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**MINIMALLY INVASIVE CARDIAC SURGERY TECHNOLOGIES
ON OPEN HEART SURGERY (literature review)**

Abstract. 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.

Methods of research. History of development of minimally invasive access.

Results. This article presents literature data on existing accesses in valvular operations and presents in-depth studies reporting that, despite the apparent benefits of longitudinal median sternotomy as access to the heart, there are possible disadvantages of access associated with large trauma, which are some of the main contributing factors for the development of mediastinitis in the early postoperative period.

Key words: mini-invasive access, minimally invasive technologies, longitudinal median sternotomy.

Over the past decade, the surgeries with using minimally invasive approach are firmly implemented into the practice of many cardiac clinics in the world. In some hospitals, such interference amounts to 65% [1, 2] of the total number of operations. Wrongly selected 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.

The diversity of existing approaches requires precise indications and contraindications to choose them. However, there is no consensus about this issue in the modern literature. Thus, the development of the algorithm which helps to choose an approach for operations between the mini-approaches may lead to increasing the quality of cardiac care. Also, 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].

The first publications about successful operations on the valves of the heart with using mini-approach appeared in 1996 [6]. Among the advantages of the usage of minimally invasive techniques, following benefits are emphasized: reducing of surgical trauma, shortening the time of stay in intensive care and hospital, decreasing of purulent complications, blood loss, good cosmetic effect, and others.

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 Massetti: "If the size and quality of the rumen 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 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, 10-15].
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 [16-20].
3. Combination (the technique includes elements of the «Port-access» in conjunction with traditional methods of heart surgery [1, 21-28]).

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

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, 34-38].

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, 39-41].

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 cardio-pulmonary 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, 42-55].

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, 56-59].

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МИНИМАЛЬНО ИНВАЗИВНЫЕ КАРДИОХИРУРГИЧЕСКИЕ ТЕХНОЛОГИИ ПРИ ОТКРЫТЫХ ОПЕРАЦИЯХ НА СЕРДЦЕ (литературный обзор)

Аннотация. 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 мини-доступов может привести к повышению качества оказываемой кардиохирургической помощи.

Методы исследования. История развития минимально инвазивной доступа при клапанных операциях сердца.

Результаты. В статье приведены литературные данные о существующих доступах при клапанных операциях и представлены углубленные исследования, которые сообщают, что, несмотря на видимые преимущества ПСС как доступа к сердцу, есть возможные недостатки доступа связанных с большой травматичностью, которые являются одними из основных предполагающих факторов для развития медиастинита в раннем послеоперационном периоде.

Ключевые слова: миниинвазивный доступ, миниинвазивные технологии, продольная срединная стернотомия (ПСС).

За последние десятилетия операции с использованием миниинвазивного доступа прочно внедрены в практику многих кардиохирургических клиник мира. В некоторых клиниках, подобного рода вмешательства составляют 65% [1, 2] 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 мини-доступов может привести к повышению качества оказываемой кардиохирургической помощи. Также, требуют уточнения критерии выбора доступа к клапанному аппарату сердца в зависимости от патологического состояния каждого из клапанов и индивидуальных анатомических особенностей пациента. Не разработаны показания и противопоказания к минимально инвазивным вмешательствам при приобретенных пороках сердца (ППС).

В литературе нет единого мнения о способах подключения аппарата искусственного кровообращения (ИК), подачи кардиоплегического раствора; указывается на необходимость разработки и применения специального инструментария [3-5].

Первые публикации об успешных операциях на клапанах сердца с использованием мини-доступа появились в 1996 г. [6]. Среди преимуществ использования миниинвазивной техники выделяют: уменьшение хирургической травмы, укорочение времени пребывания в реанимации и стационаре, уменьшение гнойных осложнений, кровопотери, хороший косметический эффект и др.

В современной медицине качество жизни приобретает немаловажное значение, что в немалой степени определяется косметическим эффектом от операции. Так по мнению M Massetti: "если размер и качество рубца приводит к снижению психологического стресса пациента, то с этим необходимо считаться при планировании операции"

Многообразие сочетаний типов конституции с вариантами патологии сердца требует от хирурга умения владеть различными вариантами мини-доступов. В литературе предлагается несколько методик выбора хирургического доступа, основанных на дооперационной визуализации.

Наиболее простой является использование рентгенографии. В дополнение к рентгенологической картине учитывается конституция пациента и связанные с ней варианты взаимоотношения внутренних органов и костного скелета [7, 8].

Другая методика предполагает использование чреспищеводной ЭхоКТ, выполняемой на операционном столе после интубации, но до выполнения кожного разреза [9]. Методикой, позволяющей очень точно определить положение сердца и выбрать требуемый доступ, является спиральная компьютерная томография (КТ). Выбор спиральной КТ для этой цели был основан на точности метода, его неинвазивности, возможности одновременной визуализации костных структур и мягких тканей, а также определения пространственных соотношений в грудной клетке. Неправильно выбранный доступ является причиной конвертации разреза, что в определенной степени дискредитирует данную методику и является причиной отказа от ее использования в практике.

В настоящее время для коррекции пороков сердца используются следующие виды миниинвазивных доступов:

1. Открытая техника с применением небольших разрезов (8-10 см) и традиционным подключением ИК [6, 10-15].
2. «Port-access» техника, при которой осуществляются подключение ИК через бедренные сосуды, окклюзия аорты эндоаортальным баллон-катетером, видеоподдержка, и операция выполняется через малые (портовые) доступы [16-20].
3. Комбинированная (техника, включающая элементы «Port-access» в сочетании с приемами традиционной кардиохирургии [1, 21-28].

В последнее время появились сообщения об операциях, выполняемых в кардиохирургии с помощью робототехники [27, 29-33].

Большинство авторов, использующих минимально инвазивную хирургию, отмечают уменьшение травматичности операций, послеоперационных осложнений, сокращение сроков пребывания в стационаре, хороший косметический эффект [7, 21, 34-38].

Многие вопросы данного раздела кардиохирургии недостаточно изучены. Так, требуют уточнения критерии выбора доступа к клапанному аппарату сердца в зависимости от патологического состояния каждого из клапанов и индивидуальных анатомических особенностей пациента. Не разработаны показания и противопоказания к минимально инвазивным вмешательствам при приобретенных пороках сердца (ППС). В литературе нет единого мнения о способах подключения аппарата ИК, подачи кардиоплегического раствора; указывается на необходимость разработки и применения специального инструментария [3, 5, 39-41].

Техника протезирования/пластика аортального, митрального, трикуспидального клапанов, пластика септальных дефектов уже стала отработанной, рутинной процедурой, осуществляемой доступом к сердцу через продольную срединную стернотомию (ПСС), которая признана «золотым стандартом» при выполнении всех операций на сердце в условиях искусственного кровообращения.

Несмотря на видимые преимущества ПСС как доступа к сердцу, углубленные исследования последних лет сообщают о возможных недостатках доступа связанных с большой травматичностью, которые являются одними из основных предполагающих факторов для развития медиастинита в раннем послеоперационном периоде. Инфекции поверхностных мягких тканей при ПСС повышают риск глубокой стернальной инфекции с некрозом грудины и развитием медиастинита. Послеоперационная смертность при последнем достигает 50%. Развитие глубокой стернальной инфекции в раннем послеоперационном периоде может привести к такому грозному осложнению как арозивное кровотечение и в отдаленном периоде может вызывать диастаз грудины с необходимостью повторной операции [8, 42-55].

Еще одним свидетельством травматичности ПСС является выраженный болевой синдром в раннем послеоперационном периоде, требующий неоднократного применения анальгетиков, даже после выписки больных. В свою очередь, выраженный болевой синдром и применение наркотических анальгетиков может вызывать явления дыхательной недостаточности из-за нарушения механики дыхания в раннем послеоперационном периоде [20, 52].

В связи с вышеуказанным кардиохирургия изменила свое направление в сторону уменьшения инвазивности в результате чего появилось такое направление как «Минимально инвазивная

хирургия сердца (МИХС)», и она была принята и утверждена как новая методика на международном форуме общества минимально инвазивных хирургов в 2003 году (STS National Database, 2003;) [5, 24, 56-59].

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**АШЫҚ ЖҮРЕККЕ ЖАСАЛЫНАТЫН ОПЕРАЦИЯЛАРДЫҢ
МИНИМАЛЬДИ ИНВАЗИВТИ ТЕХНОЛОГИЯЛАРЫ
(әдебиет шолу)**

Аннотация. Соңғы он жылдықта миниинвазиялық ену арқылы ота жасау әдісі әлемнің көптеген 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.

Зерттеу әдістері. Минимальды инвазиялық енудің даму тарихы.

Нәтижелер. КОС арқасында жүрекке ота жасауға мүмкіндік туганымен, соңғы жылдардағы тереңдетілген зерттеу жұмыстары ота жасалғаннан кейін аз уақыт ішінде көкірек аралықтың қабынуына ықпал ететін қауіпті жарақат кесірінен медициналық жәрдем көрсетуге мүмкіндіктің болмау ықтималдығын анықтаған болатын.

Түйін төздер: миниинвазиялық ену, миниинвазиялық технологиялар, көлденең орталық стернотомия (КОС).