**Table II:** Distribution of nurse and doctors workforces in different districts (n=41)

| Status of workforce | Status of doctors and nurse workforces | | |
|---|---|---|---|
| | Mean ± SD | Number of districts | % |
| *Nurses* | | | |
| Present post >100 | 127 ± 50 | 27 | 65.9 |
| Working at present >75 | 103 ± 46 | 31 | 75.6 |
| Vacant post ≤50 | 23 ± 21 | 30 | 73.2 |
| *Physicians* | | | |
| Present post ≥76 | 116 ± 66 | 29 | 70.8 |
| Working at present ≤75 | 87 ± 68 | 22 | 53.6 |
| Vacant post >25 | 60 ± 38 | 32 | 78.0 |

The target population for a health assistant on an average increased from 4,311 to 8,505. Therefore, the ratio of increase of target population for a health assistant is 1:1.97 and the rate of increase is 97.29% of target population. There are 39.0% study districts (highest) have found ≥76 vacant posts for physicians. On an average 51.72% posts of physicians are vacant in study districts. As the target population for a health assistant is increased near to double and just two-thirds of existing posts for health assistant are filled up and still more than one third of existing posts are remained vacant. Therefore, a strong policy decision is urgently needed for the recruitment of the necessary workforces. This proportionately decreases the working health assistant against the available posts which identifies the inadequacy of required health assistant workforce. As there are increasing population size for each health assistant more than double to above four times of the base number of population and simultaneously the working health assistant disproportionately decreased, therefore public health workforce and population grossly become negatively imbalanced that could much influence negatively upon work performance of the workforces.

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## Safety and efficacy of atrial septal defect closure on normothermic on-pump beating heart

The advancement of percutaneous intervention technique has been a driving factor for the development of new surgical techniques that are less invasive, less traumatic, and safer and covers a broader spectrum of cases, which were previously thought as inoperable. Though the use of cardio-pulmonary bypass, hypothermia and hyperkalemic cardioplegic arrest gained wide acceptance yet the deleterious effect of extracorporeal circulation and unavoidable ischemic-reperfusion injury of aortic cross clamping and cardioplegic arrest resulting in myocardial edema and cardiac dysfunction could not be avoided. Several new strategies were worked out for better myocardial protection which included the method of sandwiched cold cardioplegia with warm induction and terminal hot shot, continuous retrograde warm blood cardioplegia, intermittent antegrade infusions of warm blood cardioplegia and eventually simultaneous antegrade/ retrograde continuousarm blood cardioplegia[1-3].

In order to avoid myocardial edema, which is intrinsic to an arrested heart and to avoid ischemic-reperfusion injury the concepts of warm beating heart surgery has been introduced[4,5]. In this technique, the aorta is clamped, warm blood is given simultaneously antegrade and retrograde,

continuously perfusing the heart, the electrocardiogram remains normal while the empty heart continues to beat. Small changes in surgical techniques avoid blood in the operative field and air removal and prevention of air embolism are done as per standard technique. Preliminary data show that beating heart surgery is safe for valvular and other complex surgery, weaning from cardiopulmonary bypass is much easier, ventricular fibrillation seldom occurs, patients do better in the post-operative period[6]. The spectrum of on-pump beating heart is widening and it covers atrial septal defect closure, aortic valve surgery, mitral valve surgery, mitral valve surgery without cross clamp, valve surgery in patients with left ventricular dysfunction and lot of others[7- 11]. In this study, 30 cases of atrial septal defect closure were done on on-pump beating heart technique and were compared with 30 cases of atrial septal defect closure on cardioplegic arrested heart; the on-pump beating heart technique gave better result.

Sixty cases of pericardial patch closure of atrial septal defect were done from July 2007 through June 2008. Patients were divided into two groups by random selection on the basis of their admission. In Group A (n=30), atrial septal defect closures were done on on-pump cold cardioplegic arrested heart and in Group B (n=30) the closures were done on on-pump normothermic beating heart perfused by oxygenated blood through the aortic root cannula after cross clamping. Comparisons were made on level of myocardial protection between two groups. Both male and female patients from 5 to 50 years of age with the presence of a secundum atrial septal defect, left-to-right shunt with a Qp/Qs ratio of ≥1.5: 1 or the presence of right ventricular volume overload or with minimal shunt in the presence of symptoms (arrhythmias, transient ischemic attacks) were included in this study.

Data were collected pre-operatively (cardiac enzyme study, electrocardiogram, echocardiogram and cardiac catheterization in relevant cases); per-operatively (clinical monitoring of pulse, blood pressure, central venous pressure, urine output, presence of arrhythmia, need for direct current shock, cross clamp time, bypass time, weaning time, requirement of inotropes) and post-operatively (cardiac enzymes, electrocardiogram, echocardiogram, post-operative mechanical ventilation time, post-operative pacing, presence of arrhythmia, inotrope support, length of intensive care unit stay) up to the 3rd post-operative day. Data were presented as mean ± standard deviation unless otherwise specified. Statistical analysis were done using SPSS 12.0 version for windows. Comparisons between the groups were performed using the non-parametric t test and the results were considered significant if $p<0.05$.

There were no significant differences regarding age, body weight, cardiac enzyme study, risk factors including systemic hypertension, diabetes, smoking, previous history of atrial arrhythmia, left ventricular ejection fraction, Qp/Qs ratio and pulmonary vascular resistance between the two groups.

**Table I:** Pre-operative data

| Variable | Group A (n =30) | Group B (n = 30) | p value |
|---|---|---|---|
| Bypass time | 66.67 ± 7.28 | 51.73 ± 6.57 | 0.00 |
| Cross clamp time | 30.50 ± 6.35 | 22.83 ± 3.31 | 0.00 |
| Weaning time | 37.60 ± 3.84 | 25.80 ± 3.66 | 0.00 |
| Arrhythmia | 8 | 0 | 0.05 |
| Mean blood pressure | 65.33 ± 4.90 | 72.47 ± 4.25 | 0.00 |
| Central venous pressure | 4.83 ± 0. 37 | 4.53 ± 0. 50 | 0.01 |
| DC shock required | 8 | 0 | 0.05 |
| Inotrope required | | | |
| Dopamine 3-5 µg/kg/min | 7 | 22 | 0. 05 |
| Dopamine >5 µg/kg/min or adrenaline | 23 | 8 | 0. 05 |

Patients included under Group B did significantly better during the peroperative period having less cross-clamp time ($p<0.0001$), weaning time ($p<0.0001$) and total bypass time ($p<0.0001$). The hemodynamic maintenance ($p<0.05$) and spontaneous return to sinus rhythm ($p<0.05$) after release of cross-clamp were better in Group B compared to Group A.

**Table II:** Post-operative data (outcome parameters)

| Variable | Group A (n=30) | Group B (n=30) | p value |
|---|---|---|---|
| Troponin I | 3.96 ± 0.90 | 1.58 ± 0. 38 | 0.00 |
| Alanine aminotranferase | 68.90 ± 8.75 | 37.90 ±2.75 | 0.00 |
| CK-MB | 42.90 ± 9.92 | 27.83 ±2.70 | 0.00 |
| Electrocardiogram | Sinus rhythm | Sinus rhythm | 0.00 |
| Ejection fraction | 55.53 ± 3.82 | 58.57 ±2.01 | 0.00 |
| Post-operative mechanical ventilation time (min) | 277 ± 51.20 | 73.10 ±14.26 | 0.00 |
| Post-operative pacing | 5 | 0 | 0.05 |
| Inotrope support | | | |
| Dopamine 3-5µg/kg/min | | | |
| Dopamine > 5 µg/kg/min or adrenaline) | 7 | 22 | 0.05 |
| | 23 | 8 | 0.05 |
| Length of ICU stay (hours) | 53.47 ±13.21 | 22.30 ±4.93 | 0.00 |

Patients under Group B also required less inotropic support ($p<0.05$), ventilator support ($p<0.0001$) and had shorter intensive care unit stay ($p<0.0001$). The maintenance of cardiac enzyme level ($p<0.0001$), left ventricular ejection fraction ($p<0.0001$) to near normal values and no requirement of post-operative pacing ($p<0.0001$) in Group B indicate a better myocardial protection technique in this group.

To avoid the deleterious effect of ischemic-reperfusion injury and its aftermath of myocardial edema in cardioplegic arrested heart the concepts of on-pump beating heart surgery has been introduced. The practical feasibility of this procedure has been established by several studies around the world and it is expected that in the near future this method will be the procedure of choice. Atrial septal defect closure is relatively simple and can be done on on-pump beating heart. Surgeons around the world are using on-pump beating heart technique to replace valves, to perform coronary by pass procedures, to correct intracardiac defects and even correction of complex congenital heart defects[9,10]. In this study the bypass time, cross clamp time and weaning time from cardiopulmonary bypass were significantly shorter in Group B patients compared to Group A patients and the occurrence of arrhythmia and the use of direct current shock were significantly lower in Group B patients (Table I). Hemodynamic parameters including mean blood pressure and central venous pressure were well maintained in Group B patients and the uses of inotrope support were less in the same group. Cardiac enzyme levels including troponin-I, alanine amino transferase, CK-MB were less elevated in Group B signifying better myocardial protection in this group. Postoperative ventilation time, inotrope support and intensive care unit stay were less in this group (Table II).

Pendse and coworkers (2009) in a recently published study on 266 patients with different varieties of atrial septal defect with or without associated cardiac anomalies showed that closure of atrial septal defect with or without valvular procedures could be done on perfused beating heart very successfully, the postoperative outcome were more favorable and some straight forward cases could be done on day case basis[12]. The scope of minimally invasive surgery is expanding, it includes not only cosmetic approach, but also beating heart surgery avoiding cardioplegia, port access to avoid sternotomy and recently experiments are underway using robotic technique under real time echocardiographic guidance to repair intracardiac defects completely avoiding cardiopulmonary bypass[13, 14].

The result of the present study shows that atrial septal defect closure on normothermic on-pump beating heart gives better result in terms of myocardial protection technique.

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