

Sternal Closure with an Absorbable Loop Suture in Children

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- ✓ The reliability of polydioxanone (PDS) suture for sternal closure was tested on 264 consecutive sternotomies in our department from April 1987 to May 1998. The reason of sternotomy was tetralogy of Fallot in 65 cases (24.62%), ventricular septal defect (VSD) in 38 cases (14.39%), atrial septal defect (ASD) in 77 cases (29.16%), ASD+VSD in 23 (8.71%), mitral valve replacement in 22 cases (8.33%), aortic valve replacement in 10 cases (3.78%) and other cardiac disorders in 29 cases (10.98%). Sternal wound infection, sternal dehiscence and mediastinitis occurred in 1.51% of patients (4/264). The overall hospital mortality related to the mediastinitis was 1.13% (3/264) in the immediate postoperative period. This absorbable suture and our different technique are a safe alternative to standard sternotomy closure after pediatric cardiac surgery.

Key words: Sternal closure, absorbable suture

✓ Çocuklarda Sternumun Absorbable Loop Sütür ile Kapatılması

Sternumun kapatılmasında, polydioxanone (PDS) sütür kullanımının uygunluğu, kliniğimizde Nisan 1987 ila Mayıs 1998 tarihleri arasındaki dönemde sternotomi uygulanan ardişık 264 hastada test edildi. Sternotomi uygulanan hastaların 65'i Fallot tetralojisi (%24.62), 38'i ventriküler septal defekt (%14.39), 77'si atrial septal defekt (%29.16), 23'ü ASD+VSD (%8.71), 22'si mitral kapak replasmanı (%8.36), 10'u aort kapak replasmanı (%3.78), 29'u çeşitli diğerkardiyak hastalıklar (%10.98) idi. Sternal yara enfeksiyonu, sternal ayrışma ve mediastinite %1.51 oranında rastlandı (4/264). Erken postoperatif dönemdeki mediastinite bağılı hastane mortalitesi %1.13 olarak saptandı (3/264). Bu absorbe edilebilir sütür materyali ve kullandığımız farklı teknik, pediatrik kalb cerrahisinde standart sternotomi kapatılmasına güvenli bir alternatif olarak görünmektedir.

Anahtar kelimeler: Sternum kapatılması, absorbe edilebilir sütür

A midline sternotomy is the approach most frequently used in adult and paediatric patients undergoing operation with cardiopulmonary bypass. For conventional sternal closure, stainless steel wire suture is used. But, this material is difficult for the surgeon to handle and may cause discomfort to the patient. New synthetic resorbable monofilaments (polydioxanone, polyglyconate)

appear effective in terms of handling, strength, and absence of inflammatory reaction. The use of absorbable sutures for sternal closure after midline sternotomy in children has developed as a suitable clinical method.

MATERIAL AND METHOD

Patients

During 11 years period (April 1987 to

May 1998), the efficacy of an absorbable loop suture (PDS; Ethicon, Johnson and Johnson, Sommerville, NJ, USA) for sternal closure was tested on 264 consecutive sternotomies performed on 264 patients in our department. The main characteristics of the patients are indicated in Table I and Table II. The patient

ages are ranged from the newborn to 17 years (mean age 6.68). The study included 147 males and 117 females. The reason for sternotomy was tetralogy of Fallot in 65 cases (24.62%), ventricular septal defect (VSD) in 38 cases (14.39%), atrial septal defect (ASD) in 77 cases (29.16%), ASD+VSD in 23 cases (8.71%), mitral valve replacement in 22 cases (8.33%), aortic valve replacement in 10 cases (3.78%) and other reasons in 29 cases (10.98%). All the patients had been operated primarily. Reoperations were excluded.

Table I. Main Characteristic of the Patients.

AGE	
Range	6 days - 17 years
Mean	6.68 years
SEX	
Male	147
Female	117
Total	264
WEIGHT	
Range	3-46 kg
Mean	18.5 kg

Surgical technique

All the surgical interventions were performed in the same fashion. No bone wax used on the sternal edges. To re-approximate the sternum, continuous suture technique with an absorbable loop suture was used. Our sternal closure technique was modified to facilitate the performance of the PDS suture. Only two trans-sternal stitch used to re-approximate the manubrium of sternum

Table II. Absorbable Suture of Sternal Closure in Childhood.

DIAGNOSIS	No. of patients	%	No. of mediastinitis	No. of exitus related to mediastinitis
Atrial septal defect (ASD)	77	29.16		
Ventricular septal defect (VSD)	38	14.39	2	2
ASD + VSD	23	8.71		
Tetralogy of fallot	65	24.62	2	1
Mitral valve replacement (MVR)	22	8.33		
Aortic valve replacement (AVR)	10	3.78		
MVR + AVR	1	0.37		
Aortic valvotomy	12	4.54		
Pulmonary stenosis	6	2.27		
Total anomalous pulmonary venous connection	1	0.37		
Aorticopulmonary window	1	0.37		
Double outlet right ventricle	2	0.75		
Other	6	2.27		
Total	264	100	4	3

and then continuous five or six stitches were passed through the intercostal spaces along the sternum. End points of the suture were tied with eight knots. The suture cut closely to the last knot. Knot place has remained beneath the sternum. Other layers were closed with polyglactin 910 (Vicryl; Ethicon) including a subcuticular continuous suture.

RESULTS

No sutures were broken during the sternal closure. Two hundred sixty of the two hundred sixty-four patients experienced an uneventful early postoperative period. Four cases presented with wound infections, sternal dehiscence and mediastinitis (1.51%). Three of them were suffering low cardiac output syndrome and one was receiving corticosteroids. Postoperatively, polydioxanone (PDS) loop suture causes little or no inflammatory reaction, minimal granulation tissue and has a reliable absorption time (range 2 to 8 months). The overall perioperative hospital mortality which related to the mediastinitis was 1.13% (3/264). Follow-up periods of the whole series of the patients were established between 1 to 132 months.

DISCUSSION

A midline sternotomy is the approaching method most commonly used in patients undergoing open heart surgery and extended mediastinal neoplasm⁽¹⁻⁴⁾. Traditionally, sternal closure is obtained with nonabsorbable sutures, such as stainless steel wire or braided polyester⁽²⁾. A lot of problems could occur with conventional stainless steel wire, especially in paediatric cardiac surgery⁽¹⁾. This material is difficult for the surgeon to handle and may cause pain and discomfort for the children^(1,2,5). Persistent sternal pain after midline sternotomy for open heart operations is reported as relatively common

complaints⁽⁶⁾. New synthetic absorbable monofilament sutures appear effective in terms of handling, strength and lack of inflammatory reaction⁽²⁾.

Schwab RI, and et al. said that the use of synthetic resorbable materials (Vicryl 4/0, PDS) have allowed a complication-free stability of the sternum, good wound healing, and very good compatibility⁽⁷⁾. Additionally, absorbable suture are easier to handle and may reduce the risk of accidental damage to the surgeon's fingers and, consequently, the potential risk of viral infection (hepatitis, AIDS)⁽²⁾. Mechanical performance of monofilament synthetic absorbable sutures have been evaluated in many studies by a lot of authors^(1,8). The use of absorbable monofilament polydioxanone suture in pediatric cardiovascular operations was reported by Myers JL, and et al⁽⁹⁾. Our sternal closure technique was modified to improve the performance and increase the strength retention of the PDS suture. A series of stitches were passed through the intercostal space, with only two trans-sternal stitches used to re-approximate the manubrium. Additional benefits of this approach include disappearance of sequelae of the closure and more improved bone healing. The choice of synthetic slowly absorbable polydioxanone suture was encouraged by the essential features of this material. In the operative field, loop polydioxanone suture is easy to handle with minimal kinking; it associates simple knotting with suitable strength retention. Needle performance is improved by the non-traumatic form, connection and strong attachment to the suture. Polydioxanone has been used in a variety of operations, for example, aortic coarctation repairs, complete repair for anomalous pulmonary veins, transposition of the great arteries, as well as

Fontan procedures and systemic-pulmonary shunts. All examinations showed good healing and there was no anastomatic disruption or aneurysm formation⁽⁹⁾. A study on sternal closure with braided polydioxanone (PDS, size 1 or 2) had been resulted in an unacceptable dehiscence rate of 20% (2/10). The authors reported that all PDS sutures had broken at the sternal puncture sites⁽¹⁰⁾. Recently larger series do not support these negative results of absorbable sutures for sternal closure⁽¹⁻³⁾. We have not observed any problem occurring with PDS sutures in our 264 patients. In 264 children (weighing up to 46 kg) we could show that the use of absorbable suture materials (PDS) allows a good sternal stability and wound healing, as well as perfect compatibility.

In conclusion, we think that this absorbable suture and our sternal closure technique is a safe and suitable method for sternal closure with good clinical results.

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