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MINIMALLY INVASIVE ACCESS FOR OPEN HEART SURGERY, FOUR YEAR EXPERIENCE

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Today in the modern medicine, the quality of life takes on great importance, what determined significantly by the cosmetic effect of the surgery. Together with it 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.

Objective. *The objective of this prospective cohort observational study was to assess in-hospital mortality, bypass time and morbidity in all patients undergoing open heart surgery at our Center using a combination of port access and direct vision.*

Material and methods. *Starting from January 2013 and December 2016 JSC "National Resarch Cardiac Surgery Center" in Astana performed 229 operations through minimally invasive access using thoracoscopic video equipment. All of 229 patients, 158 were female, 71 were male patients. The age distribution was between 18 and 72 (the average age is 42). Mean New York Heart Association functional class 2.18±0.8). Mean ejection fraction 48±11. Pulmonary hypertension (PAP>30 mmHg, n=169 [74%]). The 82 (36%) patients underwent with atrial septal defect, 64 (30%) patients primarily underwent Mitral valve repair (14 (22%) Annuloplasty, 31 (48%) Chordoplasty, 16 (25%) Posterior leaflet resection and sliding valvuloplasty, 2 (3%) augmentation, 1 (2%) Cleft closure) and 51(22%) underwent Mitral vale replacement (26 (51%) biological and 25 (49%) mechanical valve), 3 (1,3%) patients underwent with ventricular septal defect, 16 (7%) patients underwent tricuspid valve repair and prosthesis, 3 (1,3%) ASD and tricuspid valve repair, 4 (1,7%) aortic valve replacement, 5 (2,1%) patients underwent fenestration and drainage of the pericardium. In 4 cases, of mitral valve surgery monopolar radiofrequency ablation of the left atrium*

Results and discussion. *There was no hospital mortality. Rethoracotomy for bleeding from intercostal arteries was made in one case. In one case we have stroke, ischemic type. Conversion to sternotomy was made in 4 patients because of adhesive pericardium. After surgery hospital stay was 4-5 days. The average time of cardiopulmonary bypass and aortic clamping was 135,4±15 min./65,8±5 minutes respectively. The number of patients complaining of mild pain in the postoperative sutures during discharge was 15 (13%).*

Conclusions. *Minimally invasive open-heart surgery using thoracoscopic equipment with cardiopulmonary bypass demonstrates that is a feasible method that can be performed safely and effectively, especially in the hands of experienced surgeons.*

Key words: *minimally invasive surgery.*

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.

Since its introduction in the mid-1990s, minimally invasive cardiac surgery (MICS) has been shown to be a feasible alternative to a conventional full- sternotomy approach, and several studies have reported excellent clinical outcomes with low perioperative morbidity and mortality. As a result, MICS is being increasingly employed as a routine procedure worldwide. On the other hand, several issues have been raised, including complications specific to this technique and its steep learning curve, while there are also concerns regarding the durability of a mitral valve repair through a limited access. In this study, the current status and future perspectives of MICS were examined.

Among the advantages of minimally invasive techniques we appreciate: reduction surgical trauma, shorter time of ICU stay and total hospital stay, decrease of infectious complications, blood loss, better cosmetic and others. In modern medicine, the quality of life is of great importance and to a large extent is determined by disturbance of body integrity. Thus according to Massetti "if the size and quality of the scar reduces the psychological stress of the patient, then these should be considered when planning the operation" (Massetti et al., 1999).

Objective - the objective of this prospective cohort observational study was to assess in-hospital mortality, bypass time and morbidity in all patients undergoing open heart surgery at our Center using a combination of port access and direct vision.

MATERIAL AND METHODS

Starting from January 2013 and December 2016 JSC "National Resarch Cardiac Surgery Center" in Astana performed 229 operations through minimally invasive access using thoracoscopic video equipment (table 1).

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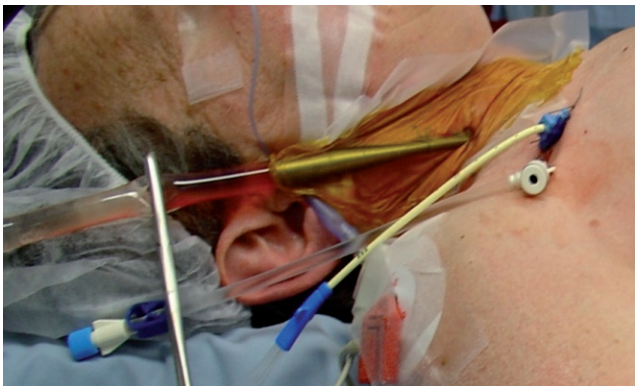
Table 1 - **Demographic data**

Age	Mean 42
Gender	Female 158 (69%)
	Male 71 (31%)
Mean NYHA functional class	II - III
Mean ejection fraction (%)	48±11
Pulmonary hypertension (PAP > 30 mm Hg)	169
ASD, AVD, AVSD	82
Mitral valve disease Myxomatous (anterior leaflet prolapse, posterior leaflet prolapse, bileaflet prolapse) Rheumatic Dilatative cardiomyopathy Endocarditis Congenital	115 54 (47%) 23 (42,6%) 30 (55,5%) 1 (1,9%) 51 (44,4%) 7 (6%) 2 (1,7%) 1 (0,9%)
Mitral valve pathophysiology Mitral regurgitation	66 (57%)
Mitral stenosis Mixed	41 (36%) 8 (7%)
Tricuspid valve disease	16
Aortic valve and other	10

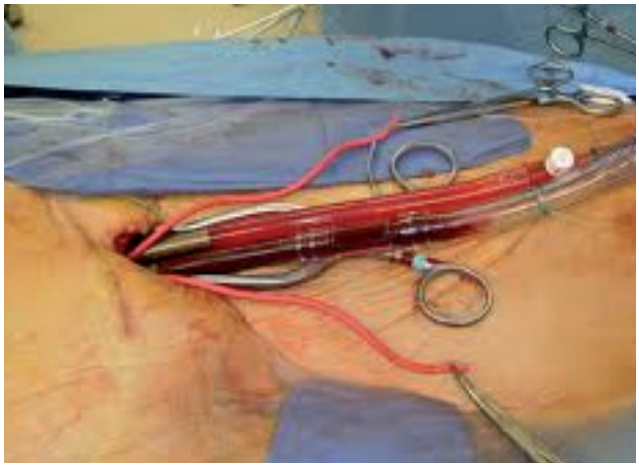
The patient is intubated with a single or double lumen endotracheal tube. In patients weighing 35 and higer kilograms and those requiring concomitant right-sided procedures like TVRp, TVR or ASD closures, an additional venous cannula is inserted percutaneously through the right internal jugular vein into the superior vena cava by the anaesthesiologist immediately after induction of anaesthesia (picture 1).



Picture 1 - Jugular vein cannulation

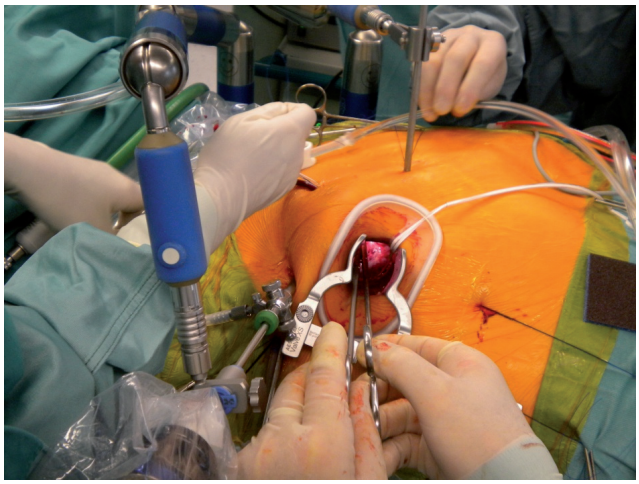
The patient is connected to CPB by cannulation of the femoral artery and vein (single venous cannula for isolated mitral valve procedures) through a 2 cm transverse incision in the groin (picture 2).

Transesophageal echocardiography (TEE) is mandatory to confirm the optimum location of the tip of the venous cannula in the right atrium. Body temperature is maintained around 34 °C and vacuum-assisted venous drainage is used throughout



Picture 2 - Femoral vein and artery cannulation

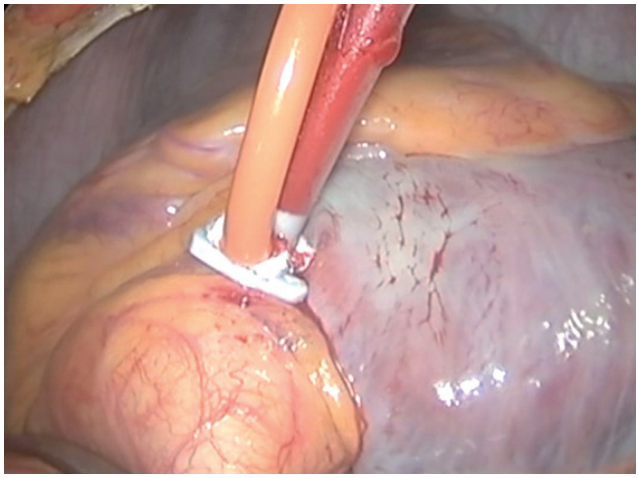
the procedure. A 5-6 cm right lateral mini-thoracotomy, just infero-lateral to the nipple in men and in the submammary crease in women, is used to enter the thorax through the fourth intercostal space (ICS). A dedicated instrument set designed for minimally invasive surgery is used to perform the operation. A small thoracic and soft tissue retractor is utilized to spread the ribs (picture 3).



Picture 3 - Right lateral mini-thoracotomy, small thoracic and soft tissue retractor with video assisting

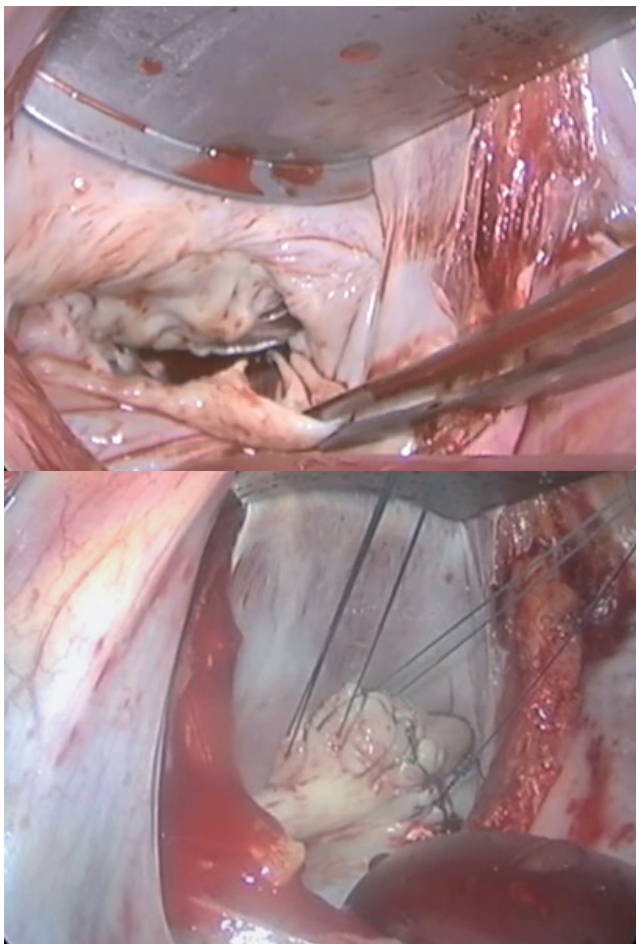
The pericardium is opened 3-4 cm anterior and parallel to the phrenic nerve from the distal ascending aorta to the diaphragm. A video camera and a transthoracic Chitwood aortic cross-clamp are inserted through 10 and 5 mm ports in the 2nd and 3rd right ICS, respectively. One litre of antegrade blood cardioplegia is delivered directly into the aortic root through a long cardioplegia needle and repeated after 20 minutes, if necessary (picture 4).

The mitral valve is accessed through a paraseptal incision and a left atrial retractor is used to expose the mitral valve. MVR is performed in a routine fashion using horizontal mattress pledgeted polyester sutures, with preservation of one or both leaflets. MVRp for degenerative mitral valve disease is most commonly performed utilising the Goretex neochordae by the “Loop technique”. Assessment of the optimal length and precise fixation of neochordae to the papillary muscles and the free edge of the mitral leaflets are the fundamental aspects

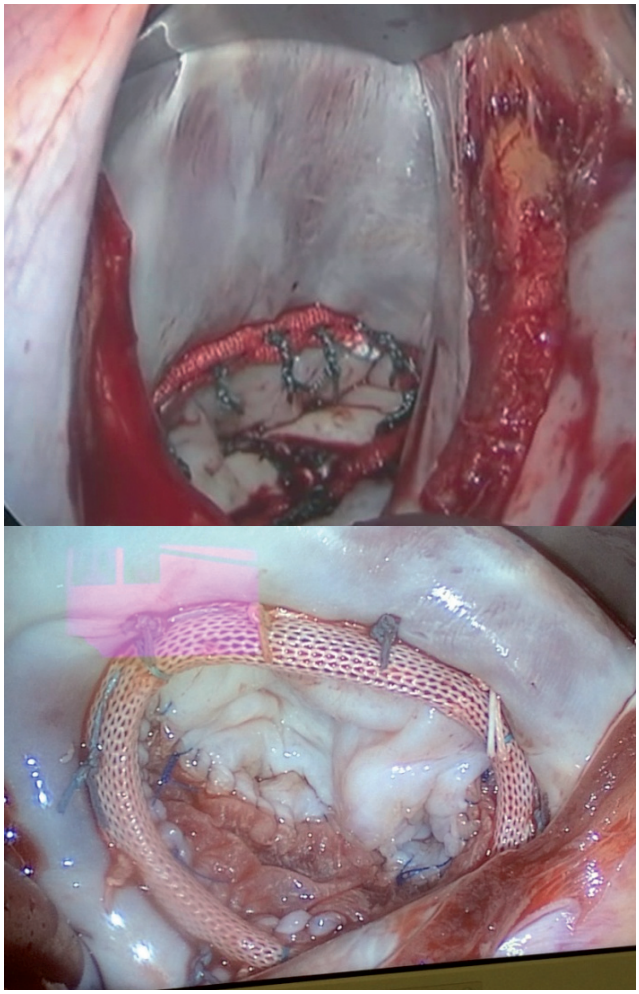


Picture 4 - The aortic root through a long cardioplegia needle and cross pump

of this technique. A semi-rigid annuloplasty ring is implanted to support the repair. Mitral valve competency is restored in patients with Barlow's disease, utilising a myriad of different techniques from leaflet resection to neochordae to Alfieri's edge-to-edge repair. Ischemic MR is corrected utilising an undersized ring annuloplasty. Following the mitral valve procedure, the left atrium is de-aired by filling it with saline during closure. (picture 5, 6)



Picture 5 - Mitral valve anterior leaflet rupture and triangular resection

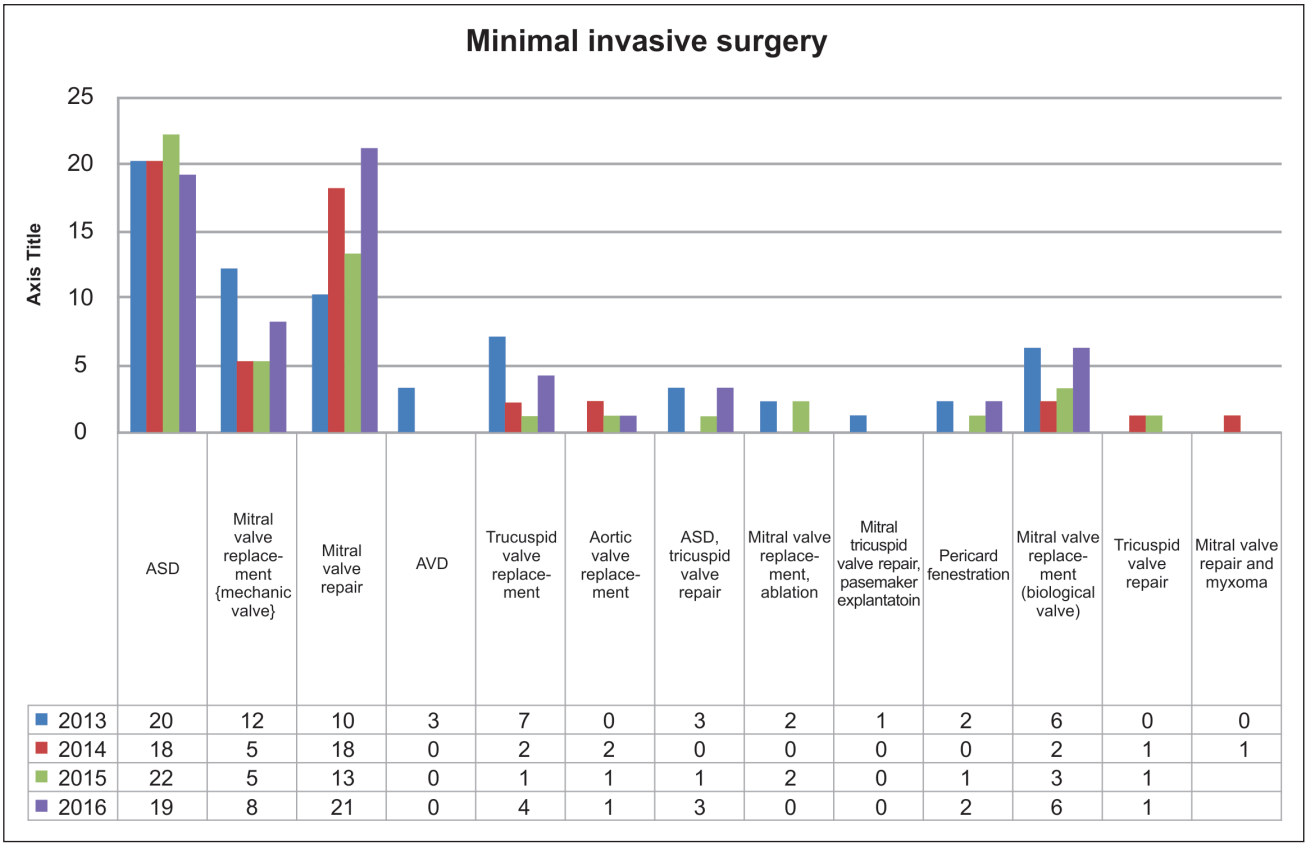


Picture 6 - Mitral valve annuloplasty ring and posterior leaflet augmentation

A direct closure of a PFO/ASD can be easily performed through the left atrial approach, however patch closure of the ASD, TVRp or TVR have to be accessed through the right atrium after establishing total CPB by clamping the superior and inferior vena cavae with large bull-dog clamps. TVRp or TVR can also be performed after releasing the aortic clamp. Following this, the patient is temporarily weaned from CPB to assess the quality of repair or replacement by TEE and to complete the de-airing procedure. Thereafter, CPB is resumed, the cardioplegia needle vent is removed, haemostasis is checked and the pericardium is closed. The patient is then finally weaned off CPB and decannulated.

All of 229 patients, 158 were female, 71 were male patients. The age distribution was between 18 and 72 (the average age is 42). Mean New York Heart Association functional class 2.18±0.8). Mean ejection fraction 48±11. Pulmonary hypertension (PAP>30 mmHg, n=169 [74%]). The 82 (36%) patients underwent with atrial septal defect, 64 (30%) patients primarily underwent Mitral valve repair (14 (22%) Annuloplasty, 31 (48%) Chordoplasty, 16 (25%) Posterior leaflet resection and sliding valvuloplasty, 2 (3%) augmentation, 1 (2%) Cleft closure) and 51 (22%) underwent Mitral vale replacement (26 (51%) biological and 25 (49%) mechanical valve), 3 (1,3%) patients underwent with

Table 2 - **Minimally invasive surgery volume**



	ASD	Mitral valve replace-ment {mechanic valve}	Mitral valve repair	AVD	Trucuspid valve replace-ment	Aortic valve replace-ment	ASD, tricuspid valve repair	Mitral valve replace-ment, ablation	Mitral tricuspid valve repair, pasemaker explantatoin	Pericard fenestration	Mitral valve replace-ment (biological valve)	Tricuspid valve repair	Mitral valve repair and myxoma
2013	20	12	10	3	7	0	3	2	1	2	6	0	0
2014	18	5	18	0	2	2	0	0	0	0	2	1	1
2015	22	5	13	0	1	1	1	2	0	1	3	1	
2016	19	8	21	0	4	1	3	0	0	2	6	1	

ventricular septal defect, 16 (7%) patients underwent tricuspid valve repair and prosthesis, 3 (1,3%) ASD and tricuspid valve repair, 4 (1,7%) aortic valve replacement, 5 (2,1%) patients underwent fenestration and drainage of the pericardium. In 4 cases, of mitral valve surgery monopolar radiofrequency ablation of the left atrium. (table 2)

RESULTS AND DISCUSSION

There was no hospital mortality. Rethoracotomy for bleeding from intercostal arteries was made in one case. In one case we have stroke, ischemic type. Conversion to sternotomy was made in 4 patients because of adhesive pericardium. After surgery hospital stay was 4-5 days. The average time of cardiopulmonary bypass and aortic clamping was 135,4±15 min/65,8±5 minutes respectively. The number of patients complaining of mild pain in the postoperative sutures during discharge was 15 (13%) (table 3).

CONCLUSIONS

Minimaly invasive access without sternotomy reduces the duration of hospital stay after surgery; early activation of the patient and the rapid recovery of physical functions; better quality of life of the patient; less pronounced postoperative pain. It is associated with very low rates of conversion to a conventional sternotomy and mortality. After surgery, the patient is not in need of rehabilitation. Minimally invasive open-heart surgery using thoracoscopic equipment with cardiopulmonary bypass demonstrates that is a feasible method that can be performed safely and effectively, especially in the hands of experienced surgeons.

Table 3 - **Intraoperative results**

Activity	Time
Duration of surgery	250±55 min
Artificial circulation	140±50min
X-clamp time	100±25min
Respiratory care	4,25±2 hrs
Intensive care unit stay	15,3±4 hrs
Postoperative hospitalization	4,1±1,2 days
Mitral valve repair	64
Posterior leaflet resection	16
Chordoplasty, anteriorleaflet resection	31
Cleft closure	1
Annuloplasty only	14
Posterior leaflet augmentation	2
Mitral vale replacement (Biological, mechanical)	26 (51%) 25 (49%)

Research transparency

Research did not have a sponsorship. The authors are absolutely responsible for presenting the release script for publication.

Declaration about financial and other relations

All authors took part in elaboration of article conception and writing the script. The release script was approved by all authors. The authors did not get the honorary for the article.

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АШЫҚ ЖҮРЕККЕ ЖАСАЛЫНТАН МИНИМАЛЬДЫ ИНВАЗИВТІ ӘДІСТЕРДІҢ 4 ЖЫЛДЫҚ ТӘЖІРИБИЕСІ

Инвазивті әдістер операция түрлері соңғы он жылда әлемдегі көптеген кардиохирургия клиникаларында белсенді түрде енгізіліп келеді. Кейбір ауруханаларда отаның бұл түрі жасалынатын отаның жалпы санының 65%-ын құрайды.

Зерттеудің мақсаты. Орталығымызда ашық жүрекке «Порт акцесс» және тікелей бақылау комбинация жолыменен минимальды инвазивті операцияларын жасланатын пациенттердің ауру-сырқауын, емделуі мен ауруханада орын алатын өлім көрсеткіштерін когортты проспективті зерттеулерін бағалау.

Материал және әдістері. 2013 жылғы қаңтар мен 2016 жылғы желтоқсан аралығында Астана қаласындағы «Ұлттық ғылыми кардиохирургия орталығы» АҚ торакоскопиялық бейне жабдығын қолдана отырып, аз инвазивті 229 ота жасады. 229 пациенттің 158 әйел, 71 ер адам болды. Пациенттердің жасы 18 бен 72 аралығында болды (орта жасы – 42). (Нью-Йорк жүрек қауымдастығының критерияларына сай орташа функционалдық класс – 2.18±0.8). Орта шығарым фракциясы – 48±11. Өкпе қысымының көтерілуі – PAP>30 сын. бағ. мм, n=169 (74%). 82 пациентке (36%) жүрекшелер аралық қалқаның кемістігі бойынша ота жасалды, 64 пациентке (30%) қос жармалы қақпақшаны қалпына келтіру бойынша ота жасалды (14 пациентке (22%) аннулопластика, 31 пациентке (48%) кордопластика, 16 пациентке (25%) артқы жарманың (створка) артық терісін алып тастау бойынша сырғымалы валвулопластика, 2 пациентке (3%) аугментация, 1 пациентке (2%) пилонидальді синус ауруын емдеу бойынша ота жасалды), 51 пациентке (22%) қос жармалы қақпақшаны алмастыру бойынша ота жасалды (26 пациентте (51%) биологиялық, 25 пациентте (49%) механикалық протезбен алмастырылды), 3 пациентке (1,3%) қарыншалар аралық қалқаның кемістігі бойынша ота жасалды, 16 пациентке (7%) үш жармалы қақпақшаны қалпына келтіру мен протездеу бойынша ота жасалды, 3 пациентке (1,3%) жүрекшелер аралық қалқаның кемістігі бойынша және үш жармалы қақпақшаны қалпына келтіру бойынша ота жасалды, 4 пациентке (1,7%) қолқа қақпақшасын алмастыру бойынша ота жасалды, 5 пациенкте (2,1%) фенестрация және перикардты дренаждау бойынша ота жасалды. Сол жақ жүрекшенің бір полюсті радиожиілікті абляциясы әдісімен қос жармалы қақпақшасына төрт ота жасалды.

Нәтижелері және талқылауы. Ауруханада пациент өлімі орын алған жоқ. Қабырғааралық күретамырдан қан кету себебінен бір рет реторакотомия жасалды. Бір рет ишемиялық инфаркт орын алды. Жүрекқабы қабынған 4 пациентке стернотомия жасалды. Пациенттер ота жасалғаннан кейін ауруханада 4-5 күн жатты. Жасанды қанайналымы мен қолқа қысқышын ұстап тұру уақыты орта есеппен алғанда сәйкесінше 135,4±15 және 65,8±5 минутты құрады. Ауруханадан шығар кезде 15 (13%) пациент операциядан кейінгі тігіс орындарының шамалы ауыратындығын айтты.

Қорытынды. Жасанды қанайналым және торакоскопиялық жабдықтың пайдаланылуымен, ашық жүрекке жасалынатын операцияның минималды инвазивті әдісті іс жүзінде қауіпсіз, әрі тиімді іске асыруға болады, әсіресе тәжірибелі хирургтар жасайтын болса.

Негізгі сөздер: *минимальды инвазивті.*

Р Е З Ю М Е

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МИНИМАЛЬНО ИНВАЗИВНЫЕ ОПЕРАЦИИ НА ОТКРЫТОМ СЕРДЦЕ, ЧЕТЫРЕХЛЕТНИЙ ОПЫТ

За последнее десятилетие операции с минимальным инвазивным вмешательством прочно внедряются в практику многих кардиологических клиник по всему миру. В некоторых больничных учреждениях такое вмешательство достигает 65% от общего числа операций.

Цель исследования. Задачей настоящего проспективного когортного исследования являлась оценка больничной летальности, периода искусственного поддержания жизни и процента смертности всех пациентов, перенесших операцию на открытом сердце в нашем Центре с комбинированным применением доступа «Порт акцесс» и прямым визуальным доступом.

Материал и методы. Начиная с января 2013 г. и по декабрь 2016 г. АО «Национальный научный кардиохирургический центр» в г. Астана провел 229 операций с минимальным инвазивным вмешательством с применением торакоскопического видеооборудования. Из 229 пациентов 158 женщин и 71 мужчина. Возрастной диапазон колебался между 18 и 72 годами (средний возраст составил 42 года). Средний функциональный класс Нью-Йоркской ассоциации сердца 2.18±0.8). Средняя фракция выброса 48±11. Легочная гипертензия (PAP>30 mmHg, n=169 [74%]). У 82 (36%) наблюдался дефект межпредсердной перегородки, 64 (30%) пациента перенесли первичное восстановление митрального клапана, 14 (22%) пациентов с аннулопластикой, 31 (48%) пациент с пластикой сухожильных хорд клапана, 16 (25%) пациентов с резекцией задней стенки клапана и скользящей пластикой клапана, 2 (3%) пациента с увеличением толщины стенки, 1 (2%) с закрытием дефекта и 51 (22%) перенесли замену митрального клапана 26 (51%) биологический и 25 (49%) механический клапан), 3 (1,3%) пациента с дефектом межжелудочковой перегородки, 16 (7%) пациентов перенесли восстановление и

протезирование трикуспидального клапана, 3 (1,3%) пациента с дефектом межпредсердной перегородки с восстановлением трикуспидального клапана, 4 (1,7%) пациента с заменой аортального клапана, 5 (2,1%) пациентов перенесли фенестрацию и дренирование перикарда. В 4 случаях операции митрального клапана использовался метод монополярной радиочастотной абляции левого предсердия

Результаты и обсуждение. Больничная летальность не наблюдалась. В одном случае проводилась реторакотомия ввиду кровотечения из межреберных артерий. В одном случае имел место ишемический инфаркт. У 4 пациентов был предпринят переход на стернотомию по причине спаечного перикардита. Послеоперационный период пребывания в больнице составил 4-5 дней. Среднее время поддержания искусственного крово-обращения и зажима аорты составило 135,4±15мин/65,8±5мин. соответственно. Число пациентов с жалобами на слабые боли в области послеоперационных швов во время выписки составляет 15 (13%).

Выводы. Операции на открытом сердце с минимальным вмешательством с использованием торакоскопического оборудования с поддержкой искусственного кровообращения демонстрируют обоснованность данной методики, которая может проводиться безопасно и эффективно, в особенности в руках опытных хирургов.

Ключевые слова: *минимально инвазивная операция.*

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