The Application of the Caprine Model within *in Vivo* Orthopaedic Research

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INTRODUCTION: The goat is a reliable, effective, and translationally relevant preclinical model for investigating a large variety of orthopaedic-related procedures. While these advantages have are the likely cause of the caprine model's increased prevalence within musculoskeletal research, there remains a paucity of literature that describes the how to effectively procure, handle, and care for the model throughout the *in vivo* experimentation. Thus, the purpose of this study was to present a comprehensive guide, from sourcing to sacrifice, for the appropriate use of the caprine body as an orthopaedic model during all three phases (preoperative, operative, postoperative) of *in vivo* surgical research.

METHODS: The foundation for this review was developed from an IACUC-approved research protocol that involved, housing, handling, medicating, and performing surgery on 24 nonpregnant female Spanish goats. The animal models were housed indoors, and after an acclimation period of one week, underwent survival surgery on the left hindlimb. After a recovery phase of either 3 or 6 months, models underwent a subsequent necropsy procedure that terminated with euthanasia and excision of the affected joint for histological processing.

RESULTS SECTION: Models had a mean preoperative weight of 41.0 (38.2–43.7) kg, and serology consisted of assaying serum specimens for antibodies against Coxiella burneti (Q-fever), caprine arthritis encephalitis virus (CAEV), and Brucella abortus. All models underwent a week-long acclimation period followed, a standardized sterilization process, and preoperative anteroposterior pelvic radiographs. Models were sedated for surgery with telazol (5 mg/kg) and intraoperative vitals monitored consisted of heart rate (HR), respiratory rate (RR), saturation of peripheral oxygen (SpO^2), mean arterial pressure (MAP), systolic blood pressure (SBP), and diastolic blood pressure (DBP). Following survival surgery, goats were weight-bearing and dosed with postoperative analgesics (buprenorphine 0.01 mg/kg IM; flunixin meglumine 1.1 mg/kg IM) to mitigate pain and encourage an uninterrupted gait pattern.

DISCUSSION: The versatility and prevalence of the goat in orthopaedic research remains unmatched by a preclinical guide for how to appropriately use the model. The findings of the present study, therefore, help to provide insight into a standardized application of the caprine model that is effective, reproducible and ethically considerate.

SIGNIFICANCE/CLINICAL RELEVANCE: As more orthopaedic-driven investigations seek out the utility of the caprine body for its translational relevance to the human musculoskeletal system, it becomes increasingly necessary to standardize the way in which the model is used, both functionally and humanely.

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IMAGES AND TABLES:

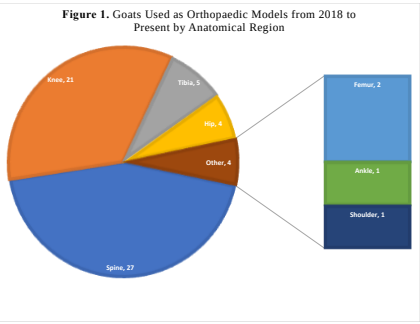

Figure 1. Goats Used as Orthopaedic Models from 2018 to Present by Anatomical Region

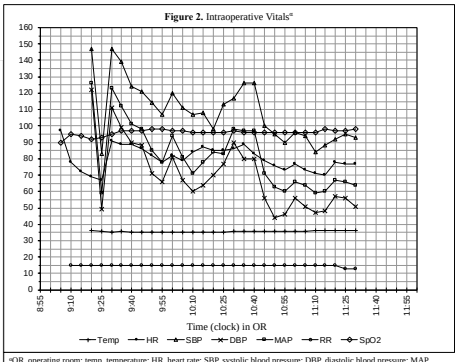

Figure 2. Intraoperative Vitals[α]

[α]OR, operating room; temp, temperature; HR, heart rate; SBP, systolic blood pressure; DBP, diastolic blood pressure; MAP, mean arterial pressure; RR, respiratory rate; SpO2, saturation of peripheral oxygen

Table 1. Medicating The Model Before, During, and After Surgery[α]

Time with Regard to Surgery	Drug	Class	Dose	Route
Preoperative Medications	Telazol	Anesthetic	5mg/kg	IM
Intraoperative Medications	Cefazolin	Antibiotic	20mg/kg	IV
	Vecuronium	Nondepolarizing Neuromuscular Blocking Agent	0.004mg/kg	IV
	Buprenorphine	Narcotic Analgesic	0.01mg/kg	IM
	Flunixin	Nonsteroidal Anti-Inflammatory Analgesic	2.2mg/kg	IM
Postoperative Medications	Buprenorphine	Narcotic Analgesic	0.01mg/kg	IM
	Flunixin	Nonsteroidal Anti-Inflammatory Analgesic	1.1mg/kg	IM

[α]IV, intravenous; IM, intramuscular; mg, milligram; kg, kilogram