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Documented and anecdotal effects of certain pharmaceutical agents used to enhance semen quality in the dog

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Abstract

Prostaglandin $F_{2\alpha}$, gonadotropin releasing hormone, cabergoline and various nutriceuticals have all been recommended by reproductive practitioners to improve sperm motility and morphology and to increase sperm numbers in the ejaculate of the dog. Increasing sperm quantity and quality in the canine ejaculate would benefit all assisted reproductive techniques used in this species. The purpose of this manuscript is to review the documented and anecdotal effects of certain pharmaceuticals used to enhance semen quality in the dog.

Keywords: Semen quality; Semen collection; Dog; Canine

1. Introduction

The demand for canine reproductive services including semen cryopreservation, chilled semen shipment and artificial insemination appears to by increasing, based on the number of litters reported by the American Kennel Club to result from such techniques. Coincidental with this increased demand is the increase in number of dogs with poor semen quality that are evaluated by practitioners. When presented with a patient with oligozoospermia, asthenozoospermia or teratozoospermia, practitioners are frequently asked by their clients what they can do to improve the dog's semen quality. Improvement in the number and quality of sperm obtained during semen collection would benefit most areas of assisted reproduction. Multiple therapeutic regimes are routinely recommended but are not substantiated in the literature. This manuscript describes the documented and anecdotal effects of a few of the more commonly recommended pharmaceuticals used to enhance semen characteristics in the dog.

2. Prostaglandin $F_{2\alpha}$

2.1. Sexual preparation

The use of sexual preparation in conjunction with semen collection has been shown to optimize the number of sperm in the ejaculate of the rabbit and bull [1–3]. In the dog, sexual preparation includes the use of a bitch in estrus or the use of pheromones in the form of vaginal discharge from a bitch in estrus (preserved on bedding or other absorbent materials). Unfortunately, the availability of teaser bitches and pheromones is frequently limited and clinicians are therefore forced to collect semen from dogs without sexual preparation. Collections obtained in this manner often have a decreased volume and total sperm number compared to collections obtained with sexual preparation. This decrease in sperm cell quantity without sexual preparation is seen in multiple species including the rabbit and bull [2,3].

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Table 1
Summary of effects of prostaglandin $F_{2\alpha}$ administration on ejaculate characteristics in multiple species

Species	Dose (mg)	Route	Treatment to collection interval	Sperm/ ejaculate	Sperm concentration	Semen volume	Author(s)
Buffalo	0.5–2.0	IM	10 min	↑	Unchanged	↑	Ibrahim [4]
Bull	40 and 2 × 40	SC	1 h; 1 and 2 h	↑	↑	Unchanged	Marshall and Hafs [6]
Rabbit	5	SC	2 and 4 h	↑	↑	Unchanged	Reichard et al. [8]
Stallion	10	IM	1 h	↑	↑ (not significant)	↑ (not significant)	Cornwell et al. [9]
Ram	1 and 2	IM	30 min	↑	Unchanged	↑	Mekonnen et al. [7]
Rabbit	2.5	SC	2 h	↑	↑	Unchanged	Hafs et al. [5]
Bull	40 or 80	IM	30 min	↑	↑	Unchanged	Hafs et al. [5]

To attempt to counter the decrease in sperm numbers seen when collecting semen without sexual preparation, multiple researchers have evaluated the effect of $PGF_{2\alpha}$ administration prior to semen collection. Administration of $PGF_{2\alpha}$ increased sperm numbers in the ejaculate of multiple species as shown in Table 1 [4–9]. Total sperm numbers are increased as a function of greater sperm concentration, ejaculate volume, or both.

2.2. Mechanism of action

The mechanism behind the increase in ejaculate volume and/or concentration in response to $PGF_{2\alpha}$ is not fully understood. It is thought that $PGF_{2\alpha}$ acts directly on the contractile tissues of the testicular capsule and epididymis, causing an increased rate of sperm passage from the epididymis to the deferent ducts. Prostaglandin receptors in the epididymis are most plentiful in the distal segments, making these areas more sensitive to changes in $PGF_{2\alpha}$ concentration [10]. Therefore, it is reasonable to speculate that endogenous prostaglandins exert more of an effect in the cauda epididymis, the portion of the epididymis that acts as a site of storage for mature sperm. When the cauda epididymis contracts in response to $PGF_{2\alpha}$, mature sperm are moved into the deferent duct where they are available for ejaculation.

There is convincing in vivo support for the effect of $PGF_{2\alpha}$ on epididymal contractility. In a series of experiments, Hafs et al. used anesthetized rabbits to demonstrate that exogenous $PGF_{2\alpha}$ significantly increased the movement of sperm from the epididymis to the deferent duct [11]. In the first experiment, one testicle and associated epididymis and deferent duct were removed. The second testicle, epididymis and deferent duct were removed 10, 30 or 60 min after injection of 5 mg $PGF_{2\alpha}$ into the tunica vaginalis surrounding the remaining testicle. The second experiment was similar to the first, except that $PGF_{2\alpha}$ was administered subcutaneously (SC) 10 or 30 min prior to removal of the testicle, epididymis and deferent duct. The number of sperm in the deferent duct, cauda epididymis and corpus-caput epididymis were determined. Following peritesticular $PGF_{2\alpha}$ injection, the number of sperm in the deferent duct was more than twice that of the controls. Thirty minutes after SC injection of $PGF_{2\alpha}$, the number of sperm in the deferent duct was 2.5-fold greater than that of controls. In a non-anesthetized study, rabbits were given 10 mg $PGF_{2\alpha}$ SC three times at 20-min intervals. The rabbits were then killed and the distribution of sperm in the epididymis and deferent was determined. As with the anesthetized rabbits, the number of sperm in the deferent duct of treated rabbits was almost three-fold greater than saline-treated controls.

In addition to the effects that $PGF_{2\alpha}$ has on smooth muscle of the epididymis, the testicular capsule also contracts in response to $PGF_{2\alpha}$ [12–14]. The dog is known to have a prominent supply of contractile cells in the testicular capsule [15,16]. It is likely that contraction of the testicular capsule in response to $PGF_{2\alpha}$ plays a role in increasing the number of sperm available for ejaculation.

The use of $PGF_{2\alpha}$ prior to collection may optimize the number of sperm in a collection by enhancing sperm movement from the epididymis to the deferent duct where they are available for ejaculation. The dosages and intervals from $PGF_{2\alpha}$ administration to collection have varied widely among reports. Response to treatment has also varied among reports and with collection method.

2.3. Effects on libido

In addition to increased sperm numbers in the ejaculate following $PGF_{2\alpha}$ administration, some researchers noted that treated animals had more libido at the time of semen collection [7,11,17]. Libido was assessed using quantifiable observations, such as time to initial false mount and time to ejaculation in buffalo, and time for collection in rams.