

Comparison between the Impact of Starch-Powdered Surgical Gloves and Powder-Free Surgical Gloves on the Formation of Postoperative Peritoneal Adhesions in Rats

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Article information	Abstract
<p>Article history: Received: 19 Jan 2011 Accepted: 17 Sep 2011 Available online: 29 Dec 2011</p> <p>Keywords: Adhesion Surgical glove Starch Rat</p> <p>*Corresponding author at: Shefa Neurosciences Research Center, Tehran University of Medical Sciences, Tehran, Iran. E-mail: adivanbeigi@farabi.tums.ac.ir</p>	<p>Background: Foreign bodies such as starch powder can be pointed as potential causes to bring about peritoneal adhesion. The aim of this study is to evaluate the role of starch-powdered surgical gloves and powder-free gloves on the formation of peritoneal adhesions.</p> <p>Materials and Methods: Sixty rats were divided randomly into two groups and then underwent laparotomy using surgical gloves, with and without starch powder (case & control groups). After two weeks, the place of injury was evaluated and the adhesion rate was recorded from 0 to 3 and then data were statistically analyzed.</p> <p>Results: There was a meaningful difference between the two groups in terms of adhesion rate, as the adhesion rate was more in case group.</p> <p>Conclusion: Using surgical gloves without starch powder for surgery operations is suggested.</p>

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Introduction

Intra-abdominal adhesions caused by peritoneal traumas often are formed through a former operation or intra-abdominal infections. Peritoneum may be damaged drastically when it touches the foreign bodies [1, 2]. Given the very expensive costs of bowel adherent obstruction surgery, preventing such adhesions is vitally important. A number of studies had been conducted or are being conducted with the aim of examining the effect the surgical gloves, as external elements, may exert on peritoneal adhesions in the case of touching the viscera [3-5]. Researchers have demonstrated that the decreased peritoneal fibrinolytic capacity caused by inflammation is accompanied with the increased adhesion [6-8].

Two recent studies on adhesion after surgery have shown that the most adhesion cases have been created as the result of foreign bodies' reaction after operation. The most common foreign bodies are powders, particularly starch powder, used to fabricate surgical gloves. Different studies have indicated that starch particles can provoke inflammatory reactions and granulomatosis and fibrosis during the initial months [9-11].

Initial studies on cellular immunity against starch powder in patients with granulomatous peritonitis showed that cellular immunity, prevention of macrophages

immigration and DNA synthesis are effective in response to stimulations caused by the starch powder and they can be involved in granulomatous peritonitis pathogenesis of starch powder and low-level chronic adhesions. The environmental factors (necessary to form fibrin) entrap starch parcels and then start an inflammatory local cell-mediated response which can lead to formation of granuloma [12, 13]. The study tries to fathom the effect the surgical gloves, with and without starch powder, may exert in forming abdominal adhesion.

Materials and Methods

In this study, which was exerted in the form of clinical trial on rats, the sample size was calculated based on the former studies. A total of 60 male rats (men: 250-300 gr.) were supplied from the Qazvin University of Medical Sciences' animal house. The lab administrator divided them randomly and blindly into two case and control groups, each included 30 rats, as neither surgeon nor his assistants were not aware about the grouping condition. The rats were kept in the lab environment set in 18°C and were fed with proper nutrition. Prior to conducting laparotomy, the abdominal area of rats was completely

shaved. Then it was prepped with Betadine solution. After that, 60mg/kg ketamine and 6mg/kg xylazine were injected intraperitoneally in order to induce local anesthesia.

Initially, under sterile condition, using normal gloves (without starch) an incision as long as 6 cm was made at the mid line of abdomen to open muscles and peritoneum; the surgeon marked cecum and held it with index and thumb fingers, then he made 5 scratches as long as 3-4 cm over the rat's cecum with a blue needle tip and the same scratches were made on parietal peritoneum. Then cecum was returned to the abdomen cavity and fascia, muscles and skin were repaired and sutured in two layers with nylon thread through running technique.

All mentioned steps were repeated with surgical gloves made of starch powder for thirty other rats. Rats of each group were marked by the lab administrator and they were returned to the animal house after finding their full consciousness through a special basket. The lab administrator was who only person informed about marking procedure. After two weeks, while all rats were completely healthy and did not suffer from any postoperative complication, they underwent anew laparotomy as same as the previous method.

The trauma formed through the former surgery was examined and adhesion rates due to trauma were recorded as "0" without adhesion, "1" with a fine adhesion which is released very easily, "2" fibro bonds which need to dissection and "3" solid and extent adhesions which should be dissected with surgical scissors. Finally, relying on Helsinki protocol all rats were killed hygienically using chloroform solution and then pathological samples were sent to be clinically approved. After collecting data, they were analyzed using SPSS-18 software. Findings were offered as statistical tables, figures and numerical indices. Student *t*-test was used to analyze data and the significant level was considered at $p < 0.05$.

Results

For the group which operated using starch-powder glove, adhesion was observed for all cases and the rate "3" was reported for the most frequency in 14 cases (46.7%). Eight cases (26.7%) were reported with "1" and "2" rates. For without powder group, 14 (46.7%) cases were reported without adhesion and the lowest frequency was 4 cases (13.3%) with "1" and "3" and eight cases (26.7%) were reported with "2" rate. Table 1 shows frequency percent and adhesion rate in groups.

Table 1. Frequency percent and adhesion rate in groups

Adhesion Grade	With starch powder	Without starch powder	Total
	Numbers (%)	Numbers (%)	
0	0(0)	14(46.7)	14(23.3)
1	8(26.7)	4(13.3)	12(20.0)
2	8(26.7)	8(26.7)	16(26.7)
3	14(46.7)	4(13.3)	18(30.0)
Total	30(100)	30(100)	60(100)

The statistical test showed a significant relationship between type of gloves and adhesions grade. As for the case group, the adhesion rate was significantly higher ($p=0.013$). Figure 1 compares the two groups in terms of adhesion. Pathology report approved diagnosis of adhesion and non-adhesion in all cases and it was in accordant with the clinical diagnosis during operation.

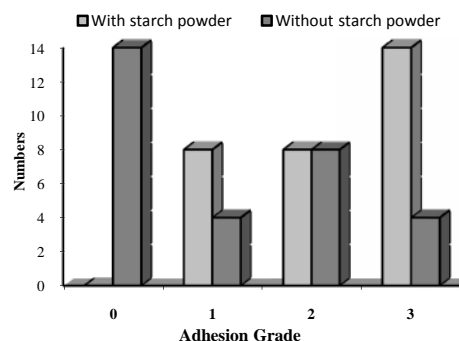


Figure 1. Comparison of groups in terms of adhesion rate

Discussion

In our study, the adhesion rate was higher in the group which has been operated using gloves made of starch powder and its statistical level was in a meaningful level, as the most adhesions belonged to grade "3" and are found in the group with the starch powder, while adhesions in the group without powder were of lower grade. Several biochemical studies on the adhesion mechanism have shown that talc and starch play notable provoking role which seemingly are in accordant with the clinical results gained from this study.

Peritoneal adhesion usually caused through a mesothelial trauma rather inducing with starch; however starch particles may exert a synergic effect along with the surgical trauma [9, 13]. In this study, three different groups of rats examined. The first group was treated with intra-abdominal application of powder obtained from starch-powdered gloves, the second group was treated with pure starch and the third one received no treatment. Both adhesion and formation of tumoral cells were lower and higher in third and second group respectively. It was concluded that using starch not only induces formation of adhesion, but increases adhesion and growth of tumoral cells [13].

In another study, the effect may surgical gloves exert on formation of peritoneal adhesion and cytokines alterations after surgical operations in rats was evaluated. No peritoneal adhesion was seen in rats operated using synthetic gloves without powder. Adhesion rate was increased in cases in which synthetic gloves with powder and latex gloves without powder had been used, also, such increased peritoneal adhesion was observed in latex gloves with powder and serum cytokines were enhanced after operation [2]. Sjosten and his colleagues studied the

effect of powder gloves in rabbits vagina before and after operation and they concluded that using starch powder gloves in control group is accompanied with movement of powder particles from vaginal into abdominal cavity where a clear peritoneal adhesion has been induced after operation [4].

Cooke and Hamilton studied 20 patients with granulomatous peritonitis who were subjected to laparotomy to get rid of adhesion. They concluded that contamination with starch is very common to pelvic cavity and formation of the starch granuloma is induced during the early months [9].

Just as other similar studies, this study indicated that intra-abdominal adhesion mechanism is not only limited to the foreign particles but other elements such as peritoneal trauma and ischemia are involved with; however, any foreign particle will accelerate the pace.

Given the two-week process of adhesion formation, it seems that starch particles induce a faster and wider adhesion. Our study which was carried out during the two first weeks, when premature peritoneal adhesions are formed, illustrated the dominant role of starch to form adhesions.

As the clinical diagnosis of adhesions was completely verified by pathological tests, a macroscopic study would be useful in analyzing adhesion length, number and locus of adhesions.

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The avoidance of prolonged exposure to the external particles during abdominal and pelvic surgeries through more precise techniques and avoidance of excessive manipulation can be very proper methods to decrease post-operative adhesions. Accordingly, it is highly proposed to surgeons to use gloves without starch powder and to cleanse and replace them during long surgeries.

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Authors' Contributions

The study presented here was carried out in collaboration between all authors. AG, HP and MN defined the research theme. AJ, AG, AD and MN designed methods, AF carried out the pathological experiments, AJ and AD analyzed the data, and AD wrote the manuscript. HP, AJ and MN co-discussed analyses and interpretation.

Conflict of Interest

None declared.

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