



## CALCIUM CHLORIDE NONSURGICAL STERILIZATION: BIBLIOGRAPHY

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### KEY STUDIES

- Leoci, R et al. 2014: “A dose-finding, long-term study on the use of calcium chloride in saline solution as a method of nonsurgical sterilization in dogs: evaluation of the most effective concentration with the lowest risk” - 40 dogs plus controls. [Acta Vet Scand](#)
- Leoci, R et al. 2014: “Alcohol diluent provides the optimal formulation for calcium chloride non-surgical sterilization in dogs” - 42 dogs plus controls. [Acta Vet Scand](#)

*Long-term, 12 month studies to determine the best CaCl<sub>2</sub> dosage and solution for dog sterilization. The first study compared different concentrations of CaCl<sub>2</sub> (10%-60%). A 20% concentration was determined to be most effective with the fewest side effects. The second study compared a 20% concentration of CaCl in saline, alcohol or lidocaine. Alcohol was determined to be the most effective solvent. Calcium chloride in alcohol resulted in complete azoospermia over the entire 12-month study, while CaCl in lidocaine was 100% effective for 6 months but saw return of a few sperm in 4 of 21 dogs by 12 months. Testosterone levels remained low for the alcohol solution, but began to increase by the end of the study for the lidocaine solution. Sexual behavior disappeared with CaCl treatment. Conclusion: 20% CaCl in alcohol is the most effective formulation for permanent effect*

### PUBLISHED LITERATURE

(first two authors listed per publication)

- Koger, 1977 (USA): Calcium Chloride, Practical Necrotizing Agent. [Am Soc An Sci](#) Ann Mtg, #451, p 180. The very first known publication on calcium chloride, explaining how the Washington State University researchers got the idea, the results of their first pilot studies, and why they found an alcohol base to be better than a water/saline base.
- Koger, 1977 (USA): “Calcium Chloride, Practical Necrotizing Agent.” [Bovine Practitioner](#). Further details on the genesis of the idea and pilot studies in 45 bull calves.
- Bowman and Koger, 1978 (USA): “Blockage of sperm transport using intraepididymal calcium chloride injections in rams.” [Journal of Animal Science](#). Intrepididymal injections (as opposed to into the testicular tissue) resulted in sterilization without hormonal neuter.
- Koger, 1978 (USA): “Calcium chloride castration.” [Modern Veterinary Practice](#). First report of pilot results in dogs (in addition to more bull calves); photos. Fascinating, plain-English report of pilot studies. [Key Pilot Study](#)
- Samanta and Jana, 1998-2007 (India):
  - Published a number of dose-finding studies with extensive physiological measurements, including: testosterone, cortisol, LH/FSH, testicular function measurements, blood values and histology. Results support use of CaCl<sub>2</sub> for chemical sterilization.

- 1998 – “Chemosterilization of stray dogs” - 48 dogs plus controls [Indian J Anim Health](#)  
[First controlled study of CaCl](#)
  - 2002 – “Dose-dependent response to an intratesticular injection of calcium chloride for induction of chemosterilization in adult albino rats” - 48 rats plus controls [Veterinary Res Comm](#)
  - 2005 – “Evaluation of single intratesticular injection of calcium chloride for nonsurgical sterilization of male Black Bengal goats (*Capra hircus*): a dose-dependent study” - 18 goats plus controls [Animal Reproduction Science](#)
  - 2006 – “Evaluation of single intratesticular injection of calcium chloride for nonsurgical sterilization in adult albino rats” - 48 rats plus controls [Contraception](#)
  - 2007 – “Sterilization of male stray dogs with a single intratesticular injection of calcium chloride: a dose-dependent study” - 24 dogs plus controls [Contraception](#).
- Canpolat and Bulut, 2006 (Turkey): “An evaluation of the out come [*sic*] of bull castration by intra-testicular injection of ethanol and calcium chloride.” Poor results (scrotal abscesses and longer-lasting scrotal swelling, with inconsistent necrosis and minimal impact on serum testosterone) of calcium chloride in aqueous solution (water or saline, not clear which) in 12 young bulls, in fact poorer than ethanol alone. Includes photos. Concludes that calcium chloride injection in saline is not effective in bulls.
- Baran and Ozdas, 2010 (Turkey): “Pilot Study: Intratesticular injection induces sterility in male cats.” Poster at the Alliance for Contraception in Cats & Dogs 4th International Symposium on Non-Surgical Contraceptive Methods of Pet Population Control, April 8-10, 2010, in Dallas, Texas. Good safety and efficacy results at higher doses in 3 cats. [ACC&D Link](#) or [alternate link](#)
- Jana and Samanta, 2010 (India): “History of calcium chloride injectable sterilization in male dogs and first report of use in cats.” Poster at the Alliance for Contraception in Cats & Dogs 4th International Symposium on Non-Surgical Contraceptive Methods of Pet Population Control, April 8-10, 2010, in Dallas, Texas. In 6 cats each at 5%, 10%, or 20% CaCl in lidocaine, 20% was determined to be the optimal concentration, and had effects on behavior. [Poster](#)
- Jana and Samanta, 2011 (India): “Clinical evaluation of non-surgical sterilization of male cats with single intra-testicular injection of calcium chloride” - 18 cats plus controls (same study as poster above). Dose-finding, testosterone, cortisol, testicular function measures; castration and histology at 2 months. 20% CaCl optimal in cats. [BCM Vet Research](#) **Key cat study**
- Paranzini and Souza, 2017 (Brazil) – “Effects of chemical castration using 20% CaCl<sub>2</sub> with 0.5% DMSO in tomcats: Evaluation of inflammatory reaction by infrared thermography and effectiveness of treatment” - 6 cats: 20% CaCl<sub>2</sub> with 0.5% DMSO, 80-day study using infrared thermography to evaluate inflammation. Method was effective with minimal adverse reactions. [Theriogenology](#)

## **TESTOSTERONE AND BEHAVIOR**

Representative publications on castration and behavior (the summary: reducing testosterone is more effective at eliminating some behaviors than others). [Hopkins 1976 dogs](#), [Knol 1989](#), [Neilson 1997 dogs](#), [Farhoody 2018](#)

## **REVIEW DOCUMENTS**

- **Full background information and overview videos** available at Parsemus Foundation's website, <https://www.parsemus.org/projects/calcium-chloride/>
- **Independent literature review** available from the Alliance for Contraception in Cats & Dogs, [http://www.acc-d.org/docs/default-source/Research-and-Innovation/accd\\_cacl2review-nov2014.pdf?sfvrsn=2](http://www.acc-d.org/docs/default-source/Research-and-Innovation/accd_cacl2review-nov2014.pdf?sfvrsn=2)
- **Important tips and guidance for real-world use** available at [SpayFIRST!](http://www.spayfirst.org/programs/non-surgical-sterilization/)

### **Parsemus Foundation**

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