

Pain and the Quality of Life Following Robotic Assisted Minimally Invasive Surgery

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ABSTRACT

Objective: Minimally invasive bypass grafting is a promising surgical treatment in proximal LAD stenosis procedures. The main goal of this study was to make comparisons between robotically assisted minimally invasive coronary bypass surgery and conventional surgery in isolated proximal LAD lesions in terms of pain and quality of life improvement.

Methods: The study contains patients with proximal LAD lesions who were treated with robotically assisted minimally invasive coronary artery bypass surgery and conventional bypass surgery between June 2005 and November 2012. Fifty patients treated with coronary bypass with cardiopulmonary bypass and complete sternotomy were categorized as Group 1. Fifty patients who applied for robotically assisted minimally invasive bypass surgery were categorized as Group 2. The evaluations of pain and quality of life were done according to the Verbal Rating Scale (VRS) and SF-36 health survey questionnaire, respectively.

Results: The conventional bypass group and robotic group had 4.8 ± 1.9 years and 4.3 ± 1.6 years mean follow-up time, respectively. The robotic bypass group had a significantly shorter ICU stay and hospital stay than the conventional bypass group ($P < .05$). The pain score was higher in the robotic bypass group on the 1st postoperative day ($P < .05$), but the score on the 4th postoperative day was higher in the conventional bypass group ($P < .05$). In terms of domains of the SF-36 questionnaire, patient scores were significantly higher in patients who were operated with robotically assisted minimally invasive direct coronary artery bypass (MIDCAB) procedure than in patients who were operated with conventional bypass technique.

Conclusion: Patients operated with robotically assisted MIDCAB procedure had results with lesser pain, shorter ICU stay, and shorter hospital stay than the other group in isolated proximal LAD stenosis. The same group also had better quality of life results according to the SF-36 questionnaire results.

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INTRODUCTION

The beating heart LIMA-LAD anastomosis in isolated LAD lesions from left anterior minithoracotomy is the most commonly known minimal invasive bypass surgery [Detter 2002].

Robotic surgery systems are presented as a potential facilitative factor for minimally invasive coronary artery revascularization procedures.

Minimally invasive direct coronary bypass grafting (MIDCAB) has been established to avoid the side effects of cardiopulmonary bypass (CPB) and to achieve better postoperative outcome and cosmetic results. The benefits of avoiding CPB have been proven, and therefore MIDCAB has become the routine method in various centers [Calafiore 1998; Jansen 1997; Emmert 2012; Kurtoğlu 2008].

Minimally invasive procedures are preferred for their better cosmetic results, small incision size that provides fewer wound infections, and less postoperative bleeding, thus less need for blood and blood products and fewer hospital/ICU stays [Diegeler 2000].

Even though MIDCAB surgery is a technically challenging method, there are studies that show it can be used safely in specific patient groups [Cisowski 2002].

Conventional coronary artery bypass grafting (CABG) is associated with long rehabilitation periods and slow quality of life (QOL) improvement. After cardiac operations, pain and quality of life are important end points for all patients.

The aim of our study was to compare the pain and the QOL improvement between robotically assisted MIDCAB and conventional bypass surgery in isolated proximal LAD lesion.

METHODS

This retrospective study included patients with proximal LAD lesion who had undergone robotically assisted minimally invasive coronary bypass surgery and conventional bypass surgery between June 2005 and November 2012 in our clinic. Fifty patients from Group 1 had on-pump coronary bypass with full sternotomy, whereas 50 patients from Group 2 had robotically assisted minimally invasive coronary bypass surgery. The operations of different groups were done with the same surgical operation team.

Surgical Technique

Group 1 patients underwent conventional CABG at the same institution using a median sternotomy approach, CPB,

moderate hypothermia (32-34° C), and tepid antegrade blood cardioplegic arrest.

The surgical technique for Group 2 consisted of: (1) robotic (Da Vinci) assisted internal thoracic artery (ITA) harvesting; (2) an anterior mini-thoracotomy through the left 4th intercostal space; and (3) ITA to the left descending coronary artery (LAD) anastomosis without CPB under direct vision by using the Octopus NS stabilizer system (Medtronic, Minneapolis, MN, USA).

Inclusion Criteria

Patients with isolated proximal LAD stenosis, 35-80 years of age, ejection fraction between 30-65%, and patients who were anatomically fit for robotic surgery were included in the study.

Exclusion Criteria

Age >80, chronic renal disease, advanced COPD (chronic obstructive pulmonary disease), serious PAD (peripheral arterial disease), EF <30%, advanced stage CHD (congestive heart disease), and patients who were unfit anatomically for endoscopic imaging.

Pain and Quality of Life

Intercostal nerve blockage for pain control was applied to patients who underwent robotic surgery. The pulmonary artery cannula, which was placed before the closure of the thoracotomy incision, was directed out from the skin. From this cannula, local anesthetic (bupivacaine hydrochloride 5 mg/mL) was continuously injected in the postoperative stage. The catheter was removed on postoperative day 3.

In the ICU the Verbal Rating Scale (VRS) was used as the postoperative pain scale, 0: no pain to 10: very intense pain. Patients described their pain as numbers and the data were recorded every 4 hours. Paracetamol 10 mg/kg IV was applied to patients with a pain score of 4 or more. Further lasting pain was treated with 0.5 mh/kg tramadol IV.

Short form 36 (SF-36) is a widely used tool in clinical studies to assess the quality of life and general health perception. It can be used to assess the physical and mental health as well as how the patient perceives his or her health or illness [Falk 2000]. This questionnaire is also commonly used after cardiovascular surgery to evaluate QOL of a patient [Kiaii 2006].

The SF-36 is a general quality of life questionnaire that assesses eight health concepts: 1, limitations in physical activities because of health problems; 2, limitations in social activities because of physical or emotional problems; 3, limitations in usual role activities because of physical health problems; 4, bodily pain; 5, general mental health; 6, limitations in usual role activities because of emotional problems; 7, vitality; and 8, general health perceptions [Ware 1992]. Scores are converted to a 0-100 scale, which allows numerical assessment of the domains. Higher scores indicate less limitation and disability.

Statistical Analysis

All analyses were performed using SPSS (Statistical Packages for the Social Sciences). In the comparison of qualitative data Pearson chi-square and Fisher Exact tests were used. For the comparison of quantitative data in the two groups, independent sample t test was used. In the comparison of the parameters in specific groups, paired sample t test was used. The ICU and hospital stay duration was obtained using the Kaplan-Meier method.

Table 1. Demographic Characteristics of Patients

	Conventional Bypass	Robotic Bypass	P
Age, mean	62.18 ± 6.74	57.40 ± 11.29	.278
Body mass index	27.18 ± 3.43	28.24 ± 3.66	.171
Ejection fraction, %	58.81 ± 6.19	60.78 ± 5.95	.068
Female sex, n (%)	28 (56)	24 (48)	.423
Male sex, n (%)	22 (44)	26 (52)	
Chronic obstructive pulmonary disease, n (%)	14 (28)	4 (8)	.009*
Hypertension, n (%)	42 (84)	32 (72)	.023*
Diabetes mellitus, n (%)	34 (68)	22 (44)	.016*
Hyperlipidemia, n (%)	30 (60)	32 (64)	.680
Myocardial infarction, n (%)	12 (24)	15 (30)	.499
Cerebrovascular accident, n (%)	1 (2)	0 (0)	-
Renal failure, n (%)	0 (0)	1 (2)	-
Peripheral vascular disease, n (%)	3 (6)	4 (8)	.695

*P < .05; **P < .01; ***P < .001.

Table 2. Pain Score, ICU and Hospital Stay of Both Groups

	Conventional bypass (mean)	Robotic bypass (mean)	P
ICU stay, day	2.1	1.3	<.05
Hospital stay, day	7.96	5.62	<.001
Pain score 1st day	0.6	2.1	<.05
Pain score 3rd day	1.9	0.8	<.05

Mean hospital stay

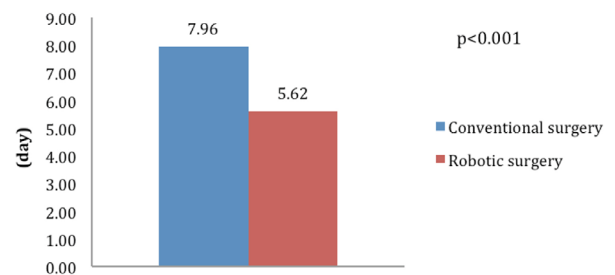


Figure 1. Mean hospital stay.

All data are expressed as mean \pm standard error of the mean. The results were evaluated by their significance ($P < .05$) and advanced significance ($P < .01$ and $P < .001$).

RESULTS

Demographic characteristics of the 100 patients are summarized in Table 1. There was no significant difference between the groups regarding hyperlipidemia, chronic renal disease, MI, and peripheral arterial disease.

According to Kaplan-Meier analysis, ICU stay of the conventional bypass group was significantly higher than the robotic bypass group ($P < .05$). Similarly, the hospital stay of the conventional bypass group was significantly higher than the robotic bypass group ($P < .001$) (Table 2; Figure 1).

The robotic bypass group had a higher mean pain score on postoperative day 1 ($P < .05$). The conventional bypass group had a higher mean pain score on postoperative day 4 ($P < .05$). The decrease of pain score between the 1st and 4th days of the postoperative period was significantly higher in the robotic bypass group ($P < .001$) (Table 2; Figure 2).

Patients who were operated with robotically assisted MIDCAB procedure had significantly higher scores in all domains on the SF-36 questionnaire compared to patients who were operated with conventional bypass technique (Table 3).

There was no postoperative transient ischemic attack (TIA) or mortality, and there was no need for intraaortic balloon pump (IABP). Wound infection was seen in 2 patients in the conventional bypass group, but it was not clinically significant ($P > .05$). Mean ejection fraction in the robotic bypass group (60.78%) was higher than in the conventional bypass group ($P > .05$).

DISCUSSION

In the last decade, efforts in all areas of surgery have focused on minimally invasive surgical techniques. In cardiac surgery, there are two important aspects of this concept: (1) minimal access to limit surgical trauma, and (2) avoidance of cardiopulmonary bypass. MIDCAB performed with smaller incisions and without cardiopulmonary bypass is becoming more popular. The reasons for the success of these procedures

are shorter hospital stay, rapid recovery, faster return to activity, reduced patient morbidity, and less postoperative pain than with standard procedures [Al-Ruzzeh 2004; Magovern 1998; Holzhey 2012].

Robotically assisted CABG is a rapidly advancing field that requires proper evaluation to ensure that the established short-term benefits are gained without compromising the known benefits of conventional CABG. Robotic surgery systems are presented as a potential facilitative factor for minimally invasive coronary artery revascularization procedures. The beating heart LIMA-LAD anastomosis in isolated LAD lesions from left anterior minithoracotomy is the most commonly known minimally invasive bypass surgery [Detter 2002].

Minimally invasive procedures are preferred for their better cosmetic results, small incision size that provides less wound infections, and less postoperative bleeding, thus less need for blood and blood products and less hospital/ICU stays [Diegeler 2000]. Even though minimally invasive coronary artery bypass grafting surgery is a technically challenging method, there are studies that show it can be used safely in specific patient groups [Falk 2000].

The mean follow-up time of the conventional bypass group was 4.8 years (± 1.9); the robotic bypass group mean follow-up time was 4.3 years (± 1.6).

Bonatti et al compared conventional bypass with the minimally invasive method in single vessel disease. The minimally invasive group had less blood product usage and less in-hospital stay [Bonatti 1998]. The potential benefits of robotically assisted MIDCAB technique include shorter hospital stay and faster recovery [Birla 2013]. In our study, ICU and hospital stays were shorter in the robotic bypass group and this was statistically significant (Table 2).

Patients who were operated with robotic MIDCAB procedure had significantly higher scores in all domains on the SF-36 questionnaire compared to patients who were operated with conventional bypass technique. Pain perception and the perceived quality of life are subjective measures that exhibit significant interpersonal variability. For instance, a subject with a serious health condition may report a relatively good quality of life, while another with a minor disability may be found to experience a poor quality of life.

Early postoperative pain can result in poor mobility and shallow breathing that may lead to complications, including deep vein thrombosis, pulmonary embolus, and pneumonia.

Table 3. SF-36 Quality of Life Questionnaire Data

	Conventional Bypass	Robotic Bypass	P
Physical functioning	63.4 \pm 19.82	80.44 \pm 19.85	.008
Physical role functioning	45.42 \pm 55.63	82.79 \pm 55.11	<.0001
Bodily pain	53.4 \pm 27.12	74.22 \pm 23.57	<.0001
General health	45.49 \pm 21.19	63.89 \pm 22.44	.001
Vitality	45.24 \pm 22.16	55.56 \pm 24.76	.02
Social functioning	65.4 \pm 25.78	84.51 \pm 21.78	.005
Emotional role functioning	55.63 \pm 47.71	81.36 \pm 35.67	.003
Mental health	61.24 \pm 22.43	71.56 \pm 21.23	.007

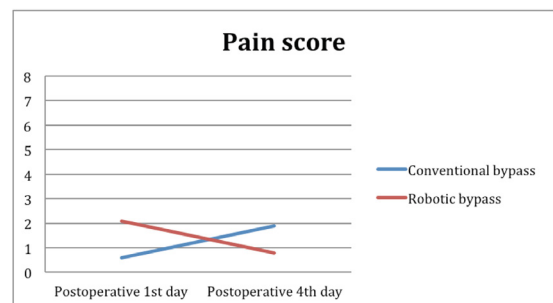


Figure 2. Pain score.

Diegeler et al compared postoperative pain of MIDCAB and conventional bypass patients. They detected a pain that is thought to be due to thoracotomy and could last up to 3 days postoperatively among MIDCAB patients. This patient group showed decrease of the pain level after the 3rd day as well as better physical activity, which is thought to be related to the absence of sternotomy and cardiopulmonary bypass [Diegeler 1999].

In our study, it was found that the robotic group had more pain on postoperative day 1 and the conventional bypass group had more pain after postoperative day 4.

Overall, pain was found in both groups in this study and was sufficiently treated in most patients. The parietal pleura is very sensitive to mechanical irritation, and chest tubes inside the pleural space are one major source of postoperative pain in cardiac patients. Thus, most of the pain related to this fact is relieved when the chest tubes are removed.

Endoscopic surgery is expected not only to provide superior cosmetics but also to reduce complications and improve postoperative quality of life [Ishikawa 2015]. Improvement in postoperative QOL and expeditious return to work are primary objectives of minimally invasive surgery [Seco 2013].

The sternotomy approach caused some pain and muscular tension in the back over a prolonged postoperative period. Due to this, a number of sternotomy patients were discharged while still receiving pain medication with indomethacine. Furthermore, even after three months, some of these patients complained about a limitation of their quality of life due to pain, which was again significantly higher when compared to the MIDCAB group.

Even a small anterior thoracotomy is painful. Thus, adequate medication and intercostal nerve blockage are mandatory in robotically assisted MIDCAB patients to achieve optimal patient comfort. Together with the avoidance of the negative impact of cardiopulmonary bypass, the minimally invasive approach results in improved activities, better mobilization, and in general an earlier recovery after coronary artery bypass surgery.

Study Limitations

The major limitation of this study is the small number of participants. Some patients could not be contacted due to changes in contact information and some others declined participation due to their remote settlement from the hospital. More studies with larger patient populations and more time intervals are justified.

Secondly, this was a retrospective study. Currently, we are still working on publishing updated outcomes in our prospective study.

Conclusion

Robotically assisted minimally invasive coronary artery bypass grafting technique is feasible and has good procedural outcomes which are associated with lesser pain in the early postoperative period, and shorter ICU and hospital stay in contrast to conventional surgery. Also, robotic assisted MIDCAB procedure leads to improved physical health and a more rapid restoration of daily activities.

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