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The Investigation of Whether the Choice of Medical Sponge in Sinus Surgery Has a Different Effect on the Recovery Period of Adhesions

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Abstract. Medical sponges play a vital role after surgery for hemostasis. However, for sinus surgery, using medical sponges will also bring one complication: adhesion. This research investigates the relationship between the choice of medical sponge in sinus surgery and the recovery period of adhesion. The method is to give out questionnaires to the professional ENT doctors in 21 hospitals in Jiangsu, one of the most productive regions in China, asking them to asses the performance of three types of medical sponges(expansion sponge, gelatin sponge, and absorbable nasopore) on the recovery period of adhesions. The result shows that the possibility of adhesions is greatest for the expansion sponge and least for the absorbable nasopore. The severity of their adhesions is almost the same. The recovery cycle takes the longest for gelatin sponges and the shortest for expansion sponges. As a result, for the future choice of medical sponges, it is recommended to choose expansion sponges and nasopore.

Keywords: adhesion, sinus surgery, recovery period, expansion sponge, gelatin sponge, absorbable nasopore.

1. Introduction

Surgery is used to diagnose and treat diseases in order to relieve physical disorders, remove diseased tissue from the body, transplant organs, and improve the functional form of the body. With the development of surgery, surgery can be performed on any part of the body[1]. For example, sinus surgery is performed by cutting holes in the nasal cavity. Sinus surgery can cope with chronic rhinitis, olfactory disorders, nasal tumors, and malignant nasal lesions. Sinus surgery, on the other hand, is associated with common complications such as persistent wound bleeding and adhesions. The most common filling materials on the market today are medical sponges: expansion sponges, gelatin sponges, and absorbable nasopore. Among them, the expansion sponge cannot be absorbed by the body, while the gelatin sponge and absorbable NasoPore can be absorbed by the body. Due to the non-absorbable nature of the expansion sponges, they need to be removed manually, which is very irritating to the nasal mucosa. The process of removal is also very painful for the patient. In contrast, the use of absorbable sponges can reduce the pressure on the wound and the pain caused to the patient, making the patient more comfortable.

However, even if you choose an absorbable sponge, you will need to rinse it with concentrated saline at a high frequency after the procedure. If the patient does not pay attention to this process, the sponge left inside the nasal cavity can cause adhesions to form between the turbinates and the side of

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the nose, leading to adhesions. Therefore, studies have been conducted to combine the original sponge with a new solvent in an attempt to further reduce the probability of adhesions. For example, steroids can be applied topically to the wound after surgery. This substance can promote wound healing and reduce swelling and granulation formation. Studies have shown that otorhinolaryngology chitosan-dextran gel(CD gel) can be highly effective in stopping bleeding. It can also enhance wound healing properties[2]. Several previous studies have demonstrated the effectiveness of different sponges in preventing adhesions to varying degrees. But no matter what, adhesions are likely to occur. If adhesions do occur, what kind of sponge will allow the patient to recover faster and thus be free of pain? This is an area that has not yet been explored in depth in nasal filler materials. The purpose of this study was to investigate whether the choice of different sponges has an effect on the recovery period of adhesions after sinus surgery, and if a relationship exists, to find out what sponges possess the fastest rate of adhesion recovery. The hospital's selection of medical sponges for sinus surgery was based on price, brand, and adhesion rate. This study may provide hospitals with a new metric: the recovery period after adhesions. It will help hospitals make a more comprehensive judgment and select the most suitable hospital sponges to reduce the pain of patients with surgical nasal filling materials.

2. Literature Review

Surgery is a means of curing the body through tools. Clinical treatment is performed through an opening in the body[1]. Common impairments in the human body include hearing impairment, visual impairment, olfactory impairment. These disorders can be appropriately alleviated by surgery. For example, endoscopic sinus surgery (ESS) can bring positive results in improving the sense of smell after nasal endoscopic sinus surgery[3]. Treating olfactory disorders through ESS will be more effective than medication alone[4]. Also, the study by Rudmik's group has shown that ESS therapy is more cost-effective than continuous drug therapy alone[5]. Sinus surgery deals with more than just olfactory disturbances. Chronic rhinosinusitis(CRS) is also a condition that sinus surgery can effectively manage. CRS affects approximately 4.5-12% of the North American population. More than 250,000 procedures are performed each year in the United States to effectively intervene in CRS[6]. However, while sinus surgery does intervene effectively in disorders such as olfactory disorders, CRS, but it also has some common complications. There are two common complications: one is postoperative bleeding and the other is adhesions. Excessive bleeding in the former is likely to lead to life-threatening conditions for the patient. Adhesions, on the other hand, are the reason why most refurbished surgeries are performed[7]. Weber, R.K.'s study shows that adhesions are not uncommon. Adhesions occur in 10% of sinus surgeries[4]. Nasal filler, which is the medical sponge, is often used after sinus surgery to effectively reduce complications. It can control bleeding after surgery, prevent the middle turbinate from deviating and adhesions from forming[8]. A good nasal filler should not only control postoperative bleeding, but also promote wound healing without affecting the wound, while not making it uncomfortable for the patient. It should be easy to insert and remove from the nasal cavity[9]. The most common nasal hemostatic filling materials on the market today are expansion sponges, gelatin sponges and NasoPore. Medtronic is a world-renowned medical company whose product Merocel hemox is the preferred expansion sponge for sinus surgery. Wang's research group shows this sponge is a foam type, made of hydroxylated polyvinyl acetate polymer. It is affordable and easy to handle and has the advantages of good wet elasticity and strong support[8]. However, this sponge is not absorbed by the body. It needs to be removed and the removal process is very painful. At the same time, the material of this expanding sponge can adhere to the nasal mucosa, triggering edema and continuous bleeding of the mucosa[10].

In contrast, nasopore, another filler material, has better clinical performance than expansion sponge. Romano's research finds that Nasopore is a bioresorbable material that absorbs blood while supporting the internal tissues of the nasal cavity, providing pressure on bleeding blood vessels. It begins to dissolve within a day and is aspirated out of the nasal cavity after a few days[10]. The researchers compared both Merocel Hemox (expansion sponge) and nasopore. They randomly assigned 72

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patients to two groups, one using Merocel Hemox to fill the nasal cavity after surgery and the other using nasopore. In contrast, 69.4% of the patients with nasopore showed no adhesions. The results suggest that the use of nasopore is effective in reducing adhesions. However, the study by Wang's group doesn't show this advantage. Their study likewise compares these two materials. It does not definitively show which is better, Merocel or nasopore. Although nasopore was more comfortable for the patient, with less pain and wound compression, there was no significant difference in terms of wound healing and adhesions between the two[8]. Both studies demonstrate that the use of nasopore gives the patient a better experience and reduces the pain of the wound as well as the compression caused by the material filling. Also, another material can be absorbed by the body as well as nasopore: gelatin sponge. As a water-soluble compound, gelatin sponge has excellent biocompatibility as well as degradability. It can promote platelet aggregation and effectively stop bleeding[11]. Gelatin sponges, on the other hand, can provide adequate wound contact and effective hemostasis, but their mechanical strength is not ideal. This means that the porous three-dimensional structural scaffold of the gelatin sponge inserted into the nasal cavity is not stable and is difficult to maintain. This drawback can only be repaired by strengthening this sponge with a suitable material [12].

Both the gelatin sponge and nasopore can be categorized as biodegradable sponges. On the contrary, the expansion sponge is non-biodegradable sponge. Burduk's study shows that biodegradable sponges can perform better than non-biodegradable sponges. The trial used a computer to randomly assign a total of 50 patients to which side of the nose to use biodegradable sponge and which side to use non-biodegradable sponge. The results show that the wound pressure and nasal congestion were much less on the side with biodegradable sponge than on the other side. This not only improves the overall comfort of the patient but also allows the wound to heal better. However, even with biodegradable sponges, the postoperative period must be flushed three to four times a day with fortified saline. If the patient is not aware of the need to rinse the nasal cavity several times, adhesions are likely to form even if nasopore is used. After the dissolvable material is left in the nasal cavity for more than ten days, it forms a bridge between the nasal turbinates and the side of the nose, which acts as a point for the formation of adhesions[13].

Therefore, to effectively reduce the occurrence of adhesions at the root, several studies have attempted to add new materials or fluids to the original sponge. For instance, The researchers added chitosan to the sponge. This is a natural product derived from the shells of marine crustaceans. It possesses biomedical properties such as rapid blood clotting, antibacterial and hypoallergenic. The results showed that the chitosan-infused sponge not only had no side effects but also stopped bleeding quickly and reduced adhesions[7]. Elhussieny, F's research group uses Mitomycin-C to prevent adhesion. They placed 0.5 mg/ml MMC solution in the nasal cavity for 5 minutes at the end of each procedure. The pads soaked in 1 ml were inserted into the nasal cavity and removed after 2 days. The use of the MMC solution was also effective and safe in stopping adhesions compared to the control group that did not use MMC solution[14]. However, another study shows that if Mitomycin-C is used, it can lead to the formation of granulation around the wound. Therefore it is not that effective. The study further more states that a mixture of hyaluronic acid(HA) and CMC(HA-CMC) is effective in preventing adhesions. Because the body does not have the enzymes to degrade CMC, this substance stays on the surface of the wound for a long time, but does not compress as tightly as a sponge. HyFence, on the other hand, is a gel containing HA, which also stably stays and blocks adhesions because of its low water solubility and high viscoelasticity[15].

3. Methodology

The purpose of the research is to determine whether the choice of medical sponge affects the severity of adhesion and the patient's recovery period if adhesions occur during sinus surgery. It uses the quantitative method. A questionnaire is designed to be distributed to the doctors.

The first is where to distribute the questionnaires. The scope should be limited to control for extraneous variables. Different regions in China have different economic levels. Therefore, the manpower and advanced level of hardware of hospitals in different regions are different. If a regional

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hospital with insufficient human resources and surgical equipment that does not work well enough is chosen, the recovery time for post-operative adhesions will also be greatly affected. Inadequate doctors can lead to improper wound management, and poor surgical equipment can also lead to poor wound management. To avoid being overly influenced by these factors, the location was chosen in Jiangsu. Jiangsu is one of the most productive regions in China, located in the Yangtze River Delta region, with abundant hospital human resources and advanced surgical equipment. All questionnaires were therefore distributed only to hospitals in Jiangsu province. Secondly, the surgery type should be limited. Different types of surgeries have diverse choices of medical sponges. If the sponges are used in different types of surgery, comparing their functions and impact is meaningless since some medical sponges are designed only for the specific type of surgery. In sinus surgery there are mainly three sponges used: expansion sponge, gelatin sponge and absorbable nasopore. Comparing different types of sponges in one surgery will be more valid.

The third is the design of the questionnaires. The questionnaire consists of several parts. The first question is "Where is the hospital you work". The second question is a multiple choice question. It asks about the medical sponges your hospital use. The first three options are expansion sponge, gelatin sponge and absorbable nasopore. The last option can fill in the blank. If the variety of sponges used in this medical practice is not one of the three options above, the physician can fill in their variety of sponge used in their hospital. Each type of sponge will have four questions. The first question is "what is the model and brand of expansion foam used in your hospital". This is a fill-in-the-blank question. Because of the wide variety of brands that can be chosen for the corresponding sponge, it is not possible to collect all the brands for multiple-choice questions. The second question asks whether will adhesion appear if you use this kind of medical sponge. The third question is a scale question. It asks about the severity of the adhesion. The scale is from 1 to 5. This range was chosen because it is reasonable in scope. If it were 1 to 3 it would be too extreme, and if it were 1 to 7 the range would be too wide, which would also make it difficult to choose. The fourth question is a fill-in-the-blank question. It asks that "approximately how long does it take for a patient to fully recover from this level of adhesions in this type of sponge". The level of adhesion is related to the third question. Each type of sponge has these four questions to answer. This is related to which sponges are used in the hospital chosen by the doctor earlier. If you choose two sponges, then you will need to answer questions for both sponges. There are eight questions in total. At the same time, it is also stated at the top of the questionnaire that the questionnaire is anonymous and will not disclose personal information to the public, so please feel free to fill out the questionnaire. This way doctors will be more relaxed and more willing to fill in the real information.

4. Results

The questionnaire was distributed to six cities in Jiangsu Province: Wuxi, Suzhou, Changzhou, Zhenjiang, Huaian, and Yancheng. The questionnaire collected information on medical sponges from a total of twenty-one hospitals in six cities.

Figure 1 depicts the probability of postoperative adhesions in sinus surgeries. Adhesions are most likely to occur after the use of expanding sponges. The percentage is 46.7%. The absorbable nasopore has the lowest adhesion rate. It is 12.5%.

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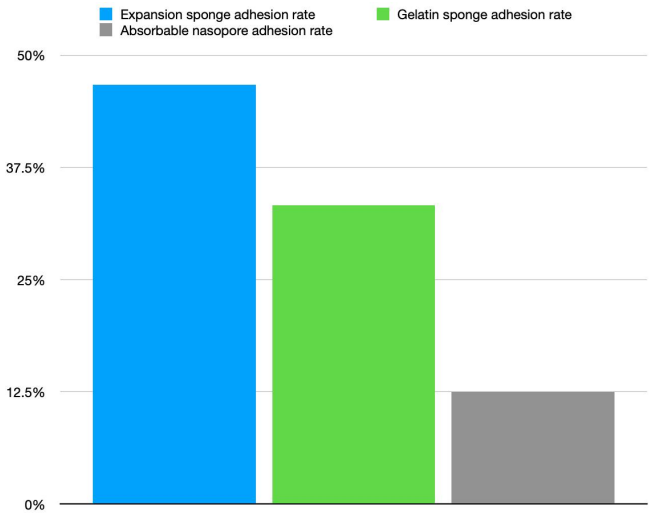


Figure 1. Medical sponge adhesion rate.

Figure 2, Figure 3, and Figure 4 depict the severity of adhesion of each type of sponge. Each column represents one hospital. Figure 5 put the average severity of adhesion rate of three sponges into one histogram. It shows that expansive sponge has the most severe adhesion. Severity is represented by a scale of one to five and expansive sponge gets 1.8. The absorbable nasopore has the least severe adhesion. Its severity is represented by 1.286.

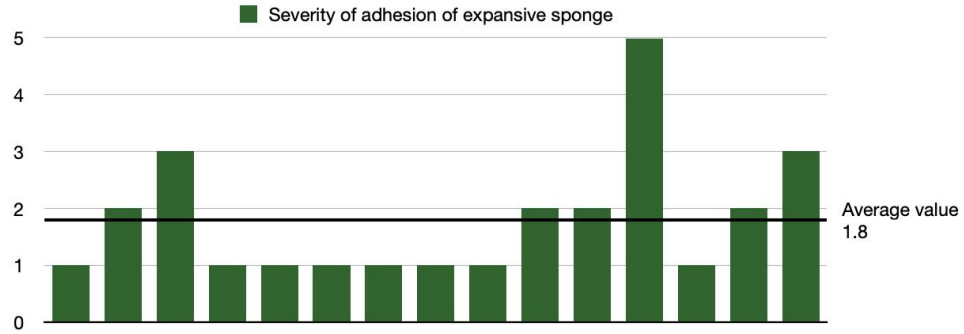


Figure 2. Severity of adhesion of expansive sponge.

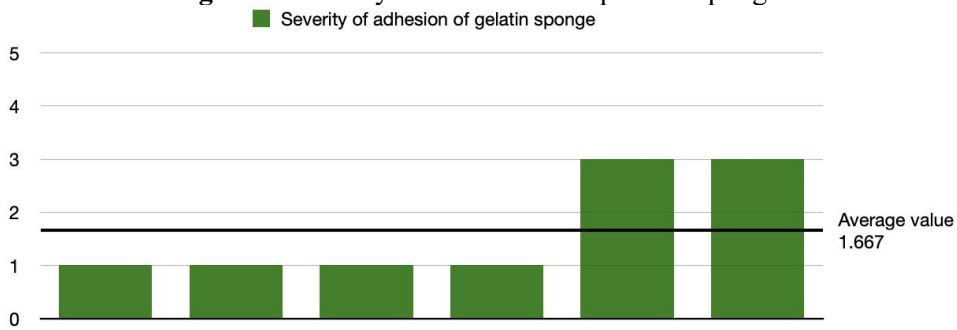


Figure 3. Severity of adhesion of gelatin sponge.

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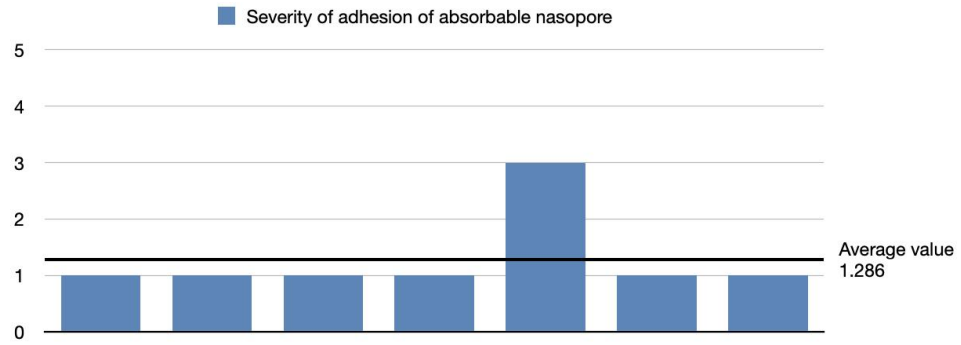


Figure 4. Severity of adhesion of absorbable nasopore.

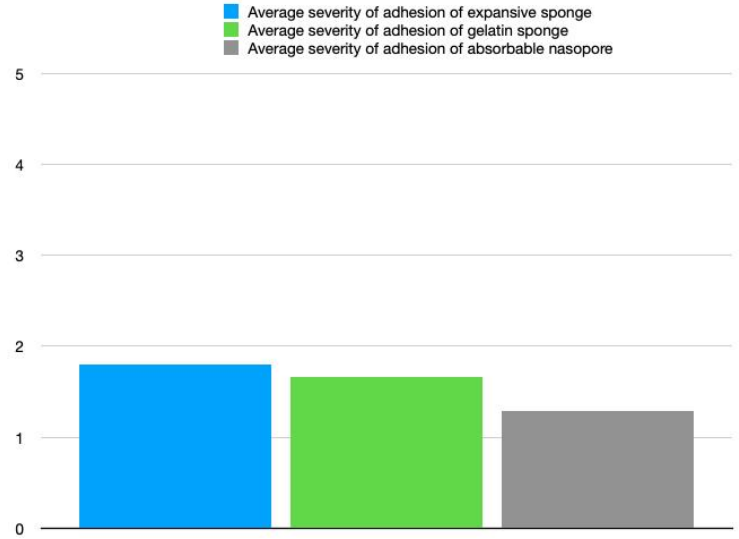


Figure 5. Average severity of medical sponge adhesion.

Figure 6, Figure 7, and Figure 8 depict the adhesion recovery cycle. Each column represents one hospital. On the y-axis, x:x represents week plus day. If it is 1:1, it represents one week and one day. Figure 9 shows the average adhesion recovery cycle of each type of sponge. It shows that gelatin sponge has the longest recovery period which is around 6 days and expansive sponge has the shortest recovery period which is around 2 weeks.

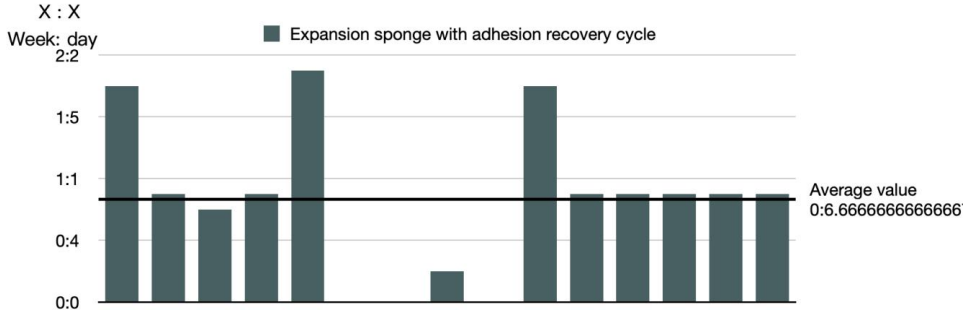


Figure 6. Expansion sponge with adhesion recovery cycle.

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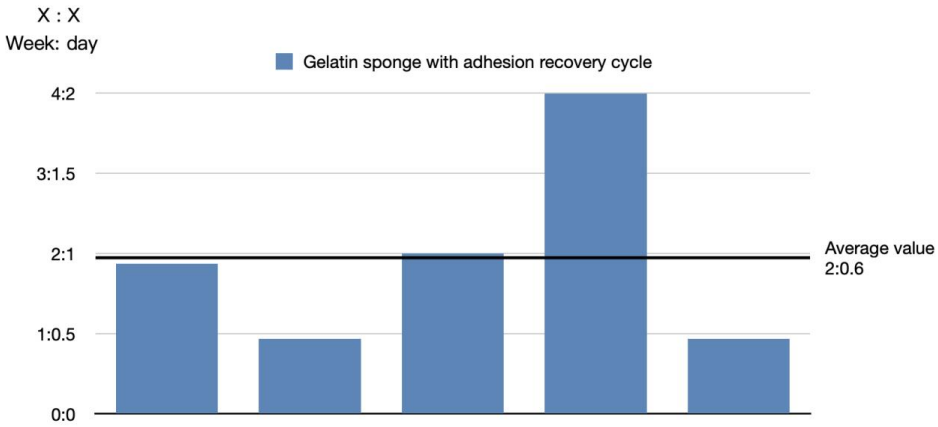


Figure 7. Gelatin sponge with adhesion recovery cycle.

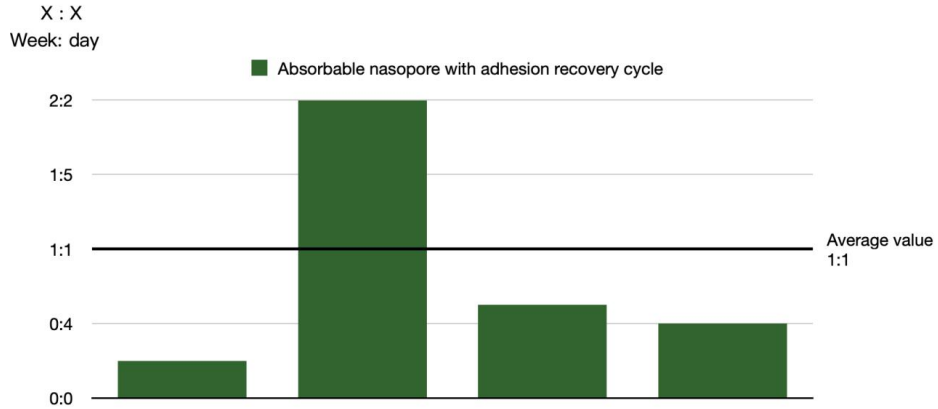


Figure 8. Absorbable nasopore with adhesion recovery cycle.

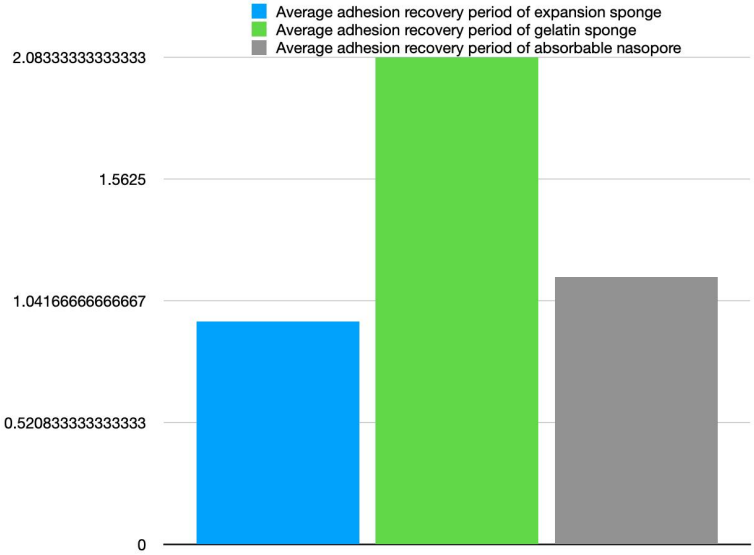


Figure 9. Medical sponge with average adhesion recovery cycle.

Figure 10 and Figure 11 analyze the selection probabilities for different types of sponges and the brand of the medical sponges in the 21 hospitals. Figure 10 analyzes the probability of a particular type of medical sponge appearing in a hospital. It shows that expansive sponge is the most commonly chosen sponge in hospitals and the percentage is 71.4%. Figure 11 shows that Medtronic is the brand that more hospitals preferred, and it is followed by Stryker. Figure 12 depicts the average market price

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of the three types of medical sponges. It shows that the absorbable nasopore has the highest price: 400 yuan. The expansion sponge is much cheaper: 100 yuan. The price of different brands of gelatin sponge varies greatly. If the gelatin sponge is produced in China companies, its average price is 60 yuan. If the sponge is produced abroad by Medtronic, its average price is 120 yuan, which is twice the price of gelatin sponge produced in China.

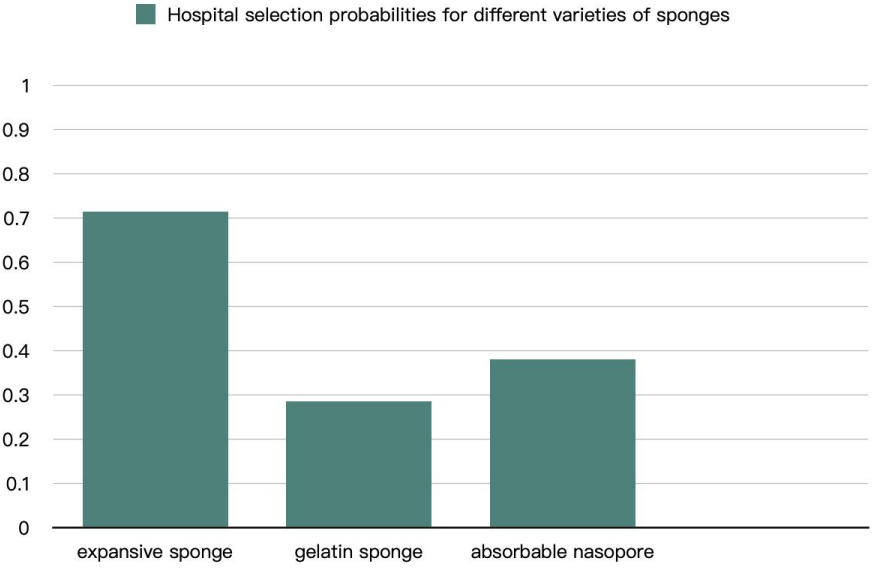


Figure 10. Hospital selection probabilities for different varieties of sponge.

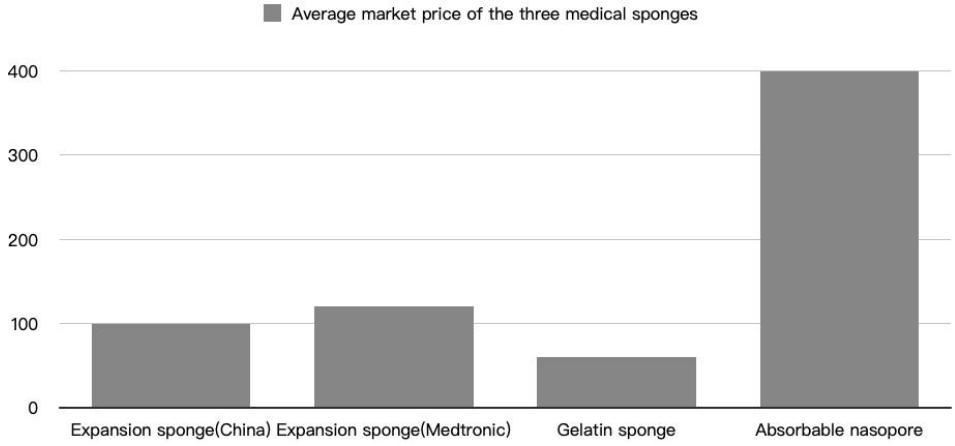


Figure 11. Average market price of the three medical sponges.

5. Discussion

The purpose of this study is to determine whether the choice of medical sponge affects the patient's recovery period if adhesions occur during sinus surgery and to make subsequent recommendations to hospitals.

Figure 1 shows that expansive sponge has the highest adhesion rate, which is 46.7%. Absorbable nasopore has the lowest adhesion rate, which is 12.5%. This means that the expansion sponge is very prone to adhesions during surgical hemostasis to remove the sponge. If an expansion sponge is used, adhesions will occur roughly every two surgeries. This is related to the principle of hemostasis of the expansion sponge. The expansion sponge expands rapidly when it encounters liquid and rapidly compresses the wound to stop bleeding. This can be analogous to the pressure to stop bleeding in daily life. However, the tight fitting of the wound also causes the expansion sponge to adhere to the clotted blood on the wound surface. Removal of the sponge can lead to adhesions, and re-rupture of the

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wound. It is supported by the previous study by Romano. Once adhesions occur, this means that the wound was not properly treated during surgery. Figure 5 in the result part shows the severity of the adhesion.It analyzes if the adhesion happens, and how severe it is. The severity of adhesion is the most severe in the expansion sponge. On a scale of 1 to 5, expansive gets an average score of 1.8. Nasopore gets an average score of 1.286, which is the lowest. In general, there was not large difference in the severity of adhesions between the three sponges. Because they are all within the 1 to 2 point range. This indicates that even if adhesions are present, they are not very severe.

Figure 9 analyzes the recovery time required after the appearance of adhesions. It shows that expansive sponge has the shortest recovery cycle. Its average recovery rate is about six days. Gelatin sponges takes the longest time to get recovered if adhesion appears. It requires 2 weeks for a patient to recover. It is surprising because the expansion sponge and gelatin sponge have almost the same principle of hemostasis. The only difference is that most of the gelatin sponge is absorbable. It will be completely absorbed in about one to three months. The expansion sponge is thought to take longer to recover adhesions than the expansion sponge that needs to be manually removed postoperatively. However, the result has shown that gelatin sponges with adhesions take more than twice as long to recover as expansion sponge. It refutes the initial hypothesis. This research hypothesizes that the expansion sponge will have the longest recovery time. Referring back to Figure 7 which shows the gelatin sponge with adhesion recovery cycle, one hospital has an extremely high recovery time. Zhengjiang First People hospital(the fourth column in Figure 7) states that if adhesion of gelatin sponge appears, it will need one month for a patient to recover. This data increases the average. Because this hospital did not provide information on the brand of sponge they use, it is not possible to study the relationship with the sponge brand issue. It may be assumed that the sponges used by this hospital are not of high quality(compared to other hospitals that use gelatin sponges). Perhaps the brand they use is an unknown and inferior brand, perhaps the sponges they have recently used have been stockpiled in the warehouse for too long, or perhaps the physician who filled out the questionnaire overestimated the recovery time needed for the patient. If the data of Zhenjiang First People's Hospital in Figure 7 are removed, then the new average adhesion recovery period obtained for the gelatin sponge is 10.75 days, which is approximately 1.5 weeks. Although 1.5 weeks is still the longest recovery time required of the three sponges, the new average reduces the difference in recovery time between the original gelatin sponge and the expansion sponge and nasopore adhesions. However, 10.75 days is still the longest recovery period among the three sponges. It still refutes the original hypothesis. Overall, gelatin sponges have the longest adhesion recovery period, regardless of the presence or absence of extremes.

In summary, different varieties of medical sponges do have an impact on the recovery period if adhesions occur. This confirms the idea that there is a relationship between the two. But the prediction at the beginning was that the expansion sponge would need to have the greatest impact on the patient and require the longest recovery time, while the absorbable nasopore would require the shortest recovery time. However, the result runs to the contrary: the expansion sponge requires the shortest recovery cycle. This may have something to do with the inaccurate data given by the doctors. This relates to one limitation in the research: the bias introduced by the subjective estimated value. Although ENT doctors already have done a lot of surgery and have plenty of clinical experience, their answers may not be entirely accurate. For example, when answering the recovery cycle, most doctors estimate the recovery time. The answer given by the doctor is most likely an estimate. It is not very accurate and might be influenced by various biases. This may only yield a general trend for the analysis of the results and not a very inferential statistical model.

Figure 10 and 11 indicate that hospitals prefer to choose expansive sponge. The brands they prefer are Medtronic and Stryker. Both of two are foreign brands. Figure12 shows that the lowest sponge price is gelatin sponge made in China. The second lowest price is the expansion sponge. The expansion sponge is less expensive. Although it has a high probability of adhesions, according to this study, the recovery period for adhesions is shorter, so this might also explain why more hospitals are willing to choose this sponge, if their self-reported recovery data are accurate. In contrast, hospitals do

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not tend to choose gelatin sponges even though they are less expensive because of the relatively long adhesion recovery period. If imported gelatin sponges are chosen, the price is even higher than that of expanded sponges. Absorbable nasopore has good overall performance: low instance rate of adhesion, low severity of adhesion, and relatively short recovery cycle after adhesion. The only drawback is its high price, it is four times more expensive than the expansion sponge.

In this research, the number of the samples are limited. The ideal sample size is at least fifty. Because of the epidemic, there were control restrictions in Jiangsu Province. The access to hospitals and giving questionnaires to doctors to fill out became difficult. So in the end, only data from twenty-one hospitals were collected. If the sample size is sufficient, the results will be more accurate and reliable. Future study should include a larger sample size. A larger sample size reduces the influence of extreme values on the final results of the study. Also a larger sample size can make it more representative and generalizable for wider hospital implications.

6. Conclusion

This study shows that different varieties of medical sponges do have an effect on the recovery cycle. The probability of adhesions was greatest for the expansion sponge and least for the absorbable nasopore. The severity of their adhesions was approximately the same. The recovery cycle took the longest for gelatin sponges and the shortest for expansion sponges. Therefore, for the future choice of medical sponges, it is recommended to choose expansion sponges and nasopore. The expansion sponge is affordable, even though adhesions are more likely to occur, they are not serious and the sponge has the fastest recovery period, based on the self-reporting done for this study. If the hospital has a larger budget, NasoPore is recommended. It has excellent overall performance: low adhesion rate, low severity of adhesion, and short recovery period. As for the future direction of study, the design of the questionnaire should be further optimized. When filling out the "brand and model of medical sponges used in hospitals", many of the questionnaires are left blank. Doctors are reluctant to write a lot of words about the brand of sponges used in hospitals because of time constraints and precautions. In the future, the time given to ENT doctors to fill out the questionnaire should be more rationally selected and not overly rushed. At the same time, it should be further clarified that the purpose of the use of the data is only a data collection of student literature and not some company collecting intelligence about the market. Otherwise, the doctor will not be able to let down his guard and fill out the questionnaire with complete trust. In the future, when designing the question, instead of setting "the brand of medical sponge used by the hospital" as a fill-in-the-blank question, several options are provided, such as Medtronic and Stryker. The last option of the question can remain a fill-in-the-blank, open question where the doctor can enter an unmentioned brand used by the hospital itself. This would guide the physician to browse through the options saving time and making it more likely to have this question more widely answered instead of being left blank. This will give more accurate information about the sponge brand. Thus, the recommendation of sponge varieties can be more accurate.

Moreover, the study shows the data about the gelatin sponge's recovery cycle after the adhesion. Although the hospitals use the same type of sponge, which is gelatin sponges, the recovery rate after adhesion can be very different. One hospital claims that the patients only need one week to get fully recovered. However, one hospital claims that they need a month. The difference between one week and one month is really large, especially under the same type of sponge. As a result, future research can start at this point after confirming that this in fact the case by surveying a larger sample: In the case that the main components of gelatin sponge are roughly the same, what other components or anything else of gelatin sponge cause the great difference in the recovery period after adhesion or to find if there really is such a large difference in recovery times for this type of sponge.

References

[1] *T*ashimaia, K. Overview on Importance of a Surgery. https://www.semanticscholar.org/paper/Overview-on-Importance-of-a-Surgery-

DOI: 10.54254/2753-8818/3/20220375

Tashimaia22b1a21d4e74fe338ceef6b169fdc7676c45e9c4. (2021)

[2] Ha, T., Valentine, R., Moratti, S., Hanton, L., Robinson, S., & Wormald, P. J. The efficacy of a novel budesonide chitosan gel on wound healing following endoscopic sinus surgery. *International Forum of Allergy & Rhinology*, **8(3)**, 435–443. (2017)

[3] Andrews, P., Poirrier, A. L., Lund, V., & Choi, D. Outcomes in endoscopic sinus surgery: olfaction, nose scale and quality of life in a prospective cohort study. *Clinical Otolaryngology*, **41(6),** 798–803. (2016)

[4] Weber, R.K. [Comprehensive review on endonasal endoscopic sinus surgery]. Laryngo- rhino-otologie, 94 Suppl 1, S64-S142. (2015)

[5] Rudmik, L., Soler, Z. M., Mace, J. C., Schlosser, R. J., & Smith, T. L. Economic evaluation of endoscopic sinus surgery versus continued medical therapy for refractory chronic rhinosinusitis. *The Laryngoscope*, **125(1),** 25–32. (2015)

[6] Stein, N. R., Jafari, A., & DeConde, A. S. Revision rates and time to revision following endoscopic sinus surgery: A large database analysis. *The Laryngoscope,* **128(1)**, 31–36. (2017)

[7] Chung, Y. J., An, S. Y., Yeon, J. Y., Shim, W. S., & Mo, J. H. Effect of a Chitosan Gel on Hemostasis and Prevention of Adhesion After Endoscopic Sinus Surgery. *Clinical and Experimental Otorhinolaryngology*, *9(2),* 143–149. (2016)

[8] Wang, J., Cai, C., & Wang, S. Merocel versus Nasopore for Nasal Packing: A Meta-Analysis of Randomized Controlled Trials. *PLoS ONE*, **9(4)**, e93959. (2014)

[9] Kastl, K., Reichert, M., Scheithauer, M., Sommer, F., Kisser, U., Braun, T., Havel, M., & Leunig, A. Patient comfort following FESS and Nasopore® packing, a double blind, prospective, randomized trial. *Rhinology Journal*, **52(1)**, 60–65. (2014)

[10] Romano, A., Salzano, G., Dell'Aversana Orabona, G., Cama, A., Petrocelli, M., Piombino, P., Schonauer, F., Iaconetta, G., Salzano, F.A., & Califano, L. Comparative study between biodegradable nasopore (BNP) and Merocel hemox 10 cm after septo-turbinoplasty procedure. *European Review for Medical and Pharmacological Sciences,* **21(4)**, 669-673. (2017)

[11] Wang, B., Johnson, A., & Li, W. Development of an extracellular matrix-enriched gelatin sponge for liver wound dressing. *Journal of Biomedical Materials Research Part A*, **108(10)**, 2057–2068. (2020)

[12] Chang, X., Wang, M., Du, L., Liao, L., He, L., Zhou, H., & He, L. A Pilot Investigation Generating an Alternative Therapeutic Strategy Combining Deproteinized Bovine Bone and Gelatin Sponge for a Novel Implant Material in Sinus Floor Elevation Operation. *Medical Science Monitor*, **27**. (2021)

[13] Burduk, P. K., Wierzchowska, M., Grześkowiak, B., Kaźmierczak, W., & Wawrzyniak, K. Clinical outcome and patient satisfaction using biodegradable (NasoPore) and non-biodegradable packing, a double-blind, prospective, randomized study. *Brazilian Journal of Otorhinolaryngology*, **83(1),** 23–28. (2017)

[14] Elhussieny, F., Saif Eldin, D., & Elsharawy, Y. Mitomycin-C as a Preventive Measure of Adhesion after Functional Endoscopic Sinus Surgery (FESS). Egyptian Journal of Ear, Nose, *Throat and Allied Sciences*, **21(3)**, 154–158. (2020)

[15] Chang, C., Hong, S. M., Cho, J. H., Shim, S. Y., Cho, J. S., & Lee, H. M. A Randomized, Multi-Center, Single Blind, Active-Controlled, Matched Pairs Clinical Study to Evaluate Prevention of Adhesion Formation and Safety of HyFence in Patients After Endoscopic Sinus Surgery. *Clinical and Experimental Otorhinolaryngology*, **7(1)**, 30. (2014)