

## Comparative Study of Histopathologic Effects of Barium Sulfate and Gastrografin on Peritoneal Membrane in Rabbits

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**Abstract:** Contrast studies have long been considered essential procedures for evaluating diseases of the gastrointestinal tract. While it is generally accepted that these procedures are safe and morbidity is low, unfortunately such procedures are not entirely innocuous and serious complications have been reported. Thirty male New Zealand white rabbits aged about 6 months with average body weight of  $2500 \pm 400$  g were selected for this study. Rabbits were divided randomly into 6 equal groups ( $n = 5$ ). Rabbits in groups 1 and 2 were injected barium sulfate 30% intraperitoneally. The 3rd and 4th groups were injected gastrografin at the same way. Animals in 5th and 6th group (control) were injected physiologic saline solution as well. Radiographs were provided of all animals at 20 min, 24 h and 7 days after injection. Animals in groups 1, 3 and 5 were sacrificed on 24 h and group 2, 4 and 6 were sacrificed on 7th day after injection. Histopathological changes of group 1 samples indicated; increasing of mononuclear inflammatory cells, fibrocytes and fibrin on the peritoneal membrane showed severe peritonitis. In group 2 inflammatory cells were decrease and they converted to polymorphs. There are no significant histopathologic changes in groups 3-6. Radiographic finding also showed that barium sulfate remained in the abdominal cavity and lead to produces ascitis, while gastrografin nearly have any side effects on animals.

**Key words:** Barium sulfate, gastrografin, histopathologic, peritoneum, rabbit

### INTRODUCTION

Barium meal (upper gastrointestinal) and barium enema studies have long been considered essential procedures for evaluating diseases of the gastrointestinal tract (Markus *et al.*, 1990). Radiographers have been regularly performing double contrast barium enemas for almost a decade. While, it is generally accepted that these procedures are safe and morbidity is low, unfortunately such procedures are not entirely innocuous and serious complications have been reported (Liew *et al.*, 2003), including necrotizing proctitis (Altobelli *et al.*, 1970), peritonitis (Vieta and Thomson, 1975), barium granuloma of the rectum (Lewis *et al.*, 1975; Slonim, 2002) septicemia (Richman *et al.*, 1973), embolization (Mahboubi *et al.*, 1974) and fatal intravasation (Karen *et al.*, 1974). Perforations resulting from barium enemas may occur at any level from the dentate line to the cecum, may be complete with the entire thickness of the bowel wall disrupted, or may be incomplete with barium dissecting between the layers of the intestinal wall while the serosa remains intact (Spector *et al.*, 1963). From the few available reports of experiments with contrast media in the

peritoneal cavity and sporadic case reports of accidental perforations, we have been unable to formulate a clear impression as to the immediate histopathologic changes of these complications. It is the purpose of this report to compare the effects of two commonly used contrast media on the peritoneal cavity.

### MATERIALS AND METHODS

Thirty healthy male New Zealand white rabbits aged about 6 months; average weighing of  $2500 \pm 400$  g were used. The media to be tested were introduced by percutaneous intra-peritoneal injection using a syringe and needle under sterile conditions. Abdominal radiographs of each rabbit were made within 20 min after injection to determine proper placement of the media. One to seven days following injection, repeat abdominal films were made and if the contrast media had disappeared, no further radiographic studies were performed. An autopsy was performed on each rabbit that did not survive and specimens were removed for histologic study. Rabbits were divided randomly into 6 equal groups ( $n = 5$ ). Ten milliliter of a 30% aqueous suspension of barium sulphate

were injected intra peritoneally into ten rabbits of groups 1 and 2; 10 mL of Gastrografin (sodium and methylglucamine diatrizoate-Squibb) were injected into 10 rabbits as groups 3 and 4 and 10 mL normal saline were injected into peritoneal cavity of 10 rabbits as control group (group 5 and 6). No special attempt was made to keep the contrast media sterile prior to injection. Animals in groups 1, 3 and 5 were sacrificed on 24 h and group 2, 4 and 6 were sacrificed on 7th day after injection.

## RESULTS

Of the 10 rabbits which received barium sulfate, all appeared quite ill within a few hours following injection and 2 were dead within 2 days. Serial radiographs of the abdomen showed almost immediate spread of the contrast media throughout the peritoneal cavity following injection. By the 2nd day, the barium had formed small clumps, probably due to absorption of water by the peritoneal surfaces and localization of the contrast media by fibrinous exudates. Autopsies on the rabbits which died showed consistent generalized peritonitis, many small white nodules scattered over mesentery, bowel and parietal peritoneum and multiple adhesions. Histopathological changes of group 1 samples indicated; increasing of mononuclear inflammatory cells, fibrocytes and fibrin on the peritoneal membrane showed severe peritonitis. In group 2 inflammatory cells were decrease and they converted to polymorphs. There are no significant histopathologic changes in groups 3-6. Radiographic finding also showed that barium sulfate remained in the abdominal cavity and lead to produces ascitis, while gastrografin nearly have any side effects on animals. In group 1 and 2 after 1st and 7th day distribution of media remained but Gastrografin was not present on 2nd day in according groups.

## DISCUSSION

In 1916 Rosenthal reported the first case of barium peritonitis from an acute perforation of a duodenal ulcer immediately after a barium meal study complicated by intestinal obstruction (Rosenthal, 1916).

Perforation of the gastrointestinal tract during barium examination is a rare but highly lethal complication. In untreated patients, mortality is 100%, as shown in laboratory models (Nahrwold *et al.*, 1971; Westfall *et al.*, 1966). Even with aggressive surgical and medical management, mortality still exceeded 50% in both experimental and clinical experience (Sisel *et al.*, 1972;

Zheutlin *et al.*, 1952; Gardiner *et al.*, 1973; Westfall, 1966). The adverse effects of barium in the peritoneal cavity seem clear from these studies. Of the 10 animals which received barium sulfate, all showed a prolonged morbidity and all demonstrated gross and histologic findings of peritonitis and/or adhesions. The effect of barium sulfate on the peritoneal cavity was found to be almost uniformly deleterious, producing widespread peritonitis and dense adhesions. This study would seem to indicate that if a perforation is suspected or likely, a water-soluble medium is definitely preferable to barium sulfate as a contrast medium.

## REFERENCES

- Altobelli, J.A., T. Yamashita and G.L. Kratzer, 1970. Necrotizing proctitis caused by injection of barium into the wall of the rectum. *Dis. Colon Rectum*, 13: 333.
- Gardiner, H. and R.E. Miller, 1973. Barium peritonitis-A new therapeutic approach. *Am. J. Surg.*, 125: 350.
- Karen, J., J. Cove and R.N. Snyder, 1974. Fatal barium intravasation during barium enema. *Radiol.*, 112: 9.
- Lewis, J.W., M.D. Kerstein and N. Koss, 1975. Barium granuloma of the rectum-An uncommon complication of barium enema. *Am. Surg.*, 181: 418.
- Liew, N.C., T. Gee, K. Sandra and Y.A. Gul, 2003. Barium peritonitis-following barium enema of the proximal colon through a colostomy. *Med. J. Malaysia.*, 58 (5): 766-768.
- Mahboubi, S., V.K. Gohel and M.K. Dalinka *et al.*, 1974. Barium embolization following upper gastrointestinal examination. *Radiology*, 111: 301.
- Markus, J.B., S. Somers, B.P. O'Malley and G.W. Stevenson, 1990. Double-contrast barium enema studies: Effect of multiple reading on perception error. *Radiology*, 175: 155-156.
- Nahrwold, D.L., J.H. Isch and D.A. Benner *et al.*, 1971. Effect of fluid administration and operation on the mortality rate in barium peritonitis. *Surgery*, 70: 778.
- Richman, L.S., W.F. Short and W.M. Cooper, 1973. Barium enema septicemia. *JAMA.*, 226: 62.
- Rosenthal, E., 1916. Rontgenologisch beobachte Magen-perforation. *Berlin Klin Wchnschr*, 53: 945, Cited by Fonseca CP, 1952. Acute perforation of a duodenal ulcer immediately after barium meal complicated by intestinal obstruction. *Lancet*, 263: 1246.
- Sisel, R.J., A.J. Donovan and A.E. Yellin, 1972. Experimental fecal peritonitis. *Arch. Surg.*, 104: 765.

- Slonim, L., 2002. Rectal perforation during double contrast barium enema. *Australas Radiol.*, 46(1): 138.
- Spector, G.W. and N. Sysmian, 1963. The Roentgen Recognition of Intramural Perforation Following Barium Examination in Obstructing Lesions of the Sigmoid. *Amer. J. Roentgen.*, 89: 876.
- Vieta, J.O. and J.B. Thomson, 1975. Barium peritonitis. *Am. J. Gastroenterology*, 63: 414.
- Vora, P. and A. Chapman, 2004. Complications from radiographer-performed double contrast barium enemas. *Clin. Radiol.*, 59 (4): 364-8.
- Westfall, R.H., R.H. Nelson and M.M. Musselman, 1966. Barium peritonitis. *Am. J. Surg.*, 112: 760.
- Zheutlin, N., E.C. Lasser and L.G. Rigler, 1952. Clinical studies on the effect of barium in the peritoneal cavity following rupture of the colon. *Surgery*, 32: 967.