group was 26.5 ± 5.7 and for negative titer group was 27.5 ± 8.3. The mean titer of anti-rubella IgG was 80.3 ± 56.8 mIu/ml (range 0-250.4 mIu/ml). **Table 1** shows the comparison of the presence of anti-rubella IgG antibody based on the variable; age, occupation, the place of residence, and the duration of marriage. This study revealed no statistically significant difference except for occupation. Immunity to rubella (94.6%) was greater than previous studies in our country but laboratory methods were different in some of them. Absence of anti-rubella IgM implies the absence of acute or recent infection in the subjects. The result of our study was similar to the result of Italy in 1999.[3] Black and Berman[4] showed that the titer of anti-rubella antibody in most developing countries is as high as in the United States of America (USA) but the immunity is lower in Taiwan and Brazil. Generally in urban and industrial areas with higher socio-economic levels, the number of susceptible women of child-bearing age is higher compared to other regions, but in our study there was not any significant statistical difference between urban and rural areas, which could due to the closeness of health services to the residence of pregnant rural women and they had similar conditions with urban residents. In this survey, the relation between immunity and age was different from Vulver[3] in Italy and this difference may be significant if our sample size becomes larger. Immunity to rubella was higher in housewives (95.7%) than jobholder women (88.5%), which could result from living in crowded families with lower socio-economic condition in housewives. Our study did not show any relation between type of occupation and immunity but Ferson and Robertson[5] showed that the majority of healthcare workers had immunity against rubella, the reason may be the availability of rubella vaccine in the USA since 1969, additionally the chance of being involved by rubella and acquiring immunity is greater in health care workers which is due to the work conditions. This research showed that despite the presence of high immunity of pregnant women to rubella virus, it is not adequate. Concerning the reports from other parts of our country we suggest to recognize and vaccinate the sensitive individuals.

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# Tepid blood versus cold crystalloid cardioplegia in cardiac protection

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The use of blood cardioplegia, as compared with cold crystalloid solutions has been proposed for myocardial protection but optimal temperature and interval of antegrade infusion remain controversial.[1] In this study, we designed to compare intermittent antegrade tepid blood (TB) with cold crystalloid cardioplegia (CC) in terms of myocardial protection in patients undergoing elective myocardial revascularization. From September 1999 to June 2000, 137 consecutive patients underwent coronary artery bypass grafting (CABG) were enrolled in this study. All patients had 2 or 3 vessel coronary artery disease with preoperative left ventricular ejection fraction of >30% in single-plane contrast ventriculography. Patients undergoing reoperation for myocardial revascularization and combined coronary and vulvar surgical procedures were excluded from the study. With approval of the hospital research committee, the patients were randomized into 2 groups. Group I (n=65) received TB cardioplegia and group II (n=72) received cold CC. In both groups, intermittent, antegrade infusion of cardioplegia via the aortic root was a common cardioplegic delivery technique. The operation was performed through a mid-sternotomy approach. Cardiopulmonary bypass was instituted at a flow rate of 2.4 L/minute per $m^2$ body surface area and body temperature was reduced to $28^0$C from $30^0$C by cooling on bypass in all patients. For preparation of high potassium TB cardioplegia, moderate hypothermic blood was taken directly from the oxygenator by a 1/4 inch tubing and crystalloid solution (Kcl = 24 and $Mgso_4$ =2.7 mmol/L in 5% dextrose in water) mixed by 4 parts of oxygenated blood with each part of crystalloid solution to deliver into the aortic root by means of roller pump. Crystalloid cardioplegia was prepared by dilution of 20 ml cardioplegia solution (Martindale Pharmaceuticals,

**Table 1 -** Comparison of preoperative, operative and postoperative characteristics of the patients in both groups.

| Characteristics | Tepid blood (n=65) | Cold crystalloid (n=72) | *p* value |
|---|---|---|---|
| Age (year) | 56 ± 8 | 55 ± 11 | 0.47 |
| Men/women (%) | 75/25 | 80/20 | 0.46 |
| 2-/3 vessel disease (n) | 23/42 | 22/50 | 0.5 |
| Left ventricular ejection fraction (%) | 45 ± 8 | 46 ± 8 | 0.6 |
| Cardiopulmonary bypass time (minute) | 95 ± 23 | 93 ± 19 | 0.5 |
| Aortic cross - clamp duration (minute) | 42 ± 11 | 45 ± 10 | 0.1 |
| Left internal mammary artery used (n) | 64 | 70 | 0.6 |
| Right internal mammary artery, used (n) | 2 | 8 | 0.07 |
| Radial artery used (n) | 19 | 40 | 0.001 |
| Saphenous vein used (n) | 62 | 69 | 0.89 |
| Grafts per patient | 2.7 ± 0.5 | 2.8 ± 0.5 | 0.36 |
| Interval of cardioplegia infusion (minute) | 19±3 | 22 ± 3 | 0.001 |
| Total volume of cardioplegia solution (ml) | 376 ± 115 | 1680 ± 490 | 0.0001 |
| Failure of diastolic arrest (%) | 8 | 0 | 0.01 |
| Spontaneously back to sinus rhythm after aorta unclamping (%) | 92 | 75 | 0.025 |
| Need to inotrops on cardiopulmonary bypass weaning (%) | 15 | 43 | 0.0001 |
| External pacing (n) | 2 | 5 | 0.305 |
| Need to intra-aortic balloon pump (n) | 0 | 3 | 0.09 |
| Creatine kinase- MB (3h) (IU/L) | 41 ± 32 | 53±30 | 0.2 |
| Creatine kinase- MB (12h) (IU/L) | 36 ± 18 | 56±40 | 0.001 |
| Creatine kinase- MB (24h) (IU/L) | 37 ± 27 | 61±50 | 0.001 |
| Perioperative myocardial infarction (n) | 1 | 2 | 0.62 |
| Postoperative bleeding in 24 hours(ml) | 550 ± 320 | 620 ± 410 | 0.3 |
| pericardial effusion (0-3) | 0.9 ± 0.7 | 1.4 ± 0.8 | 0.0001 |
| Operative mortality (n) | 1 | 1 | 0.94 |

Romford, UK) in one litre of ringer's injection solution. After cross-clamping of the aorta, in both groups, cardioplegia solutions were infused into the aortic root. The first dose of high potassium TB cardioplegia was delivered at a flow rate of 250 ml/min during 4 minutes. The low-potassium (13 mmol/L) blood cardioplegia was used thereafter every 15-20 minutes at a flow rate of 250 ml/min in 2 minutes for repeat infusions throughout the procedure, unless electrical activity sustained, in which cases additional high potassium solution was infused. The initial infusion of crystalloid cardioplegia was delivered at a temperature of 4-8°C in a flow rate of 250 ml/min during 4 minutes and further doses similar to the first dose were infused with interval of 20-25 minutes. In all patients, during a single aortic cross-clamp, distal anastomosis of veins, radial artery to obtus marginalis and internal mammary artery to the left anterior descending coronary artery were performed. In some cases, right internal mammary artery was anastomosed to right coronary artery. After the aorta was unclamped, rewarming began and proximal anastomoses were constructed on the ascending aorta by partial clamping. Perioperative myocardial infarction was identified by the detection of new Q wave in electrocardiography, enzymatic criteria and wall motion abnormality in transthoracic echocardiography. Pericardial effusion on sixth day of operation was assessed by transthoracic echocardiography and graded from nil (0) to severe (3) effusion.

Data was analyzed using Statistical Package for Social Sciences 9.0, (SPSS Inc, Chicago, IL). Continuous variables are expressed as mean ± standard deviation. Categorical data is displayed as a percentage or the absolute frequency. Differences were considered significant when $p$ value was $<0.05$.

The preoperative, surgical and postoperative characteristics of the patients in both groups are presented in **Table 1**. Mean cardioplegia infusion intermittency and total volume of cardioplegia solution were significantly less in the TB group.

Failure of diastolic arrest was found in 8% of the patients with TB cardioplegia compared with none in the CC group. When sustained arrest was not found, >500 ml of high-potassium TB cardioplegia infused and then in all of these patients, arrest was obtained. After unclamping of the aorta, spontaneous back to sinus rhythm in TB group was higher than cold CC group and need to electrical defibrillation was lower in TB cardioplegia group. Inotropic agents during the

early postoperative period was occurred in 43% of cold CC group and 3 of them required to support of intraaortic balloon pump compared with 15% of patients in TB group were needed to inotropic drugs support. No significant difference in postoperative blood loss was found between 2 groups but on the sixth day of operation, pericardial effusion significantly was less in TB cardioplegia group.

In the present study, interval of cardioplegia infusion time is <20 minutes in TB cardioplegia group. There is more conflicting reports regarding to intermittency in intermittent antegrade warm blood cardioplegia infusion.[2] Lichtenstein et al[3] reported the limitation of intermittency and found prolonged time off cardioplegia was a risk factor for adverse outcome.[3] Minatoya et al[4] extended an ischemic interval to approximate 30 minutes. Because reduding the heart temperature from 37°C to 29°C did not alter myocardial oxygen consumption but decrease myocardial lactate and acid release, we prolong an ischemic interval to approximately 20 minutes in TB cardioplegia group. Whereas diastolic arrest of the heart was nearly always obtained with cold CC, sustained electromechanical arrest of the heart failed to achieve in 8% of the patients in TB cardioplegia group. Pelletier et al[5] reported 13% failure rate of warm blood cardioplegia to achieve electromechanical arrest.[5] The postoperative creatine kinase-MB (CK-MB) in our study is relatively high in both groups compared with the other reported data. As calafiore and associates reported, there are some possible reasons that the value of CK-MB might be elevated, such as the dissection of the muscle and the harvesting of the internal mammary arteries (IMA). In all patients, we harvested to use IMA and in 30-55% of them second conduit was radial artery. We think muscle dissection in radial artery harvesting may lead to high value of CK-MB and ischemic time had not influence in this regard. Postoperative more pericardial effusion in CC group can be attributed to infusion of cold (4-8°C) cardioplegia that leads to inflammation.

This study indicate that intermittent antegrade TB cardioplegia with moderate systemic hypothermia is a clinically safe to provide adequate myocardial protection during CABG. Whereas TB cardioplegia promotes immediate recovery of ventricular function, sustained electromechanical arrest of the heart was not achieved in 8%.

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