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Original Research

Palatability Assessment of an Oral Recuperation Fluid in Healthy Dogs During the Perioperative Period

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The objective of this study was to determine whether healthy dogs undergoing elective surgery will accept and prefer an oral recuperation fluid (ORF) to water during the perioperative time period and if the consumption of an ORF would lead to increased caloric intake during the final preoperative and first postoperative periods. This prospective, observational study was performed in the setting of a University Veterinary Teaching Hospital. A total of 67 healthy dogs were presented for routine ovariectomy (n = 30) or castration (n = 37). Before surgical intervention, dogs were offered an ORF to assess their voluntary acceptance of the fluid. After 2 hours, the ORF was offered alongside water to assess fluid preference. Routine castration or ovariectomy was then performed. During the immediate postoperative period, dogs were reassessed as to their acceptance and preference of the ORF. A high percentage of dogs accepted the ORF in both the preoperative (55/67, 82%) and postoperative (42/67, 63%) periods ($P < .01$ and $P = .04$, respectively). Of dogs that demonstrated a preference between the ORF and water, 87% (95% CI: 77%-93%) chose the ORF preoperatively, whereas 98% (95% CI: 87%-99.5%) chose the ORF postoperatively ($P < .01$ and $P < .01$, respectively). Dogs that consumed the ORF in each measurement period ingested a higher amount of food (measured as percentage of kilocalories offered) when compared with those that did not consume the ORF (preoperatively 83% vs. 49%, $P < .01$; postoperatively 51% vs. 27%, $P = .01$). A commercially manufactured veterinary ORF was found to be palatable, as determined by acceptance and preference testing, in healthy dogs during the preoperative and postoperative phases of routine sterilization. Further studies in dogs undergoing more intensive surgical procedures or recovering from nonsurgical illness or both are warranted.

Introduction

Oral recuperation fluids (ORFs) are commercially available or individually prepared fluids that are provided orally to help maintain proper hydration and electrolyte balance. The benefits of ORF administration has been investigated in patients with gastrointestinal tract (GIT) upset and dehydration.[1] In the human pediatric literature, oral electrolyte solutions are recommended as first-line hydration support in cases of viral gastroenteritis and diarrhea causing mild to moderate dehydration.[2,3] Veterinary studies evaluating the efficacy of ORF are mostly limited to large animal species.[4,5] More recently, Reineke et al.[6] used a commercially prepared oral electrolyte solution to treat dogs with hemorrhagic diarrhea. Findings of this study support the use of an ORF in mild to moderately dehydrated dogs with good success and minimal cost.

The use of ORF in the perioperative setting has not been described in the veterinary literature. Dogs undergo surgery for a variety of etiologies, ranging from routine sterilization to complicated abdominal procedures. Hospitalization with supportive care is often required until the animal is cardiovascularly stable, well hydrated, eating, and tolerating oral medications. Early enteral nutrition aids in surgical recovery and helps reduce postoperative complications, while also promoting enterocyte health and gastrointestinal immune function.[7,8] An ORF may foster a rapid transition to enteral feeding and therefore be of benefit in a variety of postoperative settings.

An ORF has been commercially prepared for use in dogs (Viyo Recuperation, Viyo International N.V., Antwerp, Belgium). The formulation contains nutrients and amino acids (i.e., glutamine, arginine, and taurine) that are considered vital to GIT health and recovery. Glutamine improves intestinal mucosal morphology, enhances GIT immune function, increases enterocyte proliferation, and decreases production of inflammatory cytokines.[9-11] Arginine enhances GIT immune function, supports the intestinal microvasculature, and decreases inflammatory cytokines.[10,11] Taurine supplementation may help ameliorate signs of inflammatory bowel disease.[12] The provision of these amino acids could also promote recovery in dogs during the postoperative period, which has been documented to be up to 14 days based on current understanding of physiology of nutrition and metabolism.[13]

The current study sought to determine the palatability of an ORF in healthy dogs during the perioperative period using acceptance and preference testing. A secondary objective was to determine if the consumption of an ORF would lead to increased caloric intake during the final preoperative and first postoperative periods. Our hypothesis was that an ORF would be readily accepted during both the preoperative and postoperative periods, and the ORF would be preferred to water. Additionally, we hypothesized

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that consumption of the ORF would subsequently lead to increased caloric intake during the final preoperative and first postoperative feedings.

Materials and Methods

Study Population

This prospective study evaluated client-owned dogs that were presented to a veterinary teaching hospital for routine ovariectomy or castration between March and May 2014. Dogs were deemed healthy based on physical examination findings, packed cell volume/serum total solids (PCV/TS), and other baseline diagnostics deemed necessary by the attending clinician. Dogs were excluded if they demonstrated signs of systemic illness, if they underwent additional procedures (e.g., lumpectomy or inguinal hernia repair), if food or water were provided outside of the prescribed study protocol, or if hospital dismissal occurred within 12 hours of anesthesia recovery. Institutional Animal Care and Use Committee permission was obtained before study initiation.

Data Collection

Demographic information obtained on each dog included age, sex, breed, and body weight (kg). Vital parameters (temperature, heart rate, and respiratory rate) were recorded on hospital intake in addition to physical examination findings, PCV (%) and TS (g/dL), body condition score (using a 9-point scale), and dehydration status ($< 5\%$, 5%-6%, 6%-8%, 8%-10%, and 10%-12%).

Preoperative and postoperative phases occurred during data collection, with each phase consisting of an acceptance testing and preference testing stage. Preoperative testing was performed at the time of hospital admission, on the day before surgery. Before offering any food or water, a standardized volume of ORF was offered according to manufacturer recommendations (Viyo Recuperation, Viyo International N.V., Antwerp, Belgium). Voluntary acceptance (i.e., consumption) of the ORF was recorded (yes or no). If acceptance occurred, then the volume consumed was reported as a percentage of the amount offered (mL consumed/mL offered [%]). Dogs were then allowed free-choice water until the preference stage, which was performed 2-3 hours later.

During the preference stage, dogs were offered the same amount of ORF alongside an identical volume of water. Both fluids were offered at the same time and in identical dishes. Preference was defined as the first fluid consumed (ORF vs. water vs. neither). Dogs were then provided a measured amount of a commercial kibble (Eukanuba Low Residue, Eukanuba, Mason, OH, USA) based on calculation of caloric resting energy requirements using a standard and accepted formula ($70 \times [\text{body weight in kg}]^{0.75}$). The amount of prescribed resting energy requirement ingested (kilocalorie [kcal] consumed/kcal prescribed [%]) was recorded.

Surgery (ovariectomy or castration) was performed the following morning. The postoperative phase of palatability testing commenced within 4-6 hours of recovery from anesthesia, defined as time of endotracheal extubation. Data recorded from the surgical procedure included length of anesthesia (minutes) and postoperative drugs (i.e., analgesics and sedatives) administered. Assessment of vital parameters, hydration status, and pain score (0-4 of 4, using a dynamic and interactive visual analog pain scale) were documented during each postoperative testing stage.

Postoperative palatability testing was performed by repeating acceptance and preference testing, with close adherence to the testing protocol used during the preoperative phase. Following collection of acceptance and preference data, all dogs were hospitalized overnight with free access to water. Additional analgesics were administered as directed by the primary clinician. Hospital dismissal occurred the following morning, once the dog had been evaluated and medically cleared by a veterinarian.

Statistical Methods

A commercially available statistics program (JMP Pro 11 for Macintosh, SAS Institute, Cary, NC, USA) was used for tabulation and analysis of all data. In both preoperative and postoperative periods, similar statistical tests were used to assess acceptance and preference testing. The percentage of dogs that accepted the ORF (yes or no) was calculated alongside a 95% CI. Pearson chi-squared analysis was used to compare the percentage of dogs that did accept the ORF with those that did not. Pearson chi-squared analysis was also used during preference testing to determine if a difference existed in the percentage of dogs that preferred the ORF vs. the percentage of those that preferred water. A Wilcoxon rank sum test was used to evaluate differences between the amount of food that was consumed when comparing those that ingested the ORF in the acceptance phase and those that did not. The aforementioned statistical tests were then repeated in the postoperative phase to reevaluate ORF acceptance, ORF preference, and caloric intake following surgical intervention.

To determine if fewer dogs accepted the ORF in the postoperative phase when compared with the preoperative phase, McNemar test was performed. Uncontrolled pain may have influenced whether a dog would accept the ORF or water orally in the immediate postoperative period; subsequently, pain scores were further evaluated to determine their effect on postoperative testing results. For postoperative acceptance and preference stages, dogs were categorized based on ingestion of a fluid (i.e., ORF for acceptance testing; ORF or water for preference testing) vs. no interest in any oral intake. Pain scores for each group were compared for both acceptance and preference trials using a 2-sample t test. All tests were performed using an established significance level set at $P < .05$.

Results

During the 3-month study period, 79 dogs were presented for routine ovariectomy or castration. Of them, 12 dogs were excluded from the study for the following reasons: access to water outside of the prescribed study protocol ($n = 8$), prolonged or additional surgical procedures ($n = 2$), systemic illness (coughing and lethargy) precluding anesthesia or surgery ($n = 1$), and data collection error ($n = 1$). Therefore, 67 dogs were eligible for study inclusion. Breeds represented included mixed breeds ($n = 46$, 68.5%), Chihuahua ($n = 3$, 4.5%), Australian Heeler ($n = 2$, 3%), Border Collie ($n = 2$, 3%), Boxer ($n = 2$, 3%), Staffordshire Terrier ($n = 2$, 3%), and 1 each of Australian Shepherd, Basset Hound, Beagle, Catahoula, Cocker Spaniel, German Shepherd, Jack Russell Terrier, Lhasa Apso, Miniature Pinscher, and Weimaraner (1.5%). There were 30 (45%) females and 37 (55%) males, with a median body weight of 12.7 kg (range: 2.5-31.1 kg). Mean body condition score was 4.8 ± 0.9 (of 9). The dogs with recorded hydration assessments on admission (57/67) were considered to have no clinical signs of dehydration ($< 5\%$ dehydrated). Collection of PCV/TS was performed on 58 of 67 dogs, with a mean PCV of $49 \pm 5.0\%$ and mean TS of 6.6 ± 0.6 g/dL.

Anesthesia duration and postoperative analgesia protocols were recorded for 66 of 67 patients; 1 anesthesia record was unable to be located. Time under inhalant anesthesia ranged from 64-333 minutes (median = 126 minutes). Postoperative analgesia was provided with a combination of morphine (Morphine Sulfate, West-Ward, Eatontown, NJ, USA) (0.5 mg/kg SQ) and carprofen

(Rimadyl, Pfizer Animal Health, New York, NY, USA) (2.2 mg/kg SQ) in 52 dogs, a combination of hydromorphone (Hydromorphone HCl, West-Ward, Eatontown, NJ, USA) (0.05 mg/kg SQ) and carprofen (2.2 mg/kg SQ) in 3 dogs, morphine (0.5 mg/kg SQ) as a sole agent in 9 dogs, and hydromorphone (0.05 mg/kg SQ) as a sole agent in 2 dogs.

In the preoperative phase, 55 of 67 dogs (82% [95% CI: 71%-89%]) consumed the ORF during the acceptance trial ($P < .01$). Those dogs accepting the ORF consumed 76 $\pm$ 0.4% of the volume offered. During the preoperative preference trial, of those dogs (62/67 [93%]) that demonstrated a preference for either water or ORF, 54 of 62 (87% [95% CI: 77%-93%])dogs chose the ORF ($P < .01$, Fig). When offered food preoperatively, dogs that accepted the ORF ingested a higher percentage of prescribed kcals when compared with those that did not consume the ORF (83% vs. 49%, $P < .01$).

In the postoperative phase, 42 of 67 dogs (63% [95% CI: 51%-73%]) consumed the ORF during the acceptance trial ($P = .04$), and those dogs ingested 57 $\pm$ 0.5% of the volume offered. Acceptance in the postoperative phase was significantly lower (42/67 [63%] dogs) when compared with that in the preoperative phase (55/67 [82%] dogs, $P < .01$). During the postoperative preference trial, of those dogs (41/67, 61%) that demonstrated a preference for either water or ORF, 40 of 41 (98%) dogs chose the ORF (95% CI: 87%-99.5%, $P < .01$, Fig). When offered food postoperatively, dogs that accepted the ORF postoperatively ingested a higher percentage of prescribed kcals when compared with those that did not consume the ORF (51% vs. 27%, $P = .01$). There were no signs of nausea or vomiting noted in the dogs that consumed the ORF or food in this postoperative period.

When pain scores were evaluated with respect to postoperative acceptance of the ORF (yes or no), the mean pain score was significantly ($P < .01$) lower in dogs that accepted the ORF (0.73 $\pm$ 0.5) vs. those that did not accept the ORF (1.02 $\pm$ 0.27). During the postoperative preference trial, no significant difference was observed when comparing pain scores of dogs that demonstrated a preference for water or the ORF (0.85 $\pm$ 0.45) with those that preferred neither (0.81 $\pm$ 0.47, $P = .26$).

Discussion

Enteral feeding is important when optimizing recovery following surgery or anesthesia. ORF-containing nutrients that support gastrointestinal health may provide benefit to dogs during the postoperative period, but effective administration will largely depend on the palatability of the fluid being provided. Our results support an ORF as being highly palatable, determined using acceptance and preference testing, in healthy dogs during the immediate preoperative and postoperative time frames. Healthy dogs undergoing routine sterilization readily accepted an ORF and preferred the ORF to water during the preoperative and postoperative periods. This study confirms that administration of an ORF to healthy dogs in the perioperative period is feasible and well tolerated.

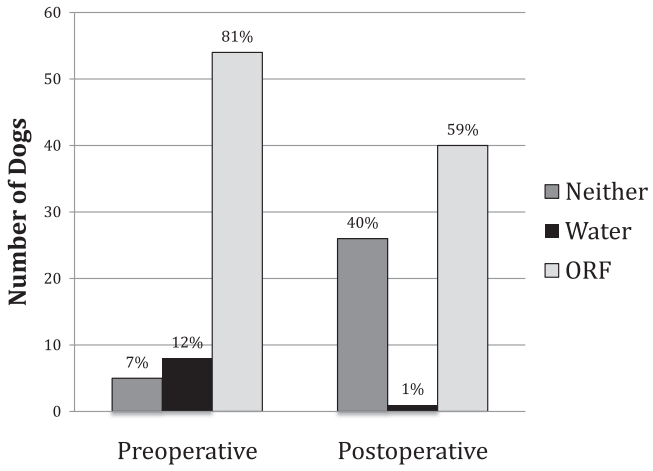

Fig. Number of dogs preferring the ORF, water, or neither during each of the preoperative and postoperative phases of preference testing. Of the dogs that demonstrated a preference for the water or ORF, 87% (54/62) and 98% (40/41) of dogs preferred the ORF in the preoperative and postoperative phases, respectively ($P < .01$ for both time points).

ORF consumption significantly decreased in the postoperative acceptance trial (63% of dogs) when compared with the preoperative acceptance trial (82% of dogs). Residual sedation from anesthesia, uncontrolled nausea, anxiety, and postoperative pain may have all contributed to this expected decrease in ORF acceptance. Dogs that did not accept the ORF in the immediate postoperative period had significantly higher pain scores compared with those that did accept the ORF, suggesting pain as an explanation for this difference. This difference in pain scoring was not observed 2-3 hours later when postoperative preference testing was performed, indicating the provided analgesics were effective and other factors may have influenced the dog's preference for the ORF, water, or neither fluid. Although the study methods were clearly defined, the potential exists for variability regarding data collection. More than one individual participated in data collection throughout the study. This may have influenced the assessment of subjective parameters, including pain scoring. This variability may also explain why no association was observed between pain score and postoperative preference testing.

Despite these small variabilities, this study population did demonstrate a consistent preference for the ORF when compared with water in both the preoperative and postoperative periods. The high preference for the ORF (87% of preoperative dogs and 98% of postoperative dogs, of those dogs that demonstrated a preference) relative to water further supports the palatability of the product and potential for clinical use to stimulate oral intake after surgery. The methods used for preference testing in this study were simple; identical dishes were used for the water and ORF, with identical volumes of both fluids provided within each dish. A more sophisticated preference analysis, including varying the position of the choices (i.e., left vs. right side) and evaluating preference at multiple time points in each phase of the study, could provide further information regarding true ORF preference.

An additional finding of this study was the significant association between ORF consumption and improved caloric intake in the preoperative and postoperative phases. This may reflect a true effect of the ORF on appetite stimulation, although individual appetite and food preference independent of the ORF is also possible. In the absence of a control group of dogs with similar physiological, physical, and personality traits, true cause and effect is difficult to ascertain, but the association is encouraging. A randomized, crossover trial may answer this question in future studies.

An additional limitation of the current study includes use of healthy dogs undergoing a relatively simple surgical procedure. Although a high level of acceptance and preference for an ORF was observed in this population, these findings should not be translated to other species or clinical settings without further investigation. Many surgical conditions or illnesses or both can affect appetite and GIT health and may not result in high ORF palatability. Future studies are needed to verify the acceptance and preference data in a more diverse, critically ill population. Additional studies are also needed to demonstrate the clinical value of the provided nutrients in GIT recovery during critical illness. It would also be prudent to follow caloric and water intake over a longer period of time in a critically ill population, to verify findings of the current study.

Conclusion

An ORF was found to be highly palatable during the perioperative period when tested in healthy dogs undergoing routine sterilization. Use of an ORF has the potential for clinical application in postoperative and critically ill dogs. Further investigation in different populations of hospitalized animals is warranted to characterize the utility and potential benefit of an ORF when managing GIT and non-GIT disease.

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