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*For further information about this article or if you need reprints, please contact:*

Mohammad Arash Ramezani
General Practitioner
P.O. Box 76195-1473
Kerman-Iran

E-mail: ramezani_arash@yahoo.com

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# Comparison of Talc Powder, Starch and Sodium Bicarbonate to Postsurgical Adhesion Formation in Rat Model

[1]Hamid Zeinalynejad and [2]Mohammad Arash Ramezani

To find out Sodium bicarbonate comparatively with Talc and Starch in intraperitonealy adhesion formation an experimental study on rat model was designed. Forty eight female rats were selected divided randomly into four groups. After a laparotomy, in the first group, 0.7 mg Talc powder (sterilized with ethyl oxide) plus 3 cc normal saline; in the second group, 0.7 mg Sodium bicarbonate (sterilized with ethyl oxide) plus 3 cc normal saline; in the third group, 0.7 mg starches powder (sterilized with ethyl oxide) plus 3 cc normal saline and in the forth group (controlling group), 3 cc normal saline entered. Four weeks following surgery, adhesion formation was evaluated by modified Swolin scoring system. There was statistical significant difference between groups in adhesion grade. Talc group had the highest grade of adhesion ($P<0.001$) and bicarbonate was equal to control group. Multivariable analysis determined statistical significant difference between groups in adhesion parameters ($P<0.0001$). Present findings suggested Sodium bicarbonate gave at least adhesion. Despite of it is inexpensive and suitable substance for dusting glove powder but needs more study about it.

**Key words:** Adhesions, intraperitoneal, post surgical, talc, starch, sodium bicarbonate, Iran

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[1]Department of General Surgery, Afzalipour Medical Center, Kerman Medical University, Iran
[2]General Practitioner, Afzal Research Center, P.O. Box 76195-1473, Kerman, Iran

## INTRODUCTION

Adhesion and adhesion formations remain an important post surgical complication in pelvic and abdominal operations and are the source of consideration by surgeons[1,2]. Weibel and Majno[3] reviewed 298 subjects at post-mortem who had previous laparotomies and 67% of these showed adhesions, after multiple operations, the incidence rose to 93%. The most common cause of peritoneal adhesion is prior surgery.

The peritoneal healing differs from that skin. From the earliest days of abdominal surgery the fibrinous adhesions develop operational trauma area. This fibrin can be either reabsorbed completely from peritoneal cavity or become organized by fibroblasts and macrophages to form an established fibrous adhesion. Any mechanical trauma such as rough handling, using retractors, surgical clamp and bands, heat trauma damages, infections, tissue ischemia and foreign bodies that damages endothelium, cause fibrinous adhesions[1,4-6].

Trauma and ischemia have the most important roll in post surgical intraperitoneal adhesion formation, but foreign materials such as sutures and glove dusting powder facilitated and intensified adhesion formation. Two major materials which use for glove dusting powder are Talc and Starch powder. Both of them intensify adhesion formation[6-8]. In the previous study, we determined that Talc powder after abdominal or pelvic surgery informed adhesion bands severely[9]. Therefore the present study was conducted to find out a material which became less amount adhesion formation and was inexpensive.

## MATERIALS AND METHODS

The experimental study was designed. Forty eight female rats were selected. The mean weight of rats was 213 g, ranging between 142 and 268 g. These were divided randomly into four groups. All rat wasn't pregnant and kept in separately in cages with 12 h light and 12 h darkness and feed with special rodent regimen in Kerman Medical Sciences University Research Center for two weeks before starting of research procedures. Then each rat was anaesthetized by 25 mg Ketamine hydrochloride (Merck Co.-Germany) intraperitonealy. The rats were put on the supine position and abdominal wall hair was shaved, then prepped by poidine iodine solution. In the sterilized condition by sterilized surgical glove, a 2 cm incision was done in midline of abdomen and the uterus horns were exposed and were brought out from the abdomen. Then rough and thick piece of sterilized bandage was utilized to make some abrasions on the horns so there were some petechiae made in the area. The uterus horns was selected because of there same adhesion place in all rats.

Then, in the first group, 0.7 mg Talc powder (sterilized with ethyl oxide) plus 3 cc normal saline; in the second group, 0.7 mg Sodium bicarbonate (sterilized with ethyl oxide) plus 3 cc normal saline; in the third group, 0.7 mg starches powder (sterilized with ethyl oxide) plus 3 cc normal saline and in the forth group (controlling group), 3cc Normal saline entered. Abdominal layer was sutured with a 3/0 nylon in two layers, peritoneum and muscle-skin.

The rats (12 in each group) were kept in different cages in a same environmental condition (22-25 centigrade degrees temperature and a mean darkness and brightness-12 h). To avoid the infection, 10 mg $kg^{-1}$ Cephalexine capsules (Daroupakhsh Co.-Iran) were added to its water (the antibiotic was saluted for two days). Two rats from each group were died during the study.

Four weeks following surgery, the second investigator who was blinded about groups deviation anesthetized the rats. Then another incision for laparotomy investigation was made and the adhesion was evaluated as the modified Swolin system. After the adhesion points counting, evaluate the adhesion length and thickness. To assess the adhesion strength, the following method was done: The adhesion disconnection after a gentle stretching and handling was scored one. Disconnection after a panset tension scored as two and if there was no disconnection, the score was three. All above stage of study and procedure assessed had tried and examined according to previously study[9-12]. The data were confirmed as modified Swolin scoring system (Table1). Then were analyzed by SPSS-9 software package. Kruskal-Wallis test, Mann-Whitney test and ANOVA test were done. For multiple variable analysis Multiple variable ANOVA model and Hotelling's trace test were used.

## RESULTS

The adhesion grades assessed were shown in Fig. 1. There was statistical significant difference between groups. Talc group had the highest grade of adhesion ($P<0.001$).

In two by two groups' comparison, there was a statistical significant difference in talc group with three other groups. Group of Starch, Sodium bicarbonate and control didn't have any significant difference (Table 2). Comparison of other four adhesion parameters (frequency of adhesion points, adhesion strength, length and thickness) showed except thickness the rest of parameter

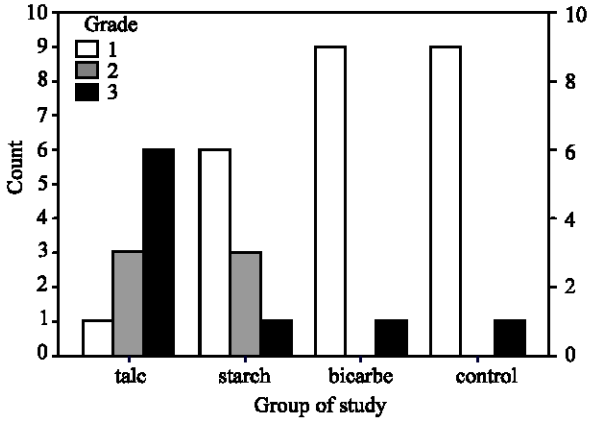


Fig. 1: Comparison of adhesions grade between study group Kruskal-Wallis test: X2=17.19, P<0.001

Table 1: Modified Sowlin scoring system for adhesion

| | Scale | | |
|---|---|---|---|
| Parameter | One | Two | Three |
| Frequency of points | 0-2 | 3-4 | >4 |
| Length | <2 | 2-10 | >10 |
| Thickness | <1 | 1-3 | >3 |
| Strength | + | ++ | +++ |

The scale 3-5 = grade I (Mild adhesion)
The scale 6-8 = grade II (Moderate adhesion)
The scale 9-12 = grade III (Severe adhesion)

Table 2: Two by two comparison of group of study

| Group of study | Mean rank | Mann-Whitney test |
|---|---|---|
| Talc | 13.75 | U=17.50 |
| Starch | 07.25 | P=00.01 |
| Talc | 14.35 | U=11.50 |
| Bicarbonate | 06.65 | P=00.002 |
| Talc | 14.35 | U=11.50 |
| Control | 06.65 | P=00.002 |
| Starch | 11.85 | U=03.65 |
| Bicarbonate | 09.50 | P=00.31 |
| Starch | 11.85 | U=03.65 |
| Control | 09.50 | P=00.31 |
| Bicarbonate | 10.50 | U=50.00 |
| Control | 10.50 | P=01.00 |

Table 3: Multivariable modeling* for adhesions parameter between groups

| Dependent variable | F | P value |
|---|---|---|
| Frequency of adhesions | 14.21 | P<0.0001 |
| Length of adhesions | 5.64 | P<0.0001 |
| Strength of adhesions | 9.81 | P<0.0001 |

Hotelling's Trace test: F=4.93, P<0.0001 Power=99.9%
* Multivariable ANOVA, General Linear Model

had statistical significant difference between groups. Therefore multivariable ANOVA model was used. It was taken for granted that group of study is independent variable and other significant parameters were dependent variable. Hotelling's trace multivariable test determined statistical significant difference in multivariable model (P<0.0001) with Power=99.9%. ANOVA modeling showed significantly between groups (Table 3). Post Hoc Tukey's test showed significant difference between Talc group with others (Table 3).

## DISCUSSION

Adhesion formation during surgical procedure remains the most common cause of intestinal obstruction and infertility in the Western worlds and small bowel obstruction by intra-abdominal adhesions is a serious cause of morbidity and mortality in surgical patients[13-19]. Analysis of large series of cases demonstrate that proximately one-third of all intestinal obstruction are likely to be due to adhesions and these are responsible for 60% of all small bowl obstructions[1].

Among the many well-known etiological factors responsible for peritoneal inflammatory reaction is surgical glove powder[7,8,20].

The investigators try to find material for surgical gloves that give at least adhesion. Talc and starch powder are common two materials that use in latex gloves, but both of them as a foreign body cause adhesion formation. Kamffer and coworkers showed that cornstarch in gloves forms adhesion postoperatively. They demonstrated that starch sterilized by auto clave caused adhesion formation less than other sterilization methods[21]. McEntee and coworkers showed starch powder caused adhesion formation twice as much as control group[22].

We presented Sodium bicarbonate as dusting glove powder. Present data suggested adhesion formation due to Sodium bicarbonate was less than Talc and Starch powder significantly. Sodium bicarbonate is inexpensive substance and suitable, In current study there aren't any complications but needs too more study that determine its complications and other factors.

This suggests that the intra-abdominal presence of foreign material is an important cause of adhesion formation. Therefore intra-abdominal contamination with foreign material should be minimized[7].

The major strategies for adhesion prevention or reduction are adjusting surgical practice and applying adjuvant. Surgeons should adjust their major practices by: 1) becoming aware of the potential adhesive complications of a procedure; 2) minimizing the invasiveness of surgery; and 3) minimizing surgical trauma, ischemia, exposure to intestinal contents, introduction of foreign material into the body and the use of talc- or starch-containing gloves; 4) washing surgical gloves by sterilized serum for reducing powder[6].

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