Clinical follow-up of chitosan dressings in congenital heart disease intervention

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[Abstract] Objective To evaluate the hemostatic properties and efficacy of Chitosan dressings hemostatic properties in congenital heart disease intervention. **Methods** From Sep 2009 to May 2010, 100 patients with congenital heart disease were enrolled in the study and divided into Chitosan dressings compression group and control group. There were 50 patients in each group, aging from 2 to 51 years. The study compared hemostasis and the restrain time of patients and complications between two groups. **Results** The hemostasis and the restrain time of patients of Chitosan dressings group was shorter than that of the control group ($P<0.001$). Meanwhile, complications as soreness of back, urinary retention, psychentonia insomnia, hemorrhage and hematoma were also few in chitosan dressings group. **Conclusion** The application of Chitosan dressings in congenital heart disease intervention can remarkably shorten hemostasis and retrain time, reducing the risk of complications.

[Key words] Congenital heart disease; Transcatheter intervention; Chitosan dressings

Congenital heart disease intervention, as a minimally invasive surgery, has been widely used in clinical practice.[1] Femoral artery and vein puncture are the fundamental links in the intervention. The traditional compression hemostasis method requires the surgeon to conduct artificial compression hemostasis for 20 - 30 min, which is very labor intensive. The weaknesses caused by the long post-operative immobilization time and more local complications will affect the hemostatic effect. [2] Since 2009, the clinical applications of Anshikang chitosan hemostatic dressings (Daxon Biomedical(Suzhou) Co., Ltd) have achieved satisfactory results. The report is as follows.

1. Subjects and methods

1.1 Subjects

From September 2009 to May 2010, 100 patients who underwent congenital ventricular septal defects and patent ductus arteriosus intervention were hospitalized at the Cardiovascular Surgery of Xijing Hospital were divided into the chitosan hemostatic dressings hemostasis group (referred to as the chitosan group) and the control group depending on whether the chitosan hemostatic dressings were applied. There were 50 cases in each group as shown in Table 1. The inclusion criteria were as follows: (1) the age > 2 years, body weight > 10 kg, either gender; (2) pre-operative platelets and blood coagulation functions are normal. The exclusion criteria were as follows: (1) severe hypertension, heart failure, electrolyte disorders, or liver and renal insufficiency; (2) participating in other research projects within three months; (3) those that researchers considered as unsuitable. This study had been approved by the Ethics Committee and the subjects had signed the informed consent before surgery.

1.2 Methods

The 6F femoral artery puncture sheathing canal and the 6 - 12F femoral vein conveying sheath were selected for both groups. The artery sheath was withdrawn for 4 - 5 cm from the skin after the congenital heart disease intervention; the surroundings were cleaned and disinfected; the blood was wiped to keep that part dry. For the experimental group, 2 cm × 6 cm chitosan hemostatic dressings and 2 pieces of 4 cm × 4 cm sterile gauze were compressed on the puncture point; the artery and vein sheaths were unplugged; 5 – l0 min after manual compression, the puncture site was wrapped with gauze and elastic rubberized fabric and compressed with the sandbag for 6 - 8 hours. The patients were kept in bed for 12 - 24 hours. For the control group, the wound was routinely and manually compressed for 15 - 30 min after the sheath was removed and then it was compressed with the sandbag for 6 - 8 hours fixed with a medical gauze bandage or self-adhesive elastic bandage by “8” method; patients were kept absolutely in bed and the limbs on the operated side were kept motionless for 12 -24 hours.

1.3 Observing indices

(1) Success rate of hemostasis by Chitosan hemostatic dressings (the standard was successful hemostasis within 10 min); (2) hemostasis time: the period from the beginning of compression after removing the artery sheath to the puncture site stopping hemorrhage; (3) lower limb immobilization time: the period from the beginning of hemostasis to ambulation; (4) local hemorrhage, local hematoma, pseudoaneurysm of the puncture point, and local skin lumps or visible color change

after ambulation; (5) vagus reflex is the phenomenon that patients suddenly become pale, with thin pulse, and the fall in blood pressure that is even undetectable in the process of removing the sheath; (6) other adverse reactions, including: backache, dysuria; sleep affected, irritability, etc. The evaluation criteria of backache are the complaints from patients. Dysuria is the phenomenon where the patients complain about wanting to urinate but urine cannot be successfully discharged from the urethra; abdomen bulging at the upper margin of pubic bone can be observed during the abdominal examination, and a dull sound can be heard in percussion; the patients can voluntarily urinate or be conducted for the catheterization after taking induction measures. Irritability is when the patients complain about impatience, weariness about staying in bed; repeated activities of the lower limbs on the healthy side of the patients can be observed, and the patients repeatedly asked for the removal of time constraints and for time to devote to other activities.

1.4 Statistical process

The measurement data are represented as mean ± standard deviation ($\bar{x} \pm s$), whereas the count data as a percentage ratio. The SPSS 16.0 statistical software was used for statistics and analysis. The comparison between groups and the measurement indicators applied the paired t-test, whereas the count data applied the x^2 test. The difference was statistically significant when $P < 0.05$.

2. Results

2.1 A comparison of the baseline clinical characteristics between the patients in the two groups

The differences in age, sex, weight, type of disease between the two groups were not statistically significant (all were $P > 0.05$).

Table 1 Comparison of the baseline clinical characteristics between the patients in the two groups [Number, (%)]

Group	Number of cases	Male	Median age (years)	Type of disease	
				Ventricular septal defect	Patent ductus arteriosus
Chitosan group	50	32(64)	8.5	21(42)	29(58)
Control group	50	37(74)	9.5	19(38)	31(62)

2.2 Comparison of the success rate of hemostasis between the two groups

The success of the hemostasis rate of the chitosan hemostatic dressings was 100%, whereas the success rate of hemostasis of the control group was 86%; the difference was statistically significant ($x^2 = 2.578$, $P < 0.05$).

2.3 Comparison of the hemostasis immobilization time between the two groups

As shown in Table 2, the hemostatic operating time of the chitosan group and post-operative immobilization time were significantly shorter than those of the control group (all were $P < 0.001$).

Table 2 Comparison of the hemostasis immobilization time and postoperative limbs immobilization time between the two groups [(%)]

Group	Number of cases	Hemostatic operating time (min)	Limbs immobilization time (h)
Chitosan group	50	9.5 ± 6.2^a	10.2 ± 4.6
Control group	50	18.4 ± 5.1^a	24.7 ± 5.8

Note: When compared with the control group, $^a p < 0.001$.

2.4 Comparison of the major complications of patients between the two groups

As shown in Table 3, the incidences of backache, dysuria, irritability, vagal reflex and hematoma in the chitosan group are slightly lower than those in the control group, but (all) the differences are not statistically significant. However, the incidence of affected sleep in the chitosan group was significantly lower ($P < 0.001$).

Table 3 Comparison of the complications in patients between the two groups [Number (%)]

Group	Hematoma	Pseudoaneurysm	Vagus reflex	Dysuria	Backache	Affected sleep	Irritability
Chitosan group	0	0	1(2)	2(4)	6(12)	5(10)	0
Control group	1(2)	0	2(4)	5(10)	12(24)	28(56)	2(4)
X^2	NS	NS	0.344	1.382	2.439	23.926	2.041
Value of P	NS	NS	1.000	0.436	0.192	< 0.001	0.495

2.3 The follow-up results

In the call back visits and out-patient follow-ups 3 months after surgery, no pain in the puncture site, lumps, lower limb movement disorder or other adverse reactions occurred in both the chitosan group and the control group.

3. Discussion

Intervention technology, with the advantages of smaller trauma, faster recovery and the obvious minimal invasion, has become the preferred method of treating atrial septal defect, ventricular septal defect, patent ductus arteriosus and other congenital heart diseases. Compared with the intervention of atrial septal defect that only requires the femoral vein puncture, interventional surgery of the ventricular septal defect and patent ductus arteriosus need to puncture the femoral artery and femoral vein at the same time. The incidence of complications, such as hemorrhage, is significantly higher than that of the patients who underwent the intervention of simple atrial septal defect. [3-4] Post-operative compression hemostasis is an important part of the intervention of congenital heart disease; the improper oppression can cause widely subcutaneous hematoma or other complications which will seriously influence the rehabilitation of patients. The traditional manual compression hemostasis method generally needs 20 - 30 min to achieve effective hemostasis, which is time-consuming and labor-intensive for the medical staff and the hemorrhaging and other complications occurred frequently. In study reports, the incidence of post-operative hemorrhaging at the puncture site is about 0.8%. At the same time, the traditional compression hemostasis has the disadvantage of long lower limb immobilization time and care time after hemostasis, a high incidence of backache, abdominal distension, difficulties in urination and defecation in patients, as well as the extension of hospitalization time, etc.

Chitosan is a natural organic polymer polysaccharide whose output in nature is next only to natural polysaccharides of cellulose. It has good biocompatibility and biodegradability and at the same time it is confirmed to be non-toxic, non-irritating, non-inflammatory, and non-antigenic, with no harmful degradation products and has a positive effect in hemostasis and antibacterial action. [5-6] The positively charged ions of chitosan (polyamino glucose; -NH3+) can promote the aggregation of negatively charged platelets and the aggregation of red blood cells, thus rapidly coagulating the blood to play the role of hemostasis at the wound site. The characteristics of hemostasis, antimicrobial effect, biocompatibility, promoting wound healing and ease to form the chitosan gel endow it with good performance as hemostatic dressings or hemostatic agents. [6-7] The ingredients in Anshikang chitosan hemostatic dressings used in this study are derivatives of chitosan of medical grade, suitable for various interventional diagnoses and treatments as well as the local hemostasis of femoral artery or radial artery puncture wounds. This study shows that chitosan hemostatic dressing has a significant hemostatic effect, with a high hemostasis success rate at the

arterial puncture site. It not only reduces the hemostatic oppression time but also reduces the immobilization time of patients, without increasing the incidence of hemorrhaging and other complications, thus patients will be more comfortable in post-operative recovery. These results suggest that chitosan hemostatic dressings can be used as an alternative manual compression treatment method. The experiences in using chitosan hemostatic dressings include: (1) the surgeons confirm the artery and vein puncture sites before removing the sheath, and take the appropriate size of chitosan hemostatic dressings according to the wound area of the catheter; ensure that the surroundings of the puncture point are clean and disinfected, and locally kept dry; (2) confirm that removing the artery and vein puncture sheath after the chitosan hemostatic dressing is accurately and stably fixed; compressing the catheter sheath wound by the force of fingers pressure can assist the compression of the upper part of the puncture site to help in the hemostasis .

In conclusion, the post-operative assisting application of the chitosan hemostatic dressings after the congenital heart disease intervention can significantly reduce the immobilization time, simplify the hemostasis operation and reduce complications; easy to be accepted by doctors and patients, it can be further promoted and applied.

References

[1] Dai Ruping. *Present Condition and Prospect of Congenital Heart Disease ntervention in China*. Chinese Journal of Cardiovasology, 2003, 31: 801-805.

[2] Xu Hairong, Zheng Xing, Qin Yongwen *et al. Comparison of Safety and Efficacy of Three Hemostasis Methods in the Hemostasis of Femoral Artery Puncture Site*. Academic Journal of Second Military Medical University, 2006, 27: 645-648.

[3] Jiang Shiliang. *Intervention Therapy of Patent Ductus Arteriosus*. Chinese Journal of Interventional Cardiology, 2009, 17: 352-355.

[4]Yang J,Yang LF, Wan Y, et al. Transcatheter device closure of perimembranous ventricular septal defects: mid-term outcomes. Eur Heart J,2010,31(18):2238-2245

[5] Lai Kunping. *Application of Chitin and Chitosan in the Medical Field*. Pharmacy Today, 2009, 19: 14-16.

[6] Wang Qingqing, Song Chao. *The Progress of Application of Chitin and its Derivatives in the Medical Field*. Chinese Journal of Clinical Medicine Research, 2008, 7: 38-40.

[7] Dailey RA, Chavez MR, et al. Use of a chitosan-based hemostatic dressing in dacryocystorhinostomy. Ophthal Plast Reconstr Surg, 2009, 25; 350-353.