MINIMALLY INVASIVE HEART SURGERY

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PREFACE

The human heart, with its ceaseless rhythm, symbolizes life itself. It sustains us, drives us, and connects us to the profound mysteries of existence. Yet, when this vital organ falters, the consequences can be dire, often necessitating urgent medical intervention. This book, "Minimal Invasive Cardiac Surgery," is a tribute to the remarkable field of cardiac surgery—a discipline that exemplifies the intersection of human ingenuity, compassion, and the relentless pursuit of healing.

Cardiac surgery has undergone an extraordinary evolution over the past century. From the bold and perilous attempts of early pioneers to the sophisticated, minimally invasive procedures of today, the journey has been marked by relentless innovation, dedication, and an unwavering commitment to saving lives. Most of this technology has evolved from the concept of a less invasive approach to improve quality of life and this concept has become the reality. This book aims to capture this journey, offering readers a comprehensive understanding of the principles, techniques, and advancements that define the minimally invasive cardiac surgery.

As you delve into these pages, you will encounter a blend of historical narratives, clinical insights, and detailed descriptions of surgical procedures. The content is designed to not only inform but also to inspire. For the seasoned practitioner, it is a reaffirmation of the profound impact that skill and knowledge can have on human lives. For the aspiring surgeon, it serves as a source of motivation and roadmap to the mastery of this demanding yet incredibly rewarding field of minimally invasive cardiac surgery.

In embarking on this literary journey, we hope to honor those who have paved the way—trailblazers whose courage and creativity laid the foundation for modern practices.

"Minimal Invasive Cardiac Surgery" is not merely a technical manual; it is a celebration of the enduring spirit of medical progress and the human capacity for empathy and innovation. We invite you to explore, reflect, and be inspired by the remarkable realm of cardiac surgery.

With heartfelt appreciation,

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CHAPTER 1

GETTING STARTED WITH MINIMALLY INVASIVE CARDIAC SURGERY

Barış Timur[1]

INTRODUCTION

The first case accepted as the beginning of cardiac surgery is the repair of a cardiac injury by German surgeon Ludwig Rehn in 1896 in Frankfurt with a penetrating instrument. This procedure was also the first indication that the heart, which was considered "untouchable" until then, could also be operated on (1).

At the beginning of the twentieth century, inflammatory diseases of the pericardium were untreated and were fatal. In 1902, the first case of pericardiectomy performed by removing the calcified parts of the pericardium was performed by Ludolf Brauer (2). In the following years, Trendelenburg performed the first pulmonary thromboembolectomy in 1908, and Robert Gross performed the first successful patent ductus arteriosus ligation in 1938 (3, 4).

The invention that led to the development of cardiac surgery was achieved by the invention of the cardiopulmonary bypass (CPB) device and integrating it into operations. The first cardiopulmonary bypass device was produced by John Gibbon with the contributions of Thomas Watson, the CEO of IBM at the time,

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One of the most important advantages of MICS is that it reduces the use of blood and blood products. International Society for Minimally Invasive Cardiothoracic Surgery, in its published consensus statement, mentioned that minimally invasive methods reduce blood usage. Of course, the use of blood is not a reason to prefer minimal surgery (38). Many studies on the subject clearly show that blood use decreases with MICS (29, 34, 39).

Conclusion

In conclusion, MICS popularity is increasing day by day. As surgeons become more experienced in this area, complications decrease, and successful operations are performed at the level of standard methods. The cost is decreasing. We can confidently say that the trend is for MICS to replace standard surgery.

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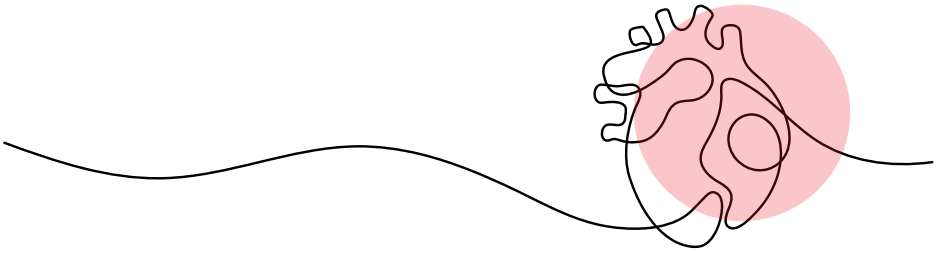

CHAPTER 2

ANESTHETIC MANAGEMENT IN MINIMALLY INVASIVE CARDIAC SURGERY

Mustafa Şimşek[1]

INTRODUCTION

Today, advances in surgical and anesthesia techniques and the routine use of intraoperative transesophageal echocardiography (TEE) have made less invasive approaches with small surgical incisions possible. Cosgrove et al. described the first minimally invasive valve interventions in 1996 (1).

Minimally invasive cardiac surgery includes many cardiac interventions; Minimally invasive direct coronary artery bypass graft (MIDCABG), Mitral valve repair or replacement, Tricuspid valve repair or replacement, Aortic valve repair or replacement, atrial septal defect (ASD) and patent foramen ovale (PFO) closure, left atrial appendage closure, tumor extirpation, cryoablation.

Anesthetic management in minimally invasive cardiac surgery varies according to the type of surgery, surgical incision and perfusion method used.

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possible complications, and have the skills and equipment to solve them. and simultaneously, he must be extremely knowledgeable in TEE and multimodal analgesia. Most importantly, the anesthesiologist must have excellent communication with the perfusionist and the surgical team.

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CHAPTER 3

MINIMALLY INVASIVE AORTIC VALVE SURGERY

Uğur Kısa[1]
Naci Cem Aydoğdu[2]

INTRODUCTION

Aortic valve diseases constitute the most common disease group among heart valve diseases. In 1931, Paul Dudley White said, "There is no cure for aortic stenosis." (1). Even today, medical treatment is not sufficient for aortic stenosis. Since then, many methods have been developed in order to address aortic valve disorders. However, definitive treatment of the disease was only possible with the invention of cardiopulmonary by-pass. Simultaneously with the development of treatment, heart valve prostheses were also developed rapidly. Available prostheses include mechanical valve prostheses, biological valve prostheses with stents, biological valve prostheses without stents, human homograft prostheses, and methods using pulmonary autograft (Ross procedure) (2). As the need for aortic valve replacement increased, not only prostheses but also alternative

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these patients have recognized risk factors for unfavorable surgical results (28). The use of sutureless valves in appropriate patients may shorten operative times and make the MIAVR approach more standardized.

CONCLUSION

MIAVR is a safe procedure yielding favorable outcomes compared to conventional methods. Although there are potential disadvantages, with the improved technology and experience it will likely become the standard of care.

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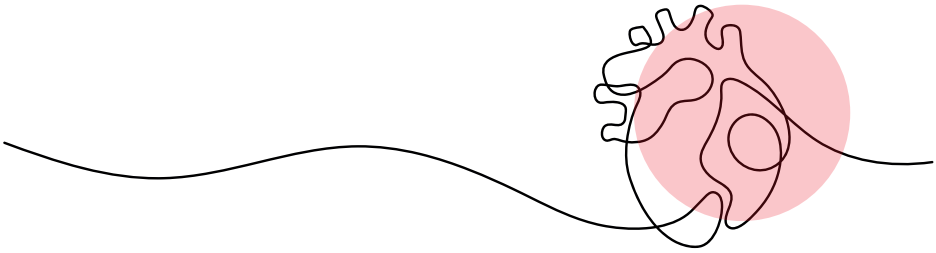

CHAPTER 4

MINIMALLY INVASIVE MITRAL VALVE SURGERY

Rezan Aksoy[1]
Kandemir Baş[2]

INTRODUCTION

Mitral valve (MV) disease remains to be one of the most frequent valve diseases caused by degenerative, rheumatic, and ischemic valve diseases or infective endocarditis (1-4). The median sternotomy still is a common approach of MV surgery. However, it remains an invasive method and has had more surgical trauma than minimally invasive mitral valve surgery (MIMVS) (4,5).

Minimally invasive mitral valve surgery usually refers to a small incision of the chest wall with no complete sternotomy (6). Although several surgical approaches, like lower mini-sternotomy and para-sternotomy have been defined, right mini-thoracotomy is most commonly performed for mitral valve (MV) disease, which warrants a specific long shaft instrument set and meticulous planning. Best visualization is commonly obtained by means of port-access two

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CHAPTER 5

MINIMAL INVASIVE TRANSCATHETER MITRAL VALVE INTERVENTIONS

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Okan Ersan[2]

INTRODUCTION

The NeoChord DS100 system appears to be a new transapical Neo-chorda implantation device via left anterior mini thoracotomy (TOP-MINI) without cardiopulmonary bypass (CBP), which is a less invasive mitral valve repair (MVr) procedure with promising results.

It is aimed to reduce mortality and morbidity with more rapid recovery. Neo-Chord and Harpoon systems has been shown to be safe and reliable. Because TOP-MINI necessitates no cardiopulmonary bypass and cardioplegic heart arrest, it is preferred as a management for degenerative mitral valve disease (DMVD), especially in patients who have had a high risk for surgery.

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CHAPTER 6

MINIMALLY INVASIVE MULTI-VALVE SURGERY

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INTRODUCTION

The development of cardiac surgery in the modern sense took place in the second half of the 19th century (1,2). The first pericardiectomy was performed by Billroth in 1882 and the first successful repair of cardiac injury was performed by Ludwig Rehn in 1896 [3]. The discovery of heparin in 1915 by Jay Mclean (4), a medical student, and the subsequent development of the modern heart-lung machine by John Gibbon accelerated the developments in cardiac surgery (5). Vineberg was a key figure in coronary surgery. Vineberg laid the foundations of coronary bypass surgery by placing the LIMA graft in the anterior wall of the heart (6). Cardiac catheterization by Forssman in 1929 and Shiney's demonstration of stenosis in the coronary vessels in 1962 marked the beginning of modern coronary surgery(7). Developments in valvular surgery started with Tuffier's first successful heart valve intervention in 1912 (8) and continued with

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Another disadvantage is the limited surgical field of view. When the studies of experienced centers with a high case volume are taken into consideration, it has been reported that minimally invasive techniques provide better visibility rather than a disadvantage compared to conventional sternotomy, especially in the approach to mitral valve pathologies (41).

Minimally invasive procedures offer proven techniques for the treatment of high-risk double and triple valve patients. These approaches result in lower morbidity and mortality rates, require less blood product usage, provide shorter intensive care and discharge time, minimize pain, and yield superior cosmetic outcomes (42-45).

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CHAPTER 7

MINIMALLY INVASIVE TRICUSPID VALVE SURGERY

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INTRODUCTION

Tricuspid valve disease has a benign course but can be underestimated, leading to delayed treatment and poor prognosis. In untreated cases, it causes multisystemic manifestations, and surgical complications increase further (1,2). Isolated tricuspid valve surgery is less common and is usually performed simultaneously with multivalve or mitral valve surgery (3). The indication for tricuspid valve surgery is the presence of at least moderate tricuspid regurgitation with NYHA 3 or more symptoms or other signs of right heart failure including pretibial edema, ascites, pleural effusion (1,3,4).

PREOPERATIVE PREPARATION

Preoperative investigations such as anamnesis, physical examination, 12-lead

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Replacement rather than repair is preferred in cases of persistent long-term disease findings such as recurrent tricuspid regurgitation, chronic atrial fibrillation, and pulmonary hypertension. The presence of other comorbidities such as a history of cardiac surgery, multiple valve surgery cases, concomitant coronary surgery, renal problems, and severe pulmonary disease are conditions that decrease survival compared to patients undergoing isolated tricuspid or first-time tricuspid valve surgery (3).

The risk of cerebrovascular events is higher in minimally invasive tricuspid surgery compared to conventional sternotomy (1,20). Postoperative arrhythmia risk is high after tricuspid valve surgery and temporary or permanent pacemaker implantation may be required. Long operative times are frequently criticized in minimally invasive tricuspid surgery but with the improvement of the surgeon's and the center's experience operative time difference becomes negligible. Delayed referral to surgery and comorbidities may be associated with a higher rate of renal complications (1,3).

CONCLUSION

The learning curve in minimally invasive cardiac surgery is a long process and depends on each surgeon's ability to assimilate and adapt adequately to new techniques. Organization and close communication between all team members is very important.

There are very few studies on minimally invasive tricuspid valve operations and the available data is limited. Almost all of the literature on these surgeries includes mitral valve studies[1].

Since patients undergoing isolated tricuspid valve surgery usually present preoperatively with signs of systemic venous congestion, such as renal or hepatic insufficiency, the management of these patients is high-risk and patients should be evaluated multisystemically (21).

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CHAPTER 8

MINIMALLY INVASIVE CONGENITAL CARDIAC SURGERY

Murat Çiçek[1]

INTRODUCTION

Minimally invasive cardiac surgery generally refers to surgical techniques performed through small incisions to minimize tissue trauma. It is a broad concept that includes access to the operative field through different anatomical sites and smaller incisions other than the classical median sternotomy, as well as operation while the heart beats and surgical approaches through specialized robotic equipment (1). In recent years, minimally invasive surgery has been preferred by patients and surgeons because it is a method that reduces perioperative morbidity and has cosmetic advantages related to the incision.

HISTORY

The goal of congenital cardiac surgery is to achieve complete repair of the anomaly with minimal morbidity, zero mortality and no residual defects. The traditional standard approach for the repair of congenital heart defects is through median sternotomy. The wide incision allows the surgeon to reach every part of the operative

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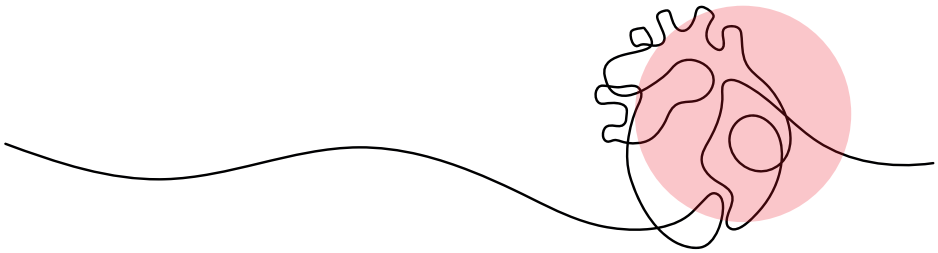

CHAPTER 9

MINIMALLY INVASIVE CORONARY ARTER BYPASS GRAFTING

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Yigit KOSE[2]
Recep CALISKAN[3]
Ferhat TUMKAYA[4]

INTRODUCTION

The development of cardiac surgery in the modern era occurred in the second half of the 19th century (1, 2). The first pericardiectomy was performed by Billroth in 1882 and the first successful repair of cardiac injury was performed by Ludwig Rehn in 1896 (3). The discovery of heparin by Jay Mclean (4), a medical student in 1915, and the foundations of the modern heart-lung machine by John Gibbon accelerated the developments in cardiac surgery (5). Vineberg was a key

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CONCLUSION

Sparing the patients from a sternotomy and cardiopulmonary bypass provides a significant reduction in bleeding and hence the blood product usage and cerebrovascular events (24, 25). Operative mortality rates are lower compared to conventional surgery (26). In the postoperative period, intensive care unit stay and overall hospitalisation durations are lower, and there is also a significant difference in wound healing times compared to open surgery, with the postop mobilisation of patients occurring earlier (27). Patients can continue their normal lives after discharge. Therefore, minimally invasive coronary artery bypass surgery is a safe and feasible procedure in selected patients.

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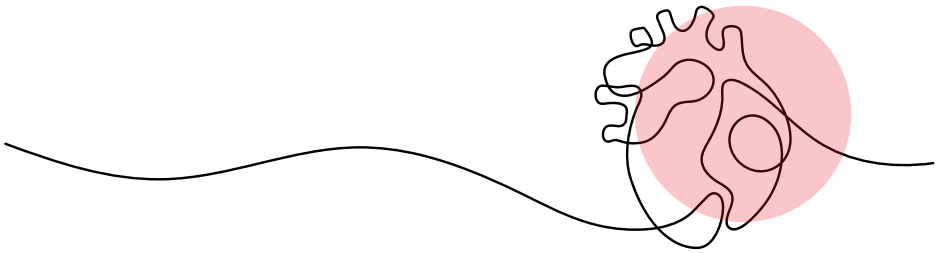

CHAPTER 10

MINIMALLY INVASIVE SURGICAL METHODS FOR THE TREATMENT OF ATRIAL FIBRILLATION

Unsal VURAL[1]
Ahmet Arif AGLAR[2]

INTRODUCTION

According to the Global Burden of Disease project, 46.3 million persons worldwide were estimated to have atrial fibrillation (AF) in 2016[1]. About 1/4 of white men and women over 40 were predicted to have a lifetime risk of AF in 2004 [2]. After a decade, it was stated that lifetime risk estimates for white people had reached roughly 1/3 and for black people, 1/5 [2]. AF raises the risk of stroke by around five times and more than doubles the chance of mortality [3]. It is well established that even postoperative transient AF alone increases the risk of stroke by 30% and death by 11% [4].

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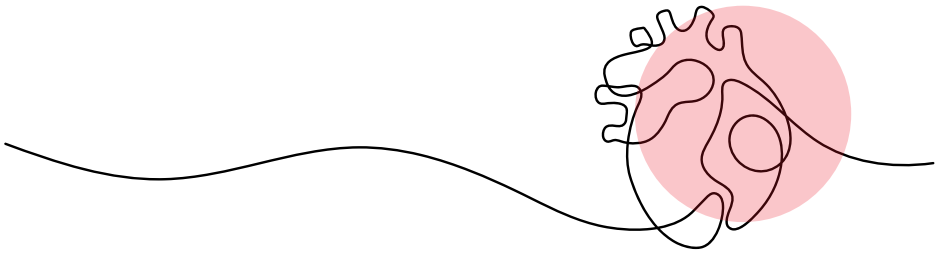

CHAPTER 11

ROBOTIC CARDIAC SURGERY

Murat Bulent Rabus[1]
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INTRODUCTION

The term of robotic surgery entered the surgical literature in the 1980s. The Aesop system was introduced in 1994, followed by the DaVinci and Zeus systems. The popularity of robotic surgery has increased day by day and it has become a significant part of routine surgical practice. Robotic surgery has been adopted more slowly in cardiac surgery. The reasons for this are high cost, complex process of cardiac surgeries, need for institutional resources (special instruments, specially prepared operating room, trained anesthesia, nurse and perfusionist team) and lack of standardized minimally invasive cardiac surgery training. Despite all, Dr. Carpentier and colleagues performed first robotic valve surgery in 1996 (1). The da Vinci system was clearanced for use in cardiac surgeries from U.S. Food and Drug Administration in the early 2000s. After FDA clearance of da Vinci surgical system for cardiac surgery, robotic cardiac surgery has become prevalent especially in the United States of America.

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be relative contraindications. For example, performing redo mitral valve surgery with robotic system is controversial. Some experienced centers have reported that they have successfully performed robotic redo mitral valve surgery (15). As an experienced clinic in robotic cardiac surgery, We agree that contraindications change according to the experience of the robotic surgery center. On the other hand, we definitely do not recommend robotic surgery in cases of moderate or severe aortic regurgitation.

The major disadvantage of robotic cardiac surgery is high system cost. Some surgeons suggest that many surgeries can be performed with low cost via mini thoracotomy instead of robotic surgery. In recent studies, robotic surgery systems have been compared with non-robotically assisted minimally invasive surgery systems (16). It has been reported that the robotic system costs are not high and can be used effectively among minimally invasive cardiac surgery methods.

Robotic cardiac surgery has both advantages and disadvantages for cardiac surgeons. Among the advantages of robotic cardiac surgery, it provides excellent surgical exposure with its 3D camera and retractor arms, prevents the reflection of hand tremors, and offers comfortable surgery to the console surgeon. Its disadvantages include the need for an experienced team in each operation and the need for a second port surgeon especially in intracardiac procedures.

CONCLUSION

Robotic cardiac surgery has been performed all over the world and in our country for the last 20 years. Although the number of robotic cardiac surgery clinics is small, we think that robotic cardiac surgery will become widespread in the coming years with the improvement of cost and training conditions. With the developing communication and robotic technologies, it is difficult to predict the future of cardiac surgery. In conclusion, robotic cardiac surgery can be performed to suitable patient effectively and safely by an experienced team.

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