A comprehensive approach to fast tracking in cardiac surgery: ambulatory low-risk open-heart surgery


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Abstract

Objective: Ambulatory surgery, where the processes of admission, surgery and discharge are completed within 24 h, is an increasingly important part of many surgical specialties. The aim of this study was to evaluate suitability of ambulatory approach for low-risk open-heart procedures. Methods: A retrospective analysis of 48 patients who had undergone atrial septal defect (ASD) closure at our centre from October 2005 through November 2006 suggested that this open-heart procedure was optimally suited for treatment with ambulatory approach. Based on this, 15 patients with ostium secundum ASD underwent surgical closure as ambulatory patients, with targeted discharge within 24 h of admission. Twenty patients receiving conventional surgery in the other two units of the department served as the control group. Results: Fourteen of the 15 patients were successfully discharged within 24 h of admission. One patient remained in the hospital for excess incision site pain and was discharged on the 2nd postoperative day. Mean hospital stay for the entire cohort of 15 patients was 1583 ± 669 min, whereas the mean hospital stay in the control group was 9.8 days. Follow-up was 100% complete at 30 days. There were no in-hospital or out-of-hospital complications in either group. No patient was readmitted at our centre or elsewhere for any complication arising from the procedure. Conclusions: This study suggests that sufficient advancement in cardiac surgery has occurred to permit low-risk open-heart procedures (with an expected uneventful postoperative course) to be performed on an ambulatory basis. Once such a practice is firmly established, expanding its horizon may provide considerable improvement in patient satisfaction, more patient turnover per bed, and significant financial savings.

Keywords: Ambulatory cardiac surgery; Ambulatory ASD closure

1. Introduction

Ambulatory surgery, where the entire process of admission, surgery and discharge are completed within 24 h, is an increasingly important part of many surgical specialties, including thoracic surgery [1,2]. The impetus for this change is increased cost of keeping patients in-bed, and long waiting lists especially in government funded hospitals. In addition, the patient also benefits from shorter hospital stay and rapid return home and normal day to day activity.

Conventional management after open-heart surgery includes a period of elective ventilation coupled with sedation and paralyzing agents, a prolonged period of recovery and delayed return of the patient to normal activity. The past few decades have seen brisk developments in cardiac surgery, cardiopulmonary bypass, myocardial protection and anaesthetic management. These have resulted in reduced incidence of complications associated with open-heart surgery. Additionally, implementation of fast track management protocols has radically changed the way patients are investigated, treated and followed. In spite of these improvements, ambulatory surgery is yet to gather momentum in our field. Nevertheless, there have been few reports of successful discharge on day one in patients undergoing off-pump coronary artery bypass grafting (CABG) [3,4]. However, open cardiac procedures performed on cardiopulmonary bypass (CPB) more or less remain out of bounds for such protocols. For long we have believed that low-risk open-heart surgery in patients not requiring preoperative optimisation and an expected uneventful postoperative recovery, may benefit from an ambulatory approach. This confidence stems partly from our own experience and partly from conclusive data that suggest that low-risk cardiac surgical patients require minimal intensive care [5]. The objective of this study was to evaluate the suitability of this ambulatory approach for low-risk open-heart procedures.

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2. Patients and methods

2.1. Study centre

This study was performed in a government funded, high-volume, Cardiovascular and Thoracic Surgery department at G.B. Pant Hospital, New Delhi, India.

2.2. Data collection

Data for retrospective analysis were obtained from medical records, which contain patient identification number, demographics, risk factors, hospitalisation and procedure dates, complications, and discharge status for all patients treated.

The data for patients in the prospective study were collected during the hospital stay, telephonically at 12 h, 24 h and 3 days after discharge and by out-patient follow-up at 7 and 30 days.

An important issue that must be resolved prior to ambulatory heart surgery is safety [6]. To resolve this issue, a retrospective study of open-heart procedures at our unit, from October 2005 through November 2006, was performed. We monitored four procedures: ASD closure, atrial myxomas, valve replacements and ventricular septal defect closures. These procedures were then evaluated for suitability to be performed on an ambulatory basis, based on perioperative data available. Patients that underwent surgical closure of ostium secundum atrial septal defects (OS-ASD) were deemed most suitable for the study (Table 1). There were no perioperative complications; all patients (48/48) were allowed to eat on the night of surgery and in 40/48 patients invasive lines were removed on the night of surgery, with chest drains being removed immediately after the first morning in 43/48 patients. Though the mean hospital stay in these patients was 10.4 (±3) days, careful assessment of the data revealed that most of these patients could have been discharged on the 1st postoperative day.

A prospective study (Fig. 1) was then planned for patients undergoing surgical closure of OS-ASD on an ambulatory basis, from December 2006 through July 2007. Once appropriateness of the patient for this approach was determined based on inclusion criteria (Table 2), preoperative evaluation of patients was made according to a structured protocol. Informed consent was obtained from all patients who entered the study protocol. The entire process of counseling, investigations and preanaesthetic check-up was completed on the same hospital visit. Patients were provided with the date of surgery and the telephone number of a senior resident to contact in case of doubts or delay/failure to arrive on the said date. On the same hospital

| Table 1 |
| Data from retrospective analysis; patients undergoing closure of ostium secundum ASD (October 2005–November 2006) on normothermic bypass |
| Total patients | 48 |
| Age (mean ± SD) | 21.2 ± 11.7 years |
| M:F | 27:21 |
| In-hospital mortality | Nil |
| Re-explorations | Nil |
| Renal, pulmonary complications | Nil |
| Hospital stay |
| Total | 10.4 ± 3.0 days |
| Preoperative | 6.2 ± 4.2 days |
| Postoperative | 6.2 ± 4.2 days |

Data are presented in absolute numbers or mean ± SD.

| Table 2 |
| Inclusion criteria for entry in the study protocol |
| Inclusion criteria |
| 1. Planned for surgical closure of OS-ASD |
| 2. ASA I or II |
| 3. An accompanying family member or a friend, available for hospitalisation time and for 48 h thereafter |
| 4. Ability for out of town patients to remain in city for 48 h after discharge |
| 5. Informed consent signed by the patient, surgeon and the anaesthetist were mandatory for the patient to enter this protocol. |
visit, samples were sent to the blood bank facility along with a form mentioning the date of surgery. Physiotherapists were actively involved in the preoperative counseling of the patients, to ensure early ambulation and physiotherapy in the postoperative period. All patients were shown deep breathing exercises and were asked to practice these at home. Patients were also provided with an instruction pamphlet, containing FAQs on the procedure and instructions on premedication, fasting etc. All patients were admitted 1 h prior to surgery. All patients who entered the study protocol were operated upon first on the operating list. Twenty patients operated for surgical OS-ASD closure during the study period in the other two units of the department (operated as routine patients) served as a control group. This study was approved by the review board of our hospital.

2.3. Anaesthetic management

All patients were premedicated with intramuscular morphine 0.2 mg/kg and promethazine 25 mg administered 1 h before surgery. In the study group, the anaesthetic technique was tailored to favour extubation in the operating room.

The objective was to decrease the dose of fentanyl and to use inhalational anaesthetic agent and/or short acting intravenous anaesthetic agent propofol. Use of Propofol ensures a prompt return of mental and psychomotor function (street fitness) and it is also an effective antiemetic agent. Accordingly, anaesthesia was induced with fentanyl 2—3 μg/kg and thiopentone 3—5 mg/kg and maintained with oxygen and nitrous oxide (FiO2, 0.5) with isoflurane until institution of CPB. At the time of institution of CPB, propofol infusion was started 2—5 mg/kg/h and continued till the end of surgery. In addition, fentanyl (2 μg/kg), pancuronium 0.1 mg/kg and midazolam 0.05 mg/kg were added to the CPB prime. Bispectral index (BIS) monitoring was used in all patients in the study group and the dose of isoflurane during the pre-bypass period and the propofol after institution of the CPB was titrated to maintain target BIS value of 50—60.

Muscle relaxation was reversed at the end of surgery by neostigmine 0.05 mg/kg and glycopyrrolate. An antiemetic (ondansetron 8 mg) was also administered to reduce postoperative emesis. Intraoperative administration of ondansetron is effective in preventing postoperative nausea and vomiting (maximally effective when given at the conclusion of surgery).

Extubation was performed once the patient was responsive and cooperative, with complete reversal of neuromuscular blockade, stable vitals, temperature of >36 °C, oxygen saturation of >94% at an FiO2 of <60% and PaCO2 of 35—55 mmHg. If the extubation criteria were not satisfied within 30 min of completion of surgery, a provision was made to shift the patient to the ICU, to be extubated once these criteria were met.

In the control group, anaesthesia was induced with fentanyl 8—10 μg/kg and thiopentone 50—100 mg. Muscle relaxation was achieved with pancuronium bromide 0.15 mg/kg to facilitate tracheal intubation. Anaesthesia was maintained with hourly boluses of fentanyl, midazolam and pancuronium bromide. Nitrous oxide and oxygen with inspired oxygen concentration (FiO2) of 0.5 were used till the CPB was established and isoflurane was administered intermittently at the discretion of the anaesthetist. In addition, fentanyl (5 μg/kg), pancuronium 0.1 mg/kg and midazolam 5 mg were added to the prime. At conclusion of surgery, these patients were returned to the ICU, sedated and ventilated.

2.4. Surgical procedure

Warm cardiac surgery has been shown to facilitate early extubation in patients undergoing on-pump CABG [7]. Normothermic bypass for low-risk cardiac procedures causes less detriment and may positively effect patient outcome compared to hypothermic cardiopulmonary bypass [8]. All procedures were performed on complete CPB with standard bicaval venous and ascending aortic cannulation, membrane oxygenator, with non-pulsatile arterial flow and at a core temperature of 37 °C. The ASDs were closed either directly or with autologous pericardial patch.

2.5. Postoperative care

At the conclusion of surgery, patients were returned to the ICU. Intensive care involved one to one nurses, haemodynamic and respiratory monitoring, maintenance of normothermia and hourly urine output measurements. A non-steroidal anti-inflammatory drug (NSAID), ketorolac, administered intra-muscularly, was used to achieve analgesia along with a routine use of antiemetics (ondansetron) and H2 blockers. An air-warming blanket was used to achieve normothermia. Patients were encouraged to ambulate as soon as invasive lines had been removed.

This was followed by rapid step down to a high dependency area where nurse/patient ratio was 1:3 and monitoring included EKG, non-invasive blood pressure, pulse oximetry, chest drainage and pain.

2.6. Criteria for discharge

Patients were discharged if their hospital stay remained uneventful with stable vital signs, were fully awake and orientated, able to eat and drink, and were ambulating with minimal support, with well controlled pain and willingness to go home. EKG, chest X-ray, and screening echocardiography were routinely performed at discharge and a senior resident’s phone number was provided to all patients and their attendants, in case of need.

Patients were informed about the possibility of emesis/nausea, pain or fever and were advised to contact us by telephone if needed. Patients were discharged with a 5-day treatment of analgesics (ibuprofen + paracetamol), antibiotics, H2 blockers and a low dose diuretic. Antiemetic (ondansetron) was continued for the first day of discharge only.

2.7. Follow-up

A telephone call back protocol was put into place, with a senior resident, aiming to call back every patient at 12 h, 24 h and 3 days after discharge.
Clinical out-patient follow-up consisted of an evaluation (that included a detailed examination, CXR, EKG) at 7 and 30 days after discharge.

2.8. Statistical evaluation

Difference in operative time, CPB time and aortic cross-clamp time between study and control groups were compared using a non-parametric test (Wilcoxon signed ranks test) and statistical package for social sciences software, version 10 (SPSS, Chicago, IL, USA). Data are presented as mean (± standard deviation); p < 0.05 was considered significant.

3. Results

Over the 8-month period, 15 patients underwent surgical closure of ostium secundum ASD as ambulatory patients (Table 3). Fourteen patients were successfully discharged within 24 h of admission (mean hospital stay 1381±30 min). One patient remained in-hospital for 2 days postoperatively because of excess incision pain. Mean hospital stay in the total study group of 15 patients was 1583±669 min.

Hospital stay of the 14 patients that were successfully discharged within 24 h of admission is represented in Fig. 2 as events over a 24 h period.

During the same study period, 20 patients undergoing conventional OS-ASD closure in the other two units of the department served as control group (Table 4). Only the operating room time differed significantly between the study and control groups; in the study group it was 222 (±37) min versus 174 (±24) min in the control group (p = 0.02). Mean CPB time in the study group was 58 (±21) min versus 52 (±7) min in the control group (p = ns). Similarly, aortic cross-clamp time between the two groups was also similar (p = ns) (Fig. 3). Out of these 15 patients, 2 were transferred from the OR intubated but breathing spontaneously on a T piece. Both were extubated within 1 h of arriving in the ICU and both were successfully discharged within 24 h of admission.

In the control group, mechanical ventilation was continued for 3.9 h (±1.9) postoperatively, and the mean ICU/HDU stay were 8.6 h (±2.3) and 13 h (±4.2), respectively. Analgesia was maintained by intravenous fentanyl until extubation, followed by parenteral NSAIDs and oral NSAIDs once the patients were allowed to eat or drink (20/20 by the night of surgery). Chest drains were removed next morning in all patients and the patients were then transferred back to the ward. In-hospital care included routine antibiotics, analgesics, low dose diuretics and GI prophylaxis.

Follow-up was 100% complete. There were no in-hospital or out-of-hospital complications in either group. No patient was readmitted at our centre or elsewhere for any complication arising from the procedure.

Fig. 2. Data fields collected from ICU flow charts of 14 patients that underwent ambulatory surgical closure of ASD are represented in this figure as events over a 24 h period (Data presented is the mean value, POD is postoperative day).

Fig. 3. Operating room (OT), cardiopulmonary bypass (CPB) and aortic cross-clamp (Acx) times in the study group, control group and in the retrospective analysis.

<table>
<thead>
<tr>
<th>Study group</th>
<th>Control group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total patients</td>
<td>15</td>
</tr>
<tr>
<td>Age (mean ± SD)</td>
<td>19.6 ± 8.2 years</td>
</tr>
<tr>
<td>M:F</td>
<td>6:9</td>
</tr>
<tr>
<td>In-hospital mortality</td>
<td>Nil</td>
</tr>
<tr>
<td>Re-explorations</td>
<td>Nil</td>
</tr>
<tr>
<td>Renal, pulmonary complications</td>
<td>Nil</td>
</tr>
<tr>
<td>Total hospital stay</td>
<td>1583 ± 669 min</td>
</tr>
<tr>
<td>Complications on follow-up</td>
<td>Nil</td>
</tr>
</tbody>
</table>

Data are presented in absolute numbers or mean ± SD.
4. Discussion

The present study suggests that with proper patient selection and management, advancements in cardiac surgery may now permit performance of low-risk open-heart procedures on an ambulatory basis, with excellent results. The potential benefits of this approach are similar to those attained by other surgical specialties performing ambulatory surgery (higher turnover per bed available, better patient satisfaction and significant financial saving).

Although the need for ambulatory cardiac surgery has been realised only recently [6], background data that validate this approach have been available for quite some time. Hospital mortality for repair of ASD and related conditions has approached zero for many years in most cardiac centres throughout the world [9]. It is also well established that most patients with minimal comorbid conditions and stable haemodynamics can be safely admitted on the day of surgery [10,11]. Thus, preoperative stay of 4 days in our retrospective analysis is unacceptable. We attribute this to admission of patients without complete workup, which was performed once the patient was in hospital. In addition, low-risk procedures like ASD closure comes lower down in the priority list when compared to higher risk procedures like CABG, leading to longer preoperative stay.

Previously, considerable concern has been raised over immediate extubation after cardiac surgery. Reports now suggest this is equally safe compared to extubation in the ICU for low-risk patients and may additionally help to decrease hospital stay and costs [12]. More so, operating room extubation is safely performed in many patients operated under deep hypothermic arrest [13]. Concern however remains on the relative respiratory acidosis in the immediate postoperative period. However, acidosis auto-corrects within a short time and does not lead to haemodynamic derangement [14].

In contrast to the above two stages of the protocol, discharge within 24 h of open-heart surgery is a newer concept, less firmly established and thus much more open to criticism.

In pace with the advancements in techniques, fast tracking of CABG patients has now given way to discharge of more than half the patients on day one following surgery [3].

Similarly, Vricella et al. [13] have shown that even for paediatric patients operated on CPB, discharge within 24 h was attained in almost 18% of the patients. In their study, in the group of patients with left to right shunts (41.3% of the entire cohort) there was only one death (1/83) and no in-hospital complications. The median length of hospital stay in this group was 2 days. These findings are in agreement with our findings and suggest that advancements in cardiac surgery now permit performance of low-risk open-heart procedures in a dedicated ambulatory set-up, similar to many other fields of surgery. However, management of postoperative issues like nausea, vomiting, fever, minor wound complications will require reorganisation of the network of care of cardiac surgical patients and close co-ordination between the patient, his family doctor, surgical team and the referring cardiologist. Experience acquired by ambulatory surgery in other specialties clearly suggests that these issues can be safely shifted outside the hospital to the patients’ family practice doctor, and by occasionally adding home-based nursing support selectively for patients in need (old age, unavailability of responsible attendants etc). A newer concept successfully promoted in Norway is Limited Care Accommodation (Medi/hospital motels) for patients who do not fulfil the criteria for home discharge [15]. A hospital hotel is a hotel close to the hospital, with the same facilities as an ordinary hotel, but no traveling is required after discharge and, if necessary, medical support is much closer.

To ensure safe and successful outcome of ambulatory surgery, careful selection of patients is critical. This is even more important for cardiac surgery, where in addition to the surgical and anaesthetic complications, other cardiac problems are to be foreseen and avoided. For example, AF commonly coexists with atrial septal defects. However, it is well known that this risk is related to the age at the time repair and presence of preoperative AF. It is unlikely that a young patient without preoperative AF will develop it postoperatively [16,17]. We attribute avoidance of this complication in our cohort to careful selection of young patients without preoperative AF. However, in the rare event of its appearance in the postoperative period, one should be prepared to cardiovert and delay discharge.

Studies looking into the economic impact of outpatient surgery suggest that ‘as soon as technical advancement allows surgical treatment with equally good clinical outcomes to be performed in an outpatient environment, savings may be significant’ [18]. Interestingly, a study comparing surgical repair of ASD against device closure concludes that device closure carries less cost than surgical closure. Even though the procedural cost was less for surgical closure, because of intensive care and longer hospital stay the total cost for surgical repair was higher [19]. Assessment of financial benefits from this protocol was not the primary aim of the study. Nonetheless, we strongly feel that once this practice is more firmly established, savings in terms of a shorter ICU and hospital stay, and lesser need for laboratory, pharmacy and nursing care, will lead to considerable financial gains.

An important concern for cardiac surgeons is that since their patients are predominantly referred, a biased opinion of the referring physician, based on the invasiveness of cardiac surgery, greatly influences the choice of therapy. For example, device closure of ASD is said to involve shorter hospital stay (29 h vs 88 h) and causes less discomfort and familial disturbance, with no difference in complication rates [19]. As a result, interventional cardiologists are increasingly attempting to treat patients with ASDs with more complex morphology. In this subset of patients with complex defects the risk of complications may well be higher than in patients with less challenging defects [20]. A fact that has been disregarded by most cardiologists and patients is the surgeon’s ability to close any ASD regardless of anatomy [21]. This is true even for coronary artery disease where ‘despite the evidence that multiple stenting will not provide revascularisation as durable and complete as coronary surgery, the concept of less than perfect repair is now, surprisingly, widely accepted’ [22]. Therefore, truly minimally invasive cardiac surgery must also be minimally
disruptive for a patient’s normal day to day activity. Only then will the gold standard care of ASD closure, which is surgery, be judged fairly against device closure, when a choice of treatment modality is being made.

For obvious reasons, performing all open-heart procedures on an ambulatory basis is not possible at this time. Therefore, an amalgamation, in which low-risk procedures (such as ASD closures, atrial myxomas, small VSD without failure etc.) are performed at dedicated ambulatory units, other patients are fast tracked when possible, and high-risk patients are managed by rigidly following the conventional protocol, appears to be the most attractive option presently available. However, further advancements in cardiac surgery will dictate the evolution of this approach and may lead to its wider applicability.

References