fig. 3: Changes in plasma cortisol concentrations after surgery and pinhole treatments

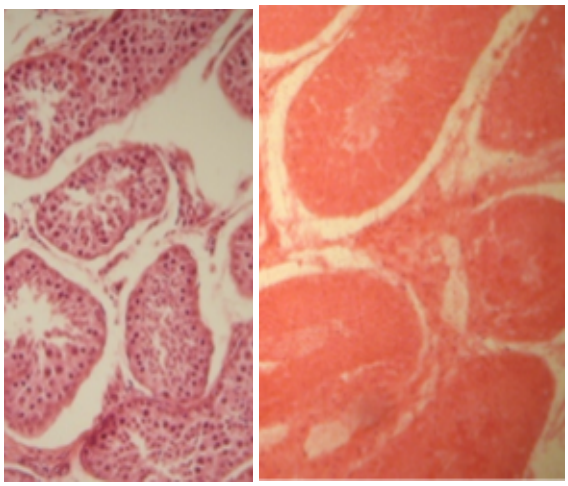

Fig. 4: Photomicrographs showing coagulatve necrosis of seminiferous tubules following pinhole castration.

cortisol levels were 18 nmol/ml and 14 nmol/ml in the surgery and pinhole groups, respectively. Cortisol levels in the treated animals had reduced by the 10th; although it remained relatively higher in the pinhole (13.5 nmol/ml) than the surgery (12 nmol/ml) group (Fig. 3).

By day 21, all *in situ* ligated testes were grossly atrophied and showed complete coagulative necrosis typical of ischemia (Fig. 4).

Discussion

After a mild sedation, only a needle and a suture strand were needed to perform pinhole castration. Meanwhile, surgery required general anesthesia, antiseptics, razor, surgical blade, syringe, cotton and a syringe, hence, making the cost of surgery four times higher than the pinhole method. This lends a lot of credence to the current study for prohibitive cost of surgical castration and associated welfare concerns have been highly touted as limiting its application in sterilization of both food and companion animals (Fordyce et al., 1989; Brenda, 2002; Okwee-Acai et al., 2008b).

It is worth noting that in this study that we estimated the cost of materials used only. However, in a practice based on setting the costs, especially for a standard surgical castration case could be a lot higher if the length of time per procedure and the effort (labour) put into it is taken into account. The current study demonstrated that performing a standard surgical castration procedure may take thrice longer than a pinhole procedure. This supports the widely held concern that surgical castration is tedious; requiring a lot of skills/experience and is time consuming (Jana et al., 2005). It also agrees with Ponvijay (2007) that the pinhole technique is simple because the spermatic cord is easily accessible and can be manipulated within the scrotal skin; and is also very easy to ligate in situ.

In this study, both surgery and pinhole castrated puppies showed elevation in mean rectal temperatures within 24-48 hours after treatments. The surge in rectal temperature was however higher for surgery than the pinhole castration. A similar observation was made by Okwee-Acai et al. (2008a) in an evaluation of pinhole castration in goats. They concluded that being an invasive procedure, surgery appear to trigger a more severe inflammatory response that triggers a correspondingly higher febrile status than pinhole castration.

We however observed a more drastic decline in mean rectal temperature from peak value in the surgery group compared to the pinhole-treatment group. This implies that dogs castrated by surgery recover faster than their pinhole treated counterparts. This finding is quite similar to what has been observed in bull calves and goats castrated by intra-testicular injection of lactic acid, where healing time for the lactic acid treated animals were almost twice longer than those surgically castrated (Fordyce et al., 1989; Okwee-Acai et al., 2008b). A plausible explanation to this is that a clean surgical incision heals very fast by primary intention (Harari, 2004). On the other hand, chemical and pinhole castration methods cause coagulative necrosis of the testes that take long to resolve. Such resolution is accompanied by fibrosis akin to secondary intention healing (Jana et al., 2005; Okwee-Acai et al., 2008b).

Plasma cortisol assay showed that both the surgical and pinhole methods elicited substantial cortisol responses. Drastic increase in plasma cortisol concentration is a measure of stress; often associated with pain (Stafford et al., 2002). Surgery however elicited a relatively higher cortisol response than pinhole technique. This augments the assertion that pinhole castration is a novel, minimally invasive and hence, a less stressful technique that should be readily adopted as an alternative to the standard surgical technique of castration (Ponvijay, 2007). We, however, observed that, just like mean rectal temperatures, cortisol values for the surgically treated puppies

Table 1: Length of time required to perform pinhole and surgical castration treatments

Treatment	Length of time per case (minutes)					Average time (minutes)
	Case 1	Case 2	Case 3	Case 4	Case 5	
Pinhole	15	14	15	14	14	14.4
Surgery	37	36	34	35	34	35.2

returned to normal (control values) and faster than their pinhole treated counter parts. This implies that, though less stressed, animals subjected to pinhole castration take longer recuperating than those surgically castrated.

All ligated testes were atrophied and showed evidence of coagulative necrosis. These findings have been similarly reported in previous studies of pinhole castration in bull calves and goats (Ponvijey, 2007; Okwee-Acai et al., 2008a). Testicular atrophy is typical of conditions that lead to degeneration or dysfunction of the testes (Awal et al., 2004). Coagulative necrosis resulting from acute ischemia is responsible for irreversible testicular dysfunction (Bergh et al., 2001). Experimental torsion and ligation of the spermatic cord in rats showed that acute testicular ischemia for as little as five minutes is sufficient to produce irreversible damage to the germinal epithelium through apoptosis (Turner and Brown, 1993; Bergh et al., 2001). It is hence, probable that removal of the *in situ* ligature within 12-48 hours could still lead to permanent sterility even in larger animals. This needs to be experimented.

It was concluded from our results that, compared to standard surgical castration, the pinhole technique is an effective, quicker, simpler and cheaper alternative for male dog sterilization. The technique should therefore be popularized in veterinary schools and practices for wider application.

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