Effects on Cognition of Conventional and Robotically Assisted Cardiac Valve Operation

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**Background.** The effect of valve surgical procedures on cognition was investigated in patients undergoing conventional or robotically assisted techniques. The confounding factors of surgical procedure, mood state, preexisting cognitive impairment, and repeated experience with cognitive tests were controlled for.

**Methods.** Patients undergoing conventional valve procedures (n = 15), robotically assisted valve procedures (n = 15), and thoracic surgical procedures (n = 15), along with a nonsurgical control group (n = 15) were tested preoperatively, 1 week after operation, and 8 weeks after operation by use of a battery of cognitive tests and a mood state assessment. Surgical group data were normalized against data from the nonsurgical control group before statistical analysis.

**Results.** Patients undergoing conventional valve procedures performed worse than those undergoing robotically assisted valve procedures on every subtest before operation, and this disadvantage persisted after operation. Age and premorbid intelligence quotient were significantly associated with performance on several cognitive subtests. Anxiety, depression, and stress were not associated with impaired cognitive performance in the surgical groups after operation. A week after operation, patients undergoing conventional valve procedures performed worse on the cognitive tests that had a motor component, which may reflect discomfort caused by the sternotomy. Patients undergoing robotically assisted valve procedures were significantly less impaired on information processing tasks 1 week after operation when compared with those undergoing conventional valve procedures. The majority of patients who were impaired 1 week after operation recovered to preoperation levels within 8 weeks.

**Conclusions.** The robotically assisted valve surgical procedure results in more rapid recovery of performance on cognitive tests. However, regardless of the type of surgical intervention, the prospect of a recovery of cognitive performance to preoperative levels is high.


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The introduction of robotically assisted valve surgical procedures has provided the potential for improvement in postoperative outcomes. In comparison with conventional valve procedures, the benefits of robotically assisted valve procedures include a reduction in intensive care unit stay, a reduction in the overall hospital stay after operation, a lower requirement for blood product transfusion, significantly less bodily pain, and a superior cosmetic appearance after operation [1].

Cardiac surgical procedures can expose the brain to potentially harmful complications (eg, microemboli, systemic inflammation, hypoperfusion), and the risk of such complications is significant with conventional valve surgical procedures, which are associated with a high incidence of microembolizations because of the invasiveness of the open chamber procedure. This factor is thought to be responsible for the higher levels of postoperative cognitive decline (POCD) that are associated with conventional valve procedures compared with coronary artery bypass grafting (CABG) procedures [2]. The invasiveness of conventional valve procedures is also related to incisional trauma because of the full median sternotomy required for direct visualization of the operative field [3]. Although both conventional and robotically assisted valve procedures involve cardiopulmonary bypass (CPB) and incisional trauma, robotically assisted valve procedures avoid the complications associated with sternotomy, resulting in less trauma and morbidity [3]. However, it is not yet known whether robotically assisted valve procedures produce better outcomes for POCD when compared with conventional valve procedures.

The aim of the present study was to compare the extent and incidence of POCD after robotically assisted and conventional valve procedures. Care was taken to control...
for methodologic factors that have been shown by previous studies to influence outcomes. For instance, baseline (preoperative) comparisons were performed to address practice effects from repeated assessment sessions [4]. Emotional state, especially anxiety and depression, have been shown to significantly interfere with neuropsychologic performance after other types of cardiac surgical procedures; hence, their impact on valve procedures was assessed [5]. The duration of anesthesia was examined for its capacity to influence outcomes in this study because this factor has been associated with increased cognitive dysfunction [6].

**Patients and Methods**

**Enrollment**

All procedures, materials, and methods had human ethics approval from three institutions: Monash University, Southern Health and Epworth Hospital. All patients were required to give informed consent before inclusion in the study. Patients were recruited when they attended a preadmission clinic before operation or were contacted by the researcher before their preadmission clinic and asked to volunteer. Nonsurgical control participants were recruited from retirement villages in Melbourne. All participants gave written consent.

A total of 60 participants completed all testing sessions and were included in the analysis of results. A total of 45 patients underwent conventional valve procedures, robotically assisted valve procedures, or thoracic surgical procedures, with 15 patients in each group. The conventional valve group underwent aortic valve replacement (n = 8), aortic valve and mitral valve replacement (n = 1), mitral valve replacement (n = 3), and mitral valve repair (n = 3). The robotically assisted valve group all underwent mitral valve repair. Valve pathologic conditions consisted of stenosis (n = 10) and regurgitation (n = 8) in the conventional valve group and stenosis (n = 1) and regurgitation (n = 14) in the robotically assisted valve group. A further 15 participants constituted the nonsurgical control group. Table 1 provides a list of participant characteristics. Exclusion criteria for all participant groups were previous cardiac operations, history of psychiatric disorders, previous neurologic complications or traumatic brain injury, age over 80 and under 50 years, and inadequate English reading and writing skills to perform the required tasks.

**Operative Technique**

All surgical procedures were elective. The anesthetic technique was standardized, and conventional general anesthesia was administered to all surgical groups. Administration regimens were left to the discretion of the individual anesthetist.

**Conventional Valve Procedure**

Five experienced surgeons performed the conventional valve operations, using a median sternotomy for all patients. Central CPB was established for all patients at moderate hypothermia (32° to 34°C), with all valve repairs

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**Table 1. Demographic Data of Patients in Surgical Groups and Control Group**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Conventional Valve Group</th>
<th>Robotic Assisted Valve Group</th>
<th>Surgical Control Group</th>
<th>Nonsurgical Control Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>No.</td>
<td>15</td>
<td>15</td>
<td>15</td>
<td>15</td>
</tr>
<tr>
<td>Age, mean (SD)</td>
<td>65.3 (9.2)</td>
<td>60.0 (5.8)</td>
<td>60.9 (7.1)</td>
<td>65.5 (9.0)</td>
</tr>
<tr>
<td>Age range, y</td>
<td>50-77</td>
<td>54-71</td>
<td>51-73</td>
<td>52-80</td>
</tr>
<tr>
<td>Sex, % male</td>
<td>60.0</td>
<td>80.0</td>
<td>40.0</td>
<td>46.7</td>
</tr>
<tr>
<td>Education level, mean (SD)</td>
<td>9.4 (2.1)*</td>
<td>12.2 (2.7)</td>
<td>10.7 (2.9)</td>
<td>11.8 (3.4)</td>
</tr>
<tr>
<td>Education range, y</td>
<td>5-12</td>
<td>8-15</td>
<td>6-15</td>
<td>7-20</td>
</tr>
<tr>
<td>WTAR score, mean (SD)</td>
<td>37.9 (9.9)</td>
<td>40.8 (7.3)</td>
<td>35.5 (10.6)</td>
<td>39.6 (6.0)</td>
</tr>
<tr>
<td>Hypertension, n</td>
<td>9</td>
<td>1</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>Cerebrovascular disease, n</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Diabetes, n</td>
<td>4</td>
<td>0</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Stress, mean (SD)</td>
<td>8.1 (5.6)</td>
<td>9.5 (7.2)</td>
<td>14.5 (9.8)b</td>
<td>6.7 (5.1)</td>
</tr>
<tr>
<td>Anxiety, mean (SD)</td>
<td>6.9 (4.7)</td>
<td>6.8 (7.0)</td>
<td>10.0 (8.8)</td>
<td>2.7 (3.6)</td>
</tr>
<tr>
<td>Depression, mean (SD)</td>
<td>7.1 (9.6)</td>
<td>3.7 (3.6)</td>
<td>8.1 (8.8)b</td>
<td>4.7 (5.7)</td>
</tr>
<tr>
<td>1 wk postop, no. days, mean (SD)</td>
<td>10 (2.2)*</td>
<td>6.6 (3.6)</td>
<td>7.2 (2.8)</td>
<td>8.9 (8.6)</td>
</tr>
<tr>
<td>8 wks postop, no. days, mean (SD)</td>
<td>64 (18)b</td>
<td>58.7 (14.4)</td>
<td>63.8 (21)</td>
<td>51.2 (8.6)</td>
</tr>
<tr>
<td>Anesthesia time, min, mean (SD)</td>
<td>288.6 (54.5)d</td>
<td>280.7 (72.7)c</td>
<td>146.2 (74.8)</td>
<td>n/a</td>
</tr>
<tr>
<td>CPB time, min, mean (SD)</td>
<td>115.2 (37.7)</td>
<td>133.4 (42.8)</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>Cross-clamp time, min, mean (SD)</td>
<td>90.7 (36.7)</td>
<td>97.5 (26.9)</td>
<td>n/a</td>
<td>n/a</td>
</tr>
</tbody>
</table>

*a* Significant difference between conventional valve and robotically assisted valve groups (p < 0.05).  
*b* Significant difference between surgical control and nonsurgical control groups (p < 0.05).  
*c* Significant difference between conventional valve and nonsurgical control groups (p < 0.05).  
*d* Significant difference between conventional valve and surgical control groups (p < 0.05).  
*e* Significant difference between robotically assisted valve and surgical control groups (p < 0.05).  
CPB = cardiopulmonary bypass;  
SD = standard deviation;  
WTAR = Weschler Test of Adult Reading.
being performed after the application of the aortic cross-clamp.

**Robotically Assisted Valve Procedure**

All patients underwent mitral valve repairs with use of the da Vinci surgical system (Intuitive Surgical, Inc). This remote, computer-enhanced telemanipulation system allows the surgeon’s movement to be registered, filtered, scaled, and translated into accurate movements of robotic arms to repair mitral valves after the establishment of peripheral CPB and cross-clamping as in conventional valve procedures [7].

**Surgical Control Group**

The surgical procedure involved a standard thoracotomy approach for lung biopsies, lobectomies, or both. The procedures were performed with the patients under standardized general anesthesia by use of a combination of low- to intermediate-dose narcotics, inhalation agents and paralytics, and, in a few selected cases, epidural analgesia. Antibiotics were administered to prevent wound infection. After the removal of lung tissue, chest tubes were secured with a suture for draining and were usually removed 48 hours after operation.

**Neurocognitive Assessment**

Cognitive assessment sessions for all surgical groups were performed before operation, and 1 week and 8 weeks afterward. Nonsurgical control participants were assessed within 1 week and 8 weeks of their initial assessment. All assessments were conducted in a quiet office, at a patient’s bedside, or at the participant’s residence.

The test battery comprised the following cognitive assessments and an assessment of mood state [8]:

1. Wechsler Test of Adult Reading (WTAR) is a measure of premorbid intelligence quotient (IQ) and was used in the preoperative assessment session only.
2. Controlled Oral Word Association Task (COWAT) is an assessment of verbal fluency and involves the spontaneous production of words beginning with a given letter.
3. The Grooved Pegboard (GP) is a test of motor coordination and dexterity of both dominant (GPDOM) and nondominant (GPNDOM) hands.
4. The Medical College of Georgia Complex Figure Task (MCG) assesses visual memory and perception and perceptual and visuospatial organization. Copy (MCG-C), immediate memory recall (MCG-I), and delayed recall (MCG-D) trials were performed.
5. The Rey Auditory-Verbal Learning Test (RAVLT) assesses verbal memory performance, immediate memory span, interference effect, and recognition memory. Learning (RAVLT-L), immediate memory recall (RAVLT-I), delayed memory recall (RAVLT-D), and recognition memory (RAVLT-R) trials were performed.
6. The Subtle Cognitive Impairment Test (SCIT) measures global cognition and processing speed [9].

Four sets of data are obtained: the number of errors made at stimulus exposure time from 16 to 64 ms (SCIT-E16) and from 80 to 176 ms (SCIT-E17) and the time taken to respond at each stimulus exposure time from 16 to 64 ms (SCIT-RT16) and from 80 to 176 ms (SCIT-RT17).

7. The Depression, Anxiety, and Stress Scale (DASS) measures the negative emotional states of depression (DASS-D), anxiety (DASS-A), and stress (DASS-S).

**Statistical Analysis**

All cognitive and mood state data were transformed relative to the nonsurgical control group by expressing the extent of change in the surgical groups as a fraction of the change in the nonsurgical control group, and then multiplying patient data by this fraction. This procedure controlled for practice effects that may have occurred as a result of repeated testing sessions. To assess whether there were differences between the conventional valve procedure, robotically assisted valve procedure, and surgical control groups before operation, a one-way analysis of variance (ANOVA) was conducted on the transformed preoperative performance for each assessment measure.

To analyze changes that occurred after operation, a 3 (group) × 2 (test session) analysis of covariance (ANCOVA) was conducted, rather than ANOVAs, so that factors known to affect cognition were removed and the statistical outcomes reflected the effects caused by differences in cognitive performance only. These comparisons were performed separately on the preoperation and 1-week postoperation test data, and the preoperation and 8-week postoperation test data.

The Reliable Change Index (RCI) was used to determine impaired or improved performance in individual patients by calculating the difference between their preoperation and postoperation scores and then dividing this value by the standard error of the difference between the pretest and posttest scores for the nonsurgical control group [10]. An RCI value in excess of ±1.96 represents a significant change in performance (ie, $p < 0.05$).

**Results**

There were no significant differences between any of the groups with respect to age or premorbid IQ (WTAR). Although there were significant differences in duration of anesthesia between both of the valve surgical groups in comparison with the surgical control group, these group differences were not correlated with performance on any cognitive subtest. The conventional valve group had a significantly lower level of education and was reassessed significantly later than the robotically assisted valve group at the first postoperative follow-up session. There was a greater incidence of comorbid factors (ie, hypertension, cardiovascular disease, and diabetes) in the conventional valve group than in the other three groups. There was no difference in mood state between any of the surgical groups before operation; however, the nonsurgical control group had significantly lower levels of stress and depression than the surgical control group before operation (Table 1).
On each cognitive assessment task subtest, the conventional valve group began with a poorer level of cognitive performance than both the robotically assisted valve and surgical control groups. However, one-way ANOVA revealed significant differences between the conventional and robotically assisted valve groups for the RAVLT-D subtest and between the conventional valve and surgical control groups for the SCIT-RTT subtest (Table 2).

**Group Comparisons**

Correlational analyses were performed at each test session to determine the effect on cognition of the potential confounding variables of age, education, premorbid IQ (WTAR), and duration of anesthesia. Performance on several cognitive assessment task subtests significantly correlated with age before operation, 1 week after operation, and 8 weeks after operation. Consequently, two-way ANCOVAs were used to remove the effects of age. After the effects of age were removed, premorbid IQ (WTAR) was still significantly correlated with performance on the COWAT, MCG-I, MCG-D, RAVLT-L, RAVLT-I, and RAVLT-D subtests. Therefore, for the analysis of performance on these six cognitive assessment subtests, ANCOVAs were used to remove the confounding effects of both age and premorbid IQ.

Both of the valve groups and the surgical control group showed similar patterns of performance on cognitive subtests after operation, with four exceptions. ANCOVA analyses revealed significant interactions between test session and surgical group 1 week after operation on the GPNDOM (F[2,39] = 4.89, p = 0.01) (Fig 1B); the GPNDOM (F[2,38] = 5.91, p = 0.01) (Fig 1C); and SCIT-ET (F[2,41] = 3.22, p = 0.05) (Fig 1N); and 8 weeks after operation on the SCIT-RTT (F[2,41] = 4.75, p = 0.01) (Fig 1L).

Significant main effects of group were also observed between the conventional and robotically assisted valve groups 1 week after operation on the GPDOM (F[2,39] = 6.73, p < 0.01) (Fig 1B, which remained 8 weeks postoperatively on GPDOM (F[2,39] = 3.17, p = 0.05) (Fig 1B). On SCIT-ET (F[2,41] = 3.35, p = 0.05) (Fig 1N), the conventional valve group performed significantly worse than did both the robotically assisted valve and surgical control groups. The only significant main effect of time occurred between the preoperative and 8 weeks postoperative test sessions for the GPNDOM subtest (F[1,38] = 5.53, p = 0.02) (Fig 1C).

**RCI Patient Profiles**

To determine whether cognitive changes in group performance were reflective of all patients, RCI individual patient profiles were compared. Following the criteria of

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**Table 2. Transformed Preoperative Mean Values for Surgical Groups, for Each Cognitive Measure, and Outcomes From ANOVA Analyses Across Surgical Groups**

<table>
<thead>
<tr>
<th>Cognitive Test</th>
<th>Conventional Valve Group</th>
<th>Robotically Assisted Valve Group</th>
<th>Surgical Control Group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>SD</td>
<td>Mean</td>
</tr>
<tr>
<td>COWAT</td>
<td>33.9</td>
<td>12.3</td>
<td>45.2</td>
</tr>
<tr>
<td>GPDOM</td>
<td>114.1</td>
<td>16.4</td>
<td>103.1</td>
</tr>
<tr>
<td>GPNDOM</td>
<td>123.5</td>
<td>24.4</td>
<td>117.3</td>
</tr>
<tr>
<td>MCG-C</td>
<td>34.5</td>
<td>1.7</td>
<td>34.8</td>
</tr>
<tr>
<td>MCG-D</td>
<td>20.9</td>
<td>7.9</td>
<td>25.9</td>
</tr>
<tr>
<td>RAVLT-L</td>
<td>43.4</td>
<td>12.0</td>
<td>49.6</td>
</tr>
<tr>
<td>RAVLT-I</td>
<td>7.5</td>
<td>2.4</td>
<td>8.5</td>
</tr>
<tr>
<td>RAVLT-D</td>
<td>7.3</td>
<td>3.1</td>
<td>10.1</td>
</tr>
<tr>
<td>RAVLT-R</td>
<td>13.3</td>
<td>1.2</td>
<td>13.9</td>
</tr>
<tr>
<td>SCIT-RT_H</td>
<td>792.5</td>
<td>168.9</td>
<td>680.1</td>
</tr>
<tr>
<td>SCIT-RT_T</td>
<td>641.1</td>
<td>198.4</td>
<td>544.0</td>
</tr>
<tr>
<td>SCIT-ET_H</td>
<td>44.9</td>
<td>23.1</td>
<td>28.8</td>
</tr>
<tr>
<td>SCIT-ET_T</td>
<td>6.7</td>
<td>8.4</td>
<td>2.7</td>
</tr>
</tbody>
</table>

* Significant difference between conventional valve and robotically assisted valve groups.  
  b Significant difference between conventional valve and surgical control groups.

Significant differences are in bold type.

COWAT = Controlled Oral Word Association Task; GPDOM = Grooved Pegboard (Dominant Hand); GPNDOM = Grooved Pegboard (Nondominant Hand); MCG-C = Medical College of Georgia Complex Figures Task (Copy Trial); MCG-D = Medical College of Georgia (Delayed Recall Trial); MCG-I = Medical College of Georgia (Immediate Recall Trial); RAVLT-D = Rey Auditory Verbal Learning Task (Delayed Recall Trial); RAVLT-I = Rey Auditory Verbal Learning Task (Immediate Recall Trial); RAVLT-L = Rey Auditory Verbal Learning Task (Learning Trials); RAVLT-R = Rey Auditory Verbal Learning Task (Recognition Trial); SCIT-ET_H = Subtle Cognitive Impairment Test (Percentage Error in tail of curve); SCIT-ET_T = Subtle Cognitive Impairment Test (Response Time in head of curve); SCIT-RTT = Subtle Cognitive Impairment Test (Response Time in tail of curve); WTAR = Wechsler Test of Adult Reading.
Bruce and colleagues [8], cognitive impairment was defined as a significant decrease in performance on at least 20% of the subtests, whereas cognitive improvement was regarded as a significant increase in performance on at least 20% of the subtests. With this definition, 1 week after operation, 5 patients (33.3%) from the conventional valve group, 8 patients (53.3%) from the robotically assisted valve group, and 5 patients (33.3%) from the surgical control group were impaired, relative to their preoperative performance. By 8 weeks after operation, most patients had recovered to baseline levels. Two patients remained impaired in the conventional valve group, and only 1 patient remained impaired in the other two surgical groups.

Improvement beyond preoperative cognitive performance was seen in several patients. By 1 week after operation, 3 patients (20%) had improved in the conventional valve group, 1 patient (6.7%) in the robotically assisted valve group, and 1 patient (6.7%) in the surgical control group. By 8 weeks, the patients who had improved performance in the robotically assisted valve and surgical control groups at 1 week maintained this improvement. Two patients who showed no cognitive difference 1 week after operation, 1 patient in the conventional valve group and 1 patient in the surgical control group, showed significant improvement by 8 weeks after operation. Of the 2 remaining patients who showed significant improvement in the conventional valve group 1 week after operation, 1 returned to baseline performance, and the other showed significant impairment by 8 weeks after operation.

Comment

Estimates vary widely concerning the degree of POCD after cardiac surgical procedures, with some of this variability being attributed to the confounding effects of general anesthesia, practice effects, levels of education and age, preexisting cognitive impairment before operation, and emotional state at the time of assessment [8]. The present study compared the cognitive performance of patients receiving conventional or robotically assisted valve procedures after these confounding factors were controlled for. The principal findings were these: (1) emotional state did not contribute to cognitive outcomes after valve procedures; (2) patients undergoing conventional valve procedures began with lower cognitive performance, and this difference was maintained after operation; (3) 50% to 70% of patients in both groups showed no cognitive change after surgical intervention; (4) 1 week after operation, patients undergoing robotically assisted valve procedures were less impaired than were those undergoing conventional valve procedures on information processing tasks and tasks that involved a gross motor component.

Several potentially confounding factors need to be considered before the principal findings of this study can be discussed. Age is a risk factor for cognitive decline [11]. Although no difference was found between groups on age, correlational analysis revealed that patient age was correlated with level of cognitive performance. This confounding factor was statistically addressed in the analyses. Years of education can also influence cognitive performance [12]. Although the conventional valve group had significantly less education than did the other groups in the present study, statistical analysis revealed no meaningful correlations between years of education and performance on any cognitive subtest; therefore, education was a confounding factor in the present study. There were no significant differences in premorbid IQ (WTAR) between surgical groups; however, correlational analysis revealed significant associations with some cognitive subtests, and consequently premorbid IQ was removed as a confounding factor from analysis on these cognitive subtests. Inasmuch as duration of anesthesia is directly related to duration of operation, group differences were unavoidable because cardiac valve procedures required significantly more surgical time than did the thoracic procedures in the surgical control group. However, correlational analysis to determine associations between anesthesia duration and cognitive subtests revealed no meaningful associations in this study.

Emotional state as a contributing factor in cognitive decline is still under debate. The present study found no correlations between measures of mood state and performance on any of the cognitive subtests in the surgical groups. This result contrasts with studies that have assessed anxiety and depression after CABG and found them to be associated with cognitive performance [5, 8, 13]. Current published reports relating to cognitive outcomes after valve procedures are extremely limited. One study examined the confounding effects of mood state in a combined valve procedure and CABG group of patients and found that patients with preoperative mood state disorders had an increased risk of postoperative mood disorders and neuropsychologic deficits [13]. In a previous study by our team, CABG patients were more stressed and depressed than were patients undergoing...
thoracic procedures, and there were significant associ-
ations between mood state and performance on cognitive subtests [8].

All surgical data were normalized against the nonsur-
gical control group to minimize any practice effects that may have occurred because of repeated testing sessions. The main findings after normalization of data were that patients in the conventional valve group exhibited lower levels of cognitive performance before operation than did those in the robotically assisted valve group. This difference was maintained 1 week after operation but in most cases was resolved by 8 weeks after operation. Although this difference between groups was not always significant, the consistent direction of this result indicates that patients undergoing conventional valve procedures are more cognitively impaired before and after operation. The reason for this difference probably lies in the patient selection process, given that patients undergoing con-
ventional valve procedures present with a greater inci-
dence of comorbid factors such as hypertension, cerebrovascular disease, and diabetes. These factors may lead to more disruption in blood flow and cerebral hypoperfusion, resulting in lower levels of cognitive performance in the conventional valve group [14, 15].

Compared with conventional procedures, robotically assisted procedures are associated with faster recovery times and improved medical outcomes, such as less bodily pain and better mental health recovery [1]. The present study compared cognitive outcomes after robot-
ically assisted and conventional valve procedures. Pa-
tients undergoing robotically assisted valve procedures were reassessed significantly earlier than were those who underwent conventional valve procedures because of the lower physical discomfort from the operation. It is notable that patients who underwent robotically assisted valve procedures performed as well as those who underwent conventional valve procedures, even though the latter group had on average an extra 4 days of recovery time after operation; this result confirms that robotically assisted valve procedures do result in more rapid patient recovery.

Despite the similarity in cognitive performance, the patients undergoing conventional valve procedures per-
formed worse than did those undergoing robotically assisted valve procedures on the GP test, for both the dominant and the nondominant hands. This difference could be attributable to the greater physical discomfort experienced by the former group as a result of surgical trauma rather than cognitive impairment. The GP test involves coordination of upper body limbs and muscu-
lature of the chest, which have undergone trauma and distortion caused by the sternotomy. However, one cognitive subtest did not involve gross motor movements and still revealed a significant difference: the SCIT-ET. This subtest measures the efficacy of information pro-
cessing, and the result suggests that conventional valve procedures impair information processing to a greater extent during the week after operation than do robotically assisted valve procedures.

Assessment of individual patients’ cognitive performance after operation revealed that 50% to 70% of pa-
tients experienced no cognitive change, and almost all patients who did experience a decline by 1 week returned to preoperative levels by 8 weeks. The only other study that we are aware of that extended the use of the RCI to examine the extent of cognitive impair-
ment between individual patients was by the present authors, and that study reported similar outcomes after CABC [8]. RCI results show that surgical procedures affect individual patients very differently, and this high level of individual variability is an important factor to be aware of in any in assessment of cognitive performance after operations. The results of this study and our pre-
vious one have shown that group differences or changes in cognitive performance after operations are generally driven by substantial changes in a minority of patients, and these changes are not reflective of the group as a whole.

The present results indicate that robotically assisted valve procedures produce levels of cognitive impairment comparable to, or lower than, those produced by con-
ventional valve procedures in the week immediately after the procedure.

However, regardless of the surgical procedure, nearly all patients in the present study demonstrated a return to preoperative levels of cognition (or better) within 8 weeks.

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ABTS Requirements for the 10-Year Milestone for Maintenance of Certification

Diplomates of the American Board of Thoracic Surgery (ABTS) who plan to participate in the 10-Year Milestone for the Maintenance of Certification (MOC) process as Certified-Active must hold an unrestricted medical license in the locale of their practice and privileges in a hospital accredited by the JCAHO (or other organization recognized by the ABTS). In addition, a valid ABTS certificate is an absolute requirement for entrance into the MOC process. If your certificate has expired, the only pathway for renewal of a certificate is to take and pass the Part I (written) and the Part II (oral) certifying examinations.

The CME requirements are 150 Category I credits over a five-year period. At least half of these CME hours need to be in the broad area of thoracic surgery. Category II credits are not accepted. Interested individuals should refer to the Board’s website (www.abts.org) for a complete description of acceptable CME credits.

Diplomates will be required to take and pass a secured exam after their application has been approved. Taking SESATS in lieu of the secured exam is not an option. The secured exam is administered over a two-week period in September of every year at Pearson Vue Testing Centers, which are located nationwide. Diplomates will have the opportunity to select the day and location of their exam. For the dates of the next MOC exam, visit the Board’s website at www.abts.org.

Starting on July 1, 2014, the ABTS will require its Diplomates to participate in an outcomes database as fulfillment of Part IV (Performance in Practice) for the 10-year Milestone of Maintenance of Certification (MOC). For a list of approved outcomes databases or for more information on how to have a database approved by the Board, visit the Board’s website at www.abts.org. Participation in the Professional Portfolio will no longer be accepted as fulfillment of MOC Part IV after July 1, 2014.

Diplomates may apply for MOC in the year their certificate expires or, if they wish to do so, they may apply up to two years before it expires. However, the new certificate will be dated 10 years from the date of expiration of their original certificate or most recent MOC certificate. In other words, going through the MOC process early does not alter the 10-year validation. Diplomates certified prior to 1976 (the year that time-limited certificates were initiated) are also required to participate in MOC if they wish to maintain valid certificates.

The deadline for submitting an application for 10-year Milestone of MOC is March 15 of every year. Information outlining the rules, requirements, and dates for MOC in thoracic surgery is available on the Board’s website at www.abts.org. For additional information, please contact the American Board of Thoracic Surgery, 633 N St. Clair St, Ste 2320, Chicago, IL 60611; telephone (312) 202-5900; fax (312) 202-5960; e-mail: info@abts.org.