A-II-34 Comparative study on the myocardial protection during cardiac surgery for adult patients with coronary or valvular heart disease;

—Assessment of enzyme activity level in serum—

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Most cardiac surgeons utilize some kind of cold cardiac arrest and topical cardiac cooling with systemic hypothermia to ensure adequate myocardial protection during prolonged ischemia¹⁻⁹⁾.

In the recent years, operative results for severely ill patients with acquired heart diseases remarkably improved with the development of myocardial protection and fine operative technique. This study is aimed to evaluate three different methods of myocardial protection during cardiac surgery for adult patients with ischemic heart disease or acquired valvular heart disease^{5,8)}.

Materials and methods

The objects were one hundred ten patients consisting of 55 survival cases who serially underwent aorto-coronary bypass during the past 10 years, and same number of survival cases (55 cases) who underwent valvular surgery during same period. Three different methods of myocardial protection were employed as follows in our clinic since 1970: That is, Group I: general hypothermia

(30–32°C)+intermittent aortic cross clamp, Group II: general hypothermia+aortic cross clamp+topical cardiac cooling by 4°C chilled lactated Ringer's solution, Group III: general hypothermia+aortic cross clamp+cold cardioplegic solution with St. Thomas Hospital solution²⁾ (pH 7.40, 300mOsm) +topical cardiac cooling by ice slush. The myocardial temperature was continuously measured in the anterior and posterior of the left ventricle and septum. Adequate cardioplegic solution (300–500ml) was given through the ascending aorta to arrest the heart and bring the myocardial temperature to near 15°C in the ventricular septum. In the cases with aortic valve replacement, direct coronary perfusion with St. Thomas Hospital solution was selectively carried out at the time intervals of 20 minutes through the aortotomy. Comparative study on myocardial protection was performed by assessment of enzyme activity level (CPK, GOT, LDH and GPT) in serum before and after surgery.

表 1 Case distribution due to myocardial protection

Myocardial Protection		A-C Bypass				Valvular heart disease			
		No. of case	Age (Average)	ECC time	ACC time	No. of case	Age	ECC time	ACC time
Group I	Intermittent Ao. cross clamp	21	50	145±(50)	43±(17)	21	35	152±(56)	66±(19)
Group II	Topical cooling	13	52	149±(59)	65±(21)	13	39	114±(15)	82±(19)
Group III	Cold cardioplegia Topical cooling	21	51	121±(28)	59±(17)	21	45	146±(37)	99±(28)
Total		55				55			

ECC: Extracorporeal circulation ACC: Aortic cross clamp (mean±SD)

表 2 Operative methods for Ischemic and valvular heart disease

<div style="display: inline-block; transform: rotate(-45deg); text-align: center;"> A-C bypass Myocardial Protection </div>	V.R.	AVR	MVR	Multiple VR	OMC	Total
		Single bypass	Double bypass	Triple bypass		
Group I		2/14	7/7	7/0	5	21/21
Group II		5/3	6/10	0/0	2	13/13
Group III		4/4	10/14	1/3	6	21/21
Total		11/21	23/31	8/3	13	55/55

AVR: Aortic valve replacement

MVR: Mitral valve replacement

OMC: Open mitral commissurotomy

Results

Cases distribution due to the methods of myocardial protection in A-C bypass group and in valvular heart surgery group is shown in Table 1. The mean age of A-C bypass group was 51 years and the mean age of valvular heart surgery group was 40 years. Mean time of the extracorporeal circulation as well as the aortic cross clamp indicated no significant differences in each group of myocardial protection. Number of cases and operative methods both A-C bypass and valvular heart surgery are shown in Table 2. No death was obtained in group II and group III except for only 3 cases died in group I after A-C bypass. On the other hand, there were no significant differences in mortality rate among each group after valvular surgery. Average of mortality rate after surgery was about 15% in three groups. However, in the recent years severely ill patients with valvular heart disease have been aggressively operated upon with excellent results in our clinic. Enzyme activity level of CPK, GOT, LDH and GPT was routinely measured during 4 weeks after surgery. Subsequently, significant differences ($P<0.05$) were recognized on 1st postoperative day between group I and group III in activity level of GOT (group I: 232 ± 155 Ku, group III: 108 ± 62 Ku) and LDH (group I: 1047 ± 172 WU/ml, group III: 717 ± 187 WU/ml) in A-C bypass group. Besides, there were a marked differences in enzyme activity level of CPK (group I: 888 ± 63 IU/l, group III: 716 ± 85 IU/l) as well as GOT (group I: 238 ± 141 Ku, group III: 129 ± 42 Ku) on 1st and 3rd postoperative day between group I and group III in valvular heart

図 1 Maximum enzyme activity level based on one minute value of aortic cross clamp time

surgery group. That is, peak activity levels of CPK, GOT and LDH after cardiac surgery disclosed lower values in group III compared with that of group I ($P<0.05$). Maximum enzyme activity level expressed as the value corrected by the aortic cross clamp time in minute was analyzed in detail. Consequently, postoperative enzyme activity revealed lower values of CPK, GOT, LDH and GPT in group III than those in group I ($P<0.05$) (Fig. 1)⁸.

Extremely high activity levels of these four enzyme were observed in only three cases in A-C bypass group.

A definite perioperative myocardial infarction (PMI) was diagnosed when a patient showed following criteria; 1) ECG changes defined as the appearance and persistence of a new Q wave of at least 4mm in depth and 40 msec or more in duration in pattern from two or more leads, 2) a peak postoperative serum enzyme elevation of CPK > 1300 IU/l (22 IU/l/min), GOT > 300 Ku (5 > Ku/min), LDH > 1200 WU/ml (20 > WU/ml/min). The peak activity levels of enzyme in the patients with PMI revealed a remarkable increase in comparison with that of patients without PMI as above described.

Discussion and Conclusion

The goal of intraoperative myocardial protection is to provide excellent cardiac function after surgery as well as relaxation of the heart during operation. Chemically induced cardioplegia and topical cardiac cooling are convenient to reduce oxygen demand and to maintain a quiet, bloodless fields as well as relaxation of the heart.

Nowadays, St. Thomas Hospital solution was used in our clinic in stead of cold blood cardioplegia, of which characteristics have been already experimentally or clinically evaluated^{2,9)}. On the basis of our clinical experiences using multidose cold St. Thomas Hospital solution, there was no evidence of myocardial injury

associated with arrest periods of up to 200 minutes. That is, upper limits of safety for ischemic arrest was 200 minutes. There was no abnormal increase in serum enzyme activity and only minimal increase in the administration either inotropic or pressor agents in group III compared with that of other two groups.

In conclusion, on the basis of these findings, it was proposed that the method of group III using cold cardioplegic solution and topical cardiac cooling by ice slush was the best method among three types of myocardial protection. Thereafter, the means of group III have been widely employed for cardiac surgery with satisfactory operative results in the recent years. It was considered that proper reduction of myocardial temperature by using of multidose cold cardioplegia was essential for optimal myocardial protection.

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A-II-35 Current Technique of Myocardial Protection in Coronary Artery Bypass Surgery

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Introduction

Cardioplegia has contributed to improve the operative result in open heart surgery, particularly in coronary artery bypass surgery (CABG). Intraoperative myocardial protection can be achieved by cold cardioplegia, however, it is known that the myocardium distal to severe stenosis of the coronary artery may be less protect-

ed from ischemia because of maldistribution of cardioplegic solution.

We have elucidated that pretreatment of the myocardium with lidocaine, aprotinin and coenzyme Q₁₀ provides additive myocardial protection from ischemia to cardioplegia.

In this communication, we describe the current technique of myocardial protection in CABG, and we evaluate