Efficacy of Serosal Patching in Dogs with Septic Peritonitis

Janet Grimes, DVM*, Chad Schmiedt, DVM, DACVS, Milan Milovancev, DVM, DACVS, MaryAnn Radlinsky, MS, DVM, DACVS, Karen Cornell, PhD, DVM, DACVS

ABSTRACT

The objective of this study was to evaluate the correlation of serosal patching in dogs with existing septic peritonitis with continued postoperative septic peritonitis and death. Records were collected from dogs that underwent intestinal surgery from 1998 to 2007 at four veterinary teaching hospitals and one private referral clinic. Dogs were included if they were diagnosed with septic peritonitis and had subsequent surgery of either the small intestine or cecum. Eighty-two surgeries were evaluated. Eighteen dogs (22%) received a serosal patch during surgery. Of those, three dogs (16.7%) had septic peritonitis postoperatively. Sixty-four dogs (78%) did not receive a serosal patch, and 19 of those dogs (29.7%) had postoperative septic peritonitis ($P = 0.27$). Of the 18 cases with serosal patching, 6 (33.3%) died prior to discharge. Of the 63 cases that did not receive a patch and had information regarding survival, 14 (22.2%) died prior to discharge ($P = 0.34$). Use of a serosal patch did not protect dogs from either postoperative septic peritonitis or failure to survive. (*J Am Anim Hosp Assoc* 2013; 49:246–249. DOI 10.5326/JAAHA-MS-5870)

Introduction

Septic peritonitis remains a challenging clinical problem in dogs. Gastrointestinal perforation is reportedly the most common cause of septic peritonitis in dogs.[1,2] Dogs with preoperative septic peritonitis have significantly higher morbidity and mortality following gastrointestinal surgery compared with dogs without peritonitis, and there is an increased risk of postoperative dehiscence associated with the presence of septic peritonitis.[3–6] Optimal surgical management of patients with preoperative septic peritonitis is critical for achieving favorable surgical outcomes.

Serosal patching is a simple strategy thought to reinforce enteric closure. The technique involves apposing the serosal surface of a healthy portion of the bowel against an enteric incision. The healthy bowel is sutured to the bowel surrounding the suture line using sutures that engage the submucosa of both bowel loops in either a continuous or interrupted pattern. Serosal patching is described as a strategy to provide mechanical support, a fibrin seal, increased resistance to leakage, and increased blood supply; however, its efficacy has not been evaluated.[7]

The serosal patch technique was originally presented as a way to close defects in which primary closure would result in luminal compromise.[8,9] In human medicine, the serosal patch is typically reserved for duodenal injuries that are nonresectable and are not able to be closed primarily.[10,11] Serosal patching has also been used to reinforce a primarily closed defect, and this application is the most common one used in veterinary surgery.[9,11] In the largest report of serosal patching in the veterinary literature, a serosal patch was used in nine dogs with either septic or suppurative peritonitis. Eight of the nine dogs in that report survived $>$ 24 hr following surgery, and further leakage of intestinal contents was not found.[9]

The purpose of this study was to retrospectively evaluate the efficacy of serosal patching in a population of dogs presenting with septic peritonitis. The authors' hypothesis was that dogs that

From the Department of Small Animal Medicine and Surgery, College of Veterinary Medicine, University of Georgia, Athens, GA (J.G., C.S., M.R., K.C.); and Department of Clinical Sciences, College of Veterinary Medicine, Oregon State University, Corvallis, OR (M.M.).

Correspondence: jag0033@auburn.edu (J.G.)

CI *confidence interval;* OR *odds ratio*

*J. Grimes' present affiliation is the Department of Clinical Sciences, College of Veterinary Medicine, Auburn University, Auburn, AL.

received a serosal patch were less likely to have postoperative septic peritonitis and were more likely to survive compared with dogs with septic peritonitis that did not receive a serosal patch.

Materials and Methods

Case Selection

Medical records of all dogs presenting with septic peritonitis due to gastrointestinal leakage from 1998 to 2007 were reviewed. Records were collected from four veterinary teaching hospitals and one private referral clinic. Dogs were included in this study if they were diagnosed with septic peritonitis either prior to or at the time of exploratory laparotomy and had subsequent surgery of either the small intestine or cecum. The diagnosis of preoperative septic peritonitis was made based on definitive cytologic evidence, positive microbial culture, or an abdominal effusion/blood glucose difference $>$ 1.11 mmol/L with subsequent intraoperative confirmation. The presence of postoperative septic peritonitis was recorded, as well as whether the dog survived to discharge or not. Postoperative septic peritonitis was diagnosed by positive bacterial culture, definitive cytologic evidence, or an abdominal effusion/blood glucose difference $>$ 1.11 mmol/L at any point in the postoperative period prior to discharge. Dogs with preoperative septic peritonitis likely had some degree of postoperative septic peritonitis; therefore, postoperative septic peritonitis, as defined here, did not include dogs in which preoperative septic peritonitis was effectively treated with surgery and peritoneal lavage and subsequently resolved in the postoperative period. The surgery report was used to determine whether a serosal patch was performed. Dogs were excluded if a surgery report either was not present or the report was unclear.

Statistical Analyses

Dogs were divided into two groups: those with and without a serosal patch. A χ^2 test was used to determine if there was a significant difference in the percentage of dogs with a serosal patch that either had postoperative septic peritonitis or died prior to discharge compared with dogs without a serosal patch. The odds ratio (OR), 95% confidence interval (CI) of the OR, and P value were calculated for both the presence of postoperative septic peritonitis and survival to discharge. Data were expressed as mean $\pm$ standard deviation. Significance was set at $P < 0.05$.

Results

Eighty-two surgeries performed on 76 dogs met the inclusion criteria. The mean age of all dogs with information regarding age (79 of 82) was 6.1 yr $\pm$ 3.78 yr. Age was not statistically different between dogs that received a patch (6.40 yr $\pm$ 4.38 yr) and those that did not (6.01 yr $\pm$ 3.62 yr; $P < 0.7$). Thirty-one surgeries were performed on spayed females, 31 on castrated males, 13 on males, and 7 on females. The most common breeds were mixed-breeds (n = 12), Labrador retrievers (n = 10), and golden retrievers (n = 9). There were also Jack Russell terriers (n = 4), rottweilers (n = 4), beagles (n = 3), Chihuahuas (n = 3), Australian cattle dogs (n = 2), basset hounds (n = 2), bluetick coonhounds (n = 2), English bulldogs (n = 2), English coonhounds (n = 2), Great Danes (n = 2), pugs (n = 2), Weimaraners (n = 2), and one each of various additional breeds. Details of some of those cases have been previously reported.[4]

An overall mortality rate of 25% was identified for all dogs in the population, and postoperative septic peritonitis was diagnosed after 27% of surgeries. Eighteen surgeries (22%) involved placement of a serosal patch, and three of those cases (16.7%) had septic peritonitis postoperatively. Sixty-four surgeries (78%) did not receive a serosal patch, and 19 of those dogs (29.7%) had septic peritonitis postoperatively. There was no significant difference between the patients that received a serosal patch and those that did not in regards to the presence of postoperative septic peritonitis ($P = 0.27$; 95% CI, 0.12–1.83; OR, 0.47). Of the 63 cases that did not receive a serosal patch and had information regarding survival, 14 (22.2%) died. Eleven of the 14 dogs (78.6%) had postoperative septic peritonitis. Six of the 18 cases (33.3%) that received a serosal patch died, and 3 of those 6 cases (50%) had confirmed postoperative septic peritonitis. The use of a serosal patch was not significant for survival ($P = 0.34$; 95% CI, 0.18–1.80; OR, 0.57).

Discussion

In the study reported here, patients with preoperative septic peritonitis were evaluated for either continued septic peritonitis or death after corrective surgery, with or without placement of a serosal patch. An overall mortality rate of 25% was identified for all dogs in the population, and postoperative septic peritonitis was diagnosed after 27% of the surgeries. Previously reported studies have shown higher numbers of patients with preoperative septic peritonitis developing postoperative septic peritonitis (35–38%).[3,4] The mortality rate for patients with preoperative septic peritonitis was reported in only one of those studies (33%).[4] In the current study, use of a serosal patch for reinforcement of closure of the gastrointestinal tract in dogs with septic peritonitis was not associated with a decreased incidence of postoperative septic peritonitis. Additionally, use of a serosal patch was not associated with increased survival to discharge from the hospital.

Preoperative septic peritonitis has been shown to be closely correlated with continued postoperative septic peritonitis and

death.[4] Enteric healing is impaired in the presence of septic peritonitis.[12,13] Collagen synthesis is an important factor in wound healing as it imparts wound strength and seals small tissue defects to prevent leakage after closure. In rodents, peritonitis results in weaker anastomotic bursting pressure and less total collagen content of the anastomosis site than in unaffected animals.[12] The reduction in collagen coincides with reduction of new collagen and total protein synthesis at the anastomotic site, potentially due to depletion of amino acid substrate and energy stores.[13] In addition, septic peritonitis results in high levels of tumor necrosis factor-α, which is a proinflammatory cytokine.[14] In turn, tumor necrosis factor-α has been shown to reduce gene expression of collagen α1(I) and of transforming growth factor-β, a profibrotic cytokine.[15] Additionally, increased collagen destruction associated with collagenases can occur with septic peritonitis. For example, in humans with septic peritonitis, active matrix metalloproteinase-8, which is a collagenase of neutrophil origin, is of higher concentration in the serum and urine than in humans without septic peritonitis.[16] The concentration of matrix metalloproteinase-8 is also substantially higher in the peritoneal fluid than in the blood in humans with septic peritonitis.[16] Thus, the presence of septic peritonitis provides a challenging environment for enteric healing because impaired collagen synthesis and increased collagen destruction both can occur.

Many procedures have been attempted to help reinforce intestinal defects in the face of septic peritonitis.[9,11,17] The most common procedures for reinforcement of intestinal defects in small animal veterinary medicine include omental patching and serosal patching. Use of small intestinal submucosa has been described experimentally for that purpose; however, its use is currently uncommon in the clinical setting.[18] Omental patching was shown to be largely ineffective compared with serosal patching in one study.[19] In that study, a duodenal defect was created and covered with either a double or quadruple omental patch or a jejunal serosal patch. All 19 dogs in the jejunal serosal patch group survived, whereas 5 of 10 dogs with a double omental patch and 7 of 11 dogs with a quadruple omental patch died of peritonitis.[19] Another study evaluated end-to-end anastomosis of an avascular bowel section. In those cases, the omentum was either wrapped around the anastomosis with the blood supply to the omentum intact or severed or the omentum was rolled up and sutured to the stomach to prevent coverage of the anastomosis. Survival rates were poor in the groups without omental coverage and the group with the omental blood supply severed (0 of 15 and 2 of 17 survived, respectively). All of the dogs that died had perforation of the avascular intestinal segment.[20] A recent report detailed the successful use of a serosal patch in a bird that had colonic perforation intraoperatively. Birds do not have an omentum; thus, use of a serosal patch can be a viable alternative in birds.[21]

The serosal patch has been described for cases in which a duodenal defect could not be closed primarily due to risk of luminal compromise.[9,11,22] Its use has been expanded for reinforcement of intestinal closures where either the suture line is of questionable viability or the abdominal environment is nonconducive to healing.[9,11] All cases in the current study had a primarily closed defect and application of a serosal patch to reinforce the suture line. When used over an open defect, studies have shown that placement of a serosal patch results in development of duodenal mucosa over the jejunal serosa.[8,11,17,22] In one study, researchers covered either one or multiple intestinal defects with a jejunal serosal patch. Animals were sacrificed on days 3, 30, and 60 after surgery, and angiography and patency tests were performed. Obstruction, leakage, and autodigestion were not observed in any of the specimens. Lumen size was near normal in tissues harvested 3 days after surgery, and by 60 days, the jejunal serosa was completely covered with duodenal mucosa.[8] In another study, a Billroth II procedure was completed, leaving 1 cm of the duodenal stump open. The dogs were recovered and were taken back to surgery 20 hr later. At that time, a jejunal serosal patch was placed over the duodenal opening. All 10 dogs survived.[17] No reports could be found detailing the histopathologic changes after application of a serosal patch over a primarily closed defect, which was the only application of the serosal patch in the current study.

Limitations of this study include the fact that patient factors other than septic peritonitis and death were not taken into account (e.g., preoperative albumin levels, age, cause of the preoperative septic peritonitis). Previous studies have shown that those factors may play a role in a patient's risk of continued postoperative leakage and death.[3,4,6] Inclusion of those factors in a multifactorial analysis may reveal a significant difference between patients receiving a patch or not. Furthermore, due to the retrospective nature of the study, clinician-dependent postoperative management techniques varied widely between cases, which may have affected patient outcomes. A prospective clinical trial with a uniform patient management protocol would need to be conducted to better control for those variables and further evaluate the potential for a protective effect of serosal patching in the face of septic peritonitis.

In this study, the number of patients that received a serosal patch is small relative to those that did not receive a serosal patch. A larger sample size of patients with a serosal patch would better delineate the association between serosal patching and septic

peritonitis. Additionally, information on how the patch was applied and surgeon experience was not collected. Technique and experience level may have varied and may be a source of error.

Perception of the severity of gross disease was not taken into account, which may have influenced what patients received a serosal patch. Surgeons might be less likely to use a serosal patch on cases in which they subjectively feel have a lesser degree of either peritonitis or bowel compromise. Those factors cannot be accurately accounted for in a retrospective study and may have had a major influence on the significance of the results. For example, a dog that had severe peritonitis and bowel compromise may have been more likely to receive a patch in addition to having a greater risk of postoperative death. Because degree of peritonitis is a subjective evaluation for each surgeon, it will be difficult to control for that factor in a prospective study. If degree of peritonitis could be normalized among patients, the true significance of using a serosal patch in the presence of septic peritonitis might be elucidated.

Conclusion

These data do not clearly support a protective effect of serosal patching on either postoperative septic peritonitis or survival; however, given the limitations of the study discussed above, the trend toward significance and the ranges of the 95% CIs, further study is warranted to evaluate serosal patching in a more controlled manner. Finally, given the ease of application and potential for a protective effect, the authors feel the use of a serosal patch to reinforce enteric closure in the face of septic peritonitis remains a consideration to be made by the individual surgeon based on his or her own preference and experience.

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