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HISTORY OF MINIMALLY INVASIVE MITRAL VALVE SURGERY DEVELOPMENT



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Over the past decades, operations using mini-invasive access have been firmly established in the practice of many cardiosurgical clinics around the world. In some clinics, this type of intervention accounts for 65% of the total number of operations. Incorrectly selected access is the reason for the conversion of the section, which to some extent discredits this technique and refusing to use it in practice.

The variety of existing accesses requires clear indications and contraindications to their choice. However, there is no unified opinion on this issue in the contemporary literature. Thus, the development of an algorithm for selecting access in operations from mini-accesses can lead to an improvement in the quality of cardiac surgical care.

This article presents literature data on existing accesses in valvular operations and presents in-depth studies reporting that, benefits of minimal invasive mitral valve surgery, there are advantages a decrease in injury rate of operations, postoperative complications, shorting periods of staying in hospitals, a good cosmetic effect.

Key words: mini-invasive access, mitral valve.

In the mid-1990s, the first mini-invasively mitral valve surgery (MIMVS) procedure was individually described by Navia and Cosgrove [68], and then by Cohn et al. [69]. Since those reports, various less invasive methods have been developed, including parasternal, hemi-sternotomy, right mini-thoracotomy, and totally endoscopic approaches [75].

A right parasternal incision was utilized in early MIMVS cases, with encouraging clinical results presented [68, 69]. However, this approach has been gradually abandoned because of potential chest wall instability and sustained pain due to resection of costal cartilages, while other disadvantages include the necessity of transection of the right internal thoracic artery and difficulty with conversion to a median sternotomy [75].

Thereafter, a hemi-sternotomy became the common approach for MIMVS, and McClure et al. described excellent early and long-term results of 707 minimally invasive MV repair cases, most of which were performed using a lower hemi-sternotomy. Among those, operative mortality was 0.4% with low perioperative morbidity, including reoperation for bleeding (2%), stroke (1.9%), and deep sternal infection (0.7%) [70]. Although some questions remain, including whether a hemi-sternotomy approach is minimally invasive, since sternotomy-related complications are not completely avoided [71], this type of incision remains in common use by some surgeons, as neither a specific surgical instrument nor cardiopulmonary bypass (CPB) system is required [75].

The first MIMVS procedure through a right mini-thoracotomy was performed in 1996 by Carpentier et al. [72]. Soon thereafter, Chitwood et al. presented clinical results of 31 video-assisted MV operations that utilized a transthoracic aortic clamp and reported a 30-day mortality rate of 3.2% with no

major complications [73]. In 1998, the Leipzig group reported 129 video-assisted MIMVS cases with port-access technology, which was based on endo-aortic balloon clamping [74]. Since then, a right mini-thoracotomy has become the most common approach for MIMVS along with development of related technologies, such as long-shafted surgical instruments, high-resolution endoscopy, and CPB systems with peripheral access. Therefore, this review was focused on MIMVS through a right mini-thoracotomy [75].

In the modern medicine, the quality of life takes on great importance, what determined significantly by the cosmetic effect of the surgery. Thus, according to M Massctti: "If the size and quality of the incision can reduce psychological stress of a patient, it should be considered during planning an operation."

The variety of combinations of types of the constitution and the options of heart diseases requires the surgeon's ability to possess different variants of mini-approaches. The literature suggests several methods of choosing a surgical approach, based on preoperative imaging. The simplest one is to use X-rays. In addition to the X-ray picture, the patient's constitution and related variants on interrelations of internal organs and skeleton are taken into account [7, 8].

Another technique involves the usage of transesophageal echocardiography performed on the operating table after intubation, but before the skin incision [9]. The technique which allows very accurately determining the position of the heart and selecting the desired approach is spiral computed tomography (CT). The selection of spiral CT for this purpose was based on the accuracy of the method, its non-invasive, the possibility of simultaneous imaging of bone structures and soft tissues, as well as determining the spatial relations in a chest. Wrong selected

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approach is the cause of the conversion of the discussion what discredits this technique to some extent; also it is the reason for not using the technique in practice.

Currently, for the correction of heart defects, the following types of minimally invasive approaches are used:

1. Open technique with using small incisions (8-10 cm) and traditional IR connection [6, 10, 11, 12, 13, 14, 15].

2. «Port-access» technique, when IR connected through the femoral vessels, the aortic occlusion by endoaortic balloon catheter, video support; the operation is performed through small (port) routs [16, 17, 18, 19, 20].

3. Combination (the technique includes elements of the «Port-access» in conjunction with traditional methods of heart surgery [1, 21, 22, 23, 24, 25, 26, 27, 28]).

4. Recently, the reports about the operations performed in cardiac surgery with using robotics have published [27, 29, 30, 31, 32, 33].

Most authors, who use minimally invasive surgery, noted a decrease in injury rate of operations, postoperative complications, shorting periods of staying in hospitals, a good cosmetic effect [7, 21, 34, 35, 36, 37, 38].

Many of the questions in this section of Cardiac have been studied insufficiently. Thus, the selection criteria of choosing an approach have to be verified depend on the pathological state of each of the valves and the individual patient's anatomy. The indications and contraindications for minimally invasive interventions in the presence of acquired valvular disease (AVD) are not developed. There is no consensus on how to connect (before the abbreviation should be written the full term) IR apparatus, supply cardioplegic solution in the literature; the need for the development and use of special tools is pointed [3, 5, 39, 40, 41].

The prosthetics technique of aortic, mitral, tricuspid valves, plastic septal defects has become a waste, routine procedure, where route to the heart is made through the longitudinal median sternotomy (LMS), which is recognized as the "gold standard" in the performance of all cardiac surgery with cardiopulmonary bypass.

Despite of the apparent advantages of the LMS like the access to the heart, the in-depth studies in recent years have reported the possible weakness of access associated with large traumatic, what is one of the main factors involving the development of mediastinitis in the early postoperative period. Infections of superficial soft tissue at the LMS increase the risk of deep sternal infection with necrosis of sternal and the development of mediastenita. Postoperative mortality caused by the last option can reach 50%. The development of deep sternal infection in the early postoperative period may lead to such severe complications as the arrosive bleeding; in the long term period can cause diastasis of sternum with the necessity of re-operation [8, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55].

Another indication of LMS traumatism is severe pain syndrome in the early postoperative period, what requires repeated use of analgesics, even after discharge. In turn, the pain syndrome and the usage of narcotic analgesics may cause the phenomenon of respiratory failure due to the breach of respiratory mechanics in the early postoperative period [20, 52].

In connection with the abovementioned, cardiac surgery has changed its direction towards the reduction of invasiveness; as a result, the new trend "Minimally invasive cardiac surgery (MICS)" has appeared, and it has been accepted and approved as the new technique at the International Forum Society of minimally invasive surgeries in 2003 (STS National Database, 2003;) [5, 24, 56, 57, 58, 59].

Along with improvements in clinical outcomes of mitral valve (MV) repair procedures, early surgical intervention for degenerative mitral valve regurgitation (MR) has been promoted. The 2014 American Heart Association/American College of Cardiology (AHA/ACC) guidelines indicate that MV repair is reasonable (Class IIa) in asymptomatic patients with chronic severe primary MR with preserved left ventricular (LV) function (LV ejection fraction [60% and LV end-systolic dimension \40 mm) in whom the likelihood of a successful and durable repair is more than 95% with a low expected mortality rate (1 %) when performed at a heart valve center of excellence [60]. Furthermore, Suri et al. reported that prompt surgical correction of severe degenerative MR within 3 months following diagnosis in asymptomatic patients with preserved LV function resulted in a decrease of 40% in risk of late death and a 60% diminution in heart failure incidence [61, 75].

These trends toward early surgery have been pushing development of less invasive approaches for MV repair. Furthermore, the belief that a minimally invasive approach leads to less pain, shorter hospital stay, faster return to normal activities, and superior cosmesis has also driven its development worldwide. As a consequence, minimally invasive mitral valve surgery (MIMVS) procedures have rapidly grown in popularity and become standard in many centers. According to The Society of Thoracic Surgeons Adult Cardiac Surgical Database (STS ACSDB) in the United States, the proportion of MIMVS procedures increased from 11.9% of mitral valve surgeries (MVS) in 2004 to 20.1 % in 2008 [62]. Similar trends have also been seen in Japan, where the ratio of MIMVS increased from 5.7% of all MV repair cases in 2008 to 15.6% in 2012 [63]. Most meta-analysis studies and reviews have shown that MIMVS provides equivalent outcomes as compared to conventional MVS with a standard sternotomy approach in terms of early mortality and morbidity [64-67]. However, as more institutes implement an MIMVS program, additional issues have become highlighted, including MIMVS-specific complications, long-term repair durability, and learning curve, as well as others [75].

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МИТРАЛЬДЫ ҚАҚПАҚШАНЫҢ МИНИМАЛЬДИ ИНВАЗИВТИ ХИРУРГИЯНЫҢ ДАМУ ТАРИХЫ

Соңғы он жылдықта миниинвазиялық ену арқылы ота жасау әдісі әлемнің көптегн кардиохирургиялық клиникаларына енгізілді. Кейбір клиникаларда араласудың осы түрі жалпы отасанының 65%-н құрайды. Қате таңдалған ену тіліктің конвертациясына себеп болады, бұл осы әдістің пайдасын белгілі бір деңгейде азайтып, оның тәжірибеден шығарылуына әкеледі.

Қолданыстағы енудің көптүрлілігі оларды таңдауда дәл көрсетімдер мен қарсы көрсетімдерді талап етеді. Алайда осы мәселе бойынша заманауи әдебиеттерде бірыңғай ой жоқ. Осылайша, ота жасау кезінде мини-енуден ену әдісін таңдау алгоритмін әзірлеу кардиохирургиялық жәрдем көрсету сапасын арттырады.

Минимальды инвазивты әдіс арқасында операциядан кейінгі ауруханада жату уақытын қысқартады; пациенттің операциядан

кейін ерте сауығып, физикалық функцияларының тез арада қалпына келуін қамтамасыз етеді; пациенттің өмір сапасын жақсартады; операциядан кейін пациенттің ауруы азырақ байқалады.

Негізгі сөздер: миниинвазиялық ену, митральды қақпақша.

Р Е З Ю М Е

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ИСТОРИЯ РАЗВИТИЯ МИНИМАЛЬНО ИНВАЗИВНОЙ ХИРУРГИИ МИТРАЛЬНОГО КЛАПАНА

За последние десятилетия операции с использованием миниинвазивного доступа прочно внедрены в практику многих кардиохирургических клиник мира. В некоторых клиниках подобного рода вмешательства составляют 65% от общего количества операций. Неправильно выбранный доступ является причиной конвертации разреза, что в определенной степени дискредитирует данную методику и является причиной отказа от ее использования в практике.

Многообразие существующих доступов требует четких показаний и противопоказаний к их выбору. Однако единого мнения по данному вопросу в современной литературе нет. Таким образом, разработка алгоритма выбора доступа при операциях из минидоступов может привести к повышению качества оказываемой кардиохирургической помощи.

В данной статье приведены литературные данные о существующих минимально инвазивных доступах при операциях на митральном клапане и представлены углубленные исследования, которые сообщают, что при минимально инвазивной хирургии митрального клапана отмечается уменьшение травматичности операций, послеоперационных осложнений, сокращение сроков пребывания в стационаре, хороший косметический эффект.

Ключевые слова: миниинвазивный доступ, митральный клапан.

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