Effects of lidocaine on fresh equine sperm membrane permeability, motility, and morphology parameters 0 to 48 hours after collection


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Lidocaine is commonly used for castration in stallions. Local anesthesia facilitates maintenance of a lighter plane of anesthesia and less resistance to mobilization of the testes during surgery. When horses are castrated with subsequent epididymal flush, surgeons are generally advised not to use lidocaine in order to prevent any negative affects local anesthetics may have on spermatozoa and subsequent fertility. However, to date there are no reports evaluating potential detrimental effects lidocaine may have on equine spermatozoa. The aim of this study was to determine effects of different concentrations of lidocaine on sperm morphology and motility after mixing fresh equine spermatozoa with lidocaine. We hypothesized that exposure to different concentrations of lidocaine would decrease total motility (TM), progressive motility (PM), normal morphology (M) and membrane permeability (MP) of the spermatozoa. Semen was collected at two time points from four fertile stallions; samples with TM, PM, and M greater than 80%, 70%, and 70%, respectively, were included in the study. The semen was diluted with INRA96 (IMV technologies, L’Aogle, France) semen extender to a final concentration of 30 x 10⁶ sperm/ml, and was mixed with 2% lidocaine to final concentrations of 1 μg/ml, 10 μg/ml, 100 μg/ml, 1,000 μg/ml and 10,000 μg/ml. A sample without lidocaine served as the control. Motility was assessed with a computer assisted sperm analysis system (Spermvision MOFA Global, Verona, WI). Sperm concentration and MP were measured with a NucleoCounter® SP-100™ (Chemometec, Allerod, Denmark). Morphology was assessed under 1000x phase contrast microscope using a wet mount preparation of semen fixed in buffered formalin. Total motility and PM were compared to the control sample at 10 min, 2 h, 4 h, 6 h, 24 h, and 48 h. Normal morphology and MP were assessed before mixing the spermatozoa with lidocaine and at 48 h. Statistical analysis was performed using mixed effects analysis of variance, with horse as the random effect, and ejaculation (first or second), concentration of lidocaine, and time as categorical fixed effects (Stata/IC 13.1, StataCorp LP, College Station, TX). Models with interactions were compared to main effects models using likelihood ratio tests. There was no significant difference for TM (p=0.46 and p=0.65) and PM (p=0.16 and p=0.78) between the control and the lower concentrations of lidocaine 1 μg/ml and 10 μg/ml, respectively, when controlling for time. There were significant decreases in TM and PM at higher concentrations of 100 μg/ml (p=0.034 and p<0.001, respectively), 1,000 μg/ml (p < 0.001), and 10,000 μg/ml (p < 0.001) compared to the control (no lidocaine). Addition of interactions between concentration and time did not significantly improve model fit. Normal morphology did not change negatively over time at any concentration. Membrane permeability decreased significantly at 10,000 μg/ml (p < 0.001). In conclusion, low concentrations of lidocaine (1 μg/ml to 10 μg/ml) did not significantly affect the parameters TM, PM, or MP when it was mixed with freshly collected semen and stored for 48 hours. Lidocaine concentrations of 100 μg/ml to 10,000 μg/ml decreased TM and PM. MP was negatively affected only at concentration 10,000 μg/ml.

Keywords: Lidocaine toxicity, sperm, stallion, lidocaine