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ОРИГІНАЛЬНІ ДОСЛІДЖЕННЯ

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Mid-term outcome and quality of life after Bentall procedure: single-center experience

The aim – to evaluate the mid-term results and quality of life of patients who underwent Bentall procedure.

Materials and methods. The research included 55 patients who underwent planned surgical treatment at the Heart Institute of Ministry of Health of Ukraine from 2015 to 2023. The mean age of the 55 patients (53 (96.36 %) males), who underwent the Bentall procedure (composite graft replacement of the aortic root), was 52.36 ± 1.56 years. We analyzed basic characteristics of the patients, intraoperative and postoperative data. The quality of life was assessed before and in the mid-term period after operations by the Medical Outcomes Study Short Form 36 (MOS SF-36) questionnaire.

Results. An average duration of the follow-up period was (3.61 ± 0.28) (CI 3.05–4.16) years ranging from 1.0 to 9.0 years. Overall, in-hospital mortality and 30-day mortality was 1.89 % (n = 1). The only case of death was caused by the acute respiratory distress syndrome. The 5-year survival rate was 94.61 ± 3.10 % for all patients. It is reasonable to say that all 3 cases of death were due to a non-cardiac cause, i.e. stroke, malignancy and acute abdomen. The average duration of the operations was 244.48 ± 7.67 minutes, the total duration of artificial blood circulation was 138.73 ± 6.47 minutes, aorta clamping time – 95.82 ± 4.79 minutes. The mean duration of hospital staying was 16.98 ± 0.91 days, intensive care unit – 4.84 ± 0.33 days. The number of patients extubated up to 8 hours after surgery was 41 (74.55 %) patients. The operation significantly improved parameters of the quality of life.

Conclusions. Patients after Bentall procedure have low overall in-hospital mortality and 30-day mortality (1 (1.89 %)). The 5-year survival rate was 94.61 ± 3.10 %. All three case of death during follow-up period were due to non-cardiac causes. Excellent mid-term results prove that Bentall procedure must be a routine surgery for patients with aortic root aneurysm, mixed aortic valve pathology and anatomically altered aortic valve leaflets. The operation significantly improved quality of life of patients in all domains.

Key words: quality of life, Bentall procedure, aortic valve, ascending aorta, aortic root aneurysm, aortic aneurysms, valvular pathology.

An aneurysm of the root and ascending part of the aorta is a pathology which is often extremely difficult to correct [1]. Patients with an aneurysm of the aortic root are usually young, in the age range 30–50 years when the diagnosis is established. These patients develop aortic insufficiency due to the dilation of the sinotubular junction and/or annulo-aortic ectasia (enlargement of the aortic valve ring) [2].

Aortic aneurysm is a very important pathology to study due to the possibility of acute complications. Rates of acute dissection or rupture according to research data are 8.8 % for aneurysms less than 4 cm, 9.5 % for aneurysms 4–4.9 cm, 17.8 % for aneurysms 5 to 5.9 cm, and 27.9 % for aneurysms larger than 6 cm. The average aneurysm size at the time of rupture or dissection was 5.9 cm [3].

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For many years Bentall operation is performed in cases of aortic root aneurysm and altered aortic cusps. It was established as a standard technique of treating this type of patients [2, 4, 5]. Tirone David initiated a valve-sparing surgery of the root and ascending part of the aorta in 1989. He divided valve-sparing operations into two main types: reimplantation and remodeling technique. Nowadays surgeons do hundreds of such interventions every year all over the world. It is an operation of choice in patients with aortic root aneurysm with minimal changes of aortic cusps [2, 5–7]. On the other hand, we can't perform valve-sparing surgery in cases of mixed aortic valve disease with altered aortic cusps. Some centers avoid performing David operations in cases of bicuspid aortic valve with aortic root aneurysms due to lack of experience. In such cases we, of course, must consider Bentall procedure and take into account the predicted changes of the quality of life.

Therefore, the aim of the research was to evaluate the mid-term results and quality of life of patients who underwent Bentall procedure.

Materials and methods

A review of the Cardiac Surgery Database of the Heart Institute of the Ministry of Health of Ukraine revealed 55 patients who underwent Bentall procedure from 2015 to 2023. This study examined the clinical outcomes of patients who had composite replacement of the aortic root. The Research Ethics Board allowed this retrospective research. All baseline clinical data are shown at *Table 1*.

Table 1
Baseline characteristics of the study patients

Indicator		Patients (n = 55)
Sex	Male	53 (96.36 %)
	Female	2 (3.64 %)
Age, years		52.36 ± 1.56
Height, cm		180.073 ± 1.05
Weight, kg		87.43 ± 2.52
Body mass index kg/m^2		26.93 ± 0.74
Bicuspid aortic valve		31 (56.36 %)
Tricuspid aortic valve		24 (43.64 %)
End diastolic volume index, ml/m^2		116.75 ± 7.41
Left ventricular ejection fraction, %		54.82 ± 1.41
Ascending aorta, mm		54.15 ± 1.43
Aortic root, mm		51.13 ± 2.08
Pulmonary hypertension		32 (58.18 %)
Smoking		32 (58.18 %)
Myocardial infarction in the past		2 (3.64 %)
History of cerebrovascular events		2 (3.64 %)
Previous interventions on the heart (stenting and open operations)		3 (5.45 %)
Diabetes		2 (3.64 %)

Operative Technique

Selective pumping of cardioplegic cold crystalloid solution «Kustodiol». Evaluation of aortic cusps. Excision of the aortic cusps, aneurysmal part of the ascending aorta and the root in area of the sinuses has been performed. Excision of the buttons of the coronary arteries was carried out and they were taken on tripods. After stitching on pledgets of aortic ring, conduit with mechanical prosthesis was implanted. Then, we stitched by prolene 4.0 aorta nadir to dacron prosthesis. Reimplantation of the buttons of the coronary arteries was carried out. If there was a need for a complete stoppage of blood circulation, parallel cerebral perfusion was performed (10 % of the work of the artificial blood circulation). A distal anastomosis was formed. Afterwards, standard restoration of the heart rhythm and wound closure were performed.

Evaluation of Quality of life

We assessed quality of life before surgery and in the mid-term period after surgery using the Medical Outcomes Study Short Form 36 (MOS SF-36) questionnaire. The survey was conducted after the informed consent of the patient to participate in the study. The rules for filling out the questionnaires were explained to the patients. Then, within 10–15 minutes, the patients filled out the Ukrainian version of the SF-36 questionnaire on their own. Results were calculated without the presence of the patients.

The questionnaire included 36 items, which are grouped in 8 scales: physical functioning (PF), role limitations due to physical health (RP), body pain (BP), general health (GH), vitality (VT), social functioning (SF), role limitations due to emotional problems (RE) and mental health (MH). The patient chose the answer to the proposed question [8–11].

Table 2
Perioperative characteristics and intensive care unit staying

Indicator	Patients (n = 55)
Total operation duration, min	244.41 ± 7.67
Total duration of artificial blood circulation, min	138.73 ± 6.47
Aortic clamping time, min	95.82 ± 4.79
Average minimum temperature, °C	29.36 ± 0.38
Complete stoppage of circulation	10 (18.18 %)
Duration of complete circulatory arrest, min	9.40 ± 0.43
Number of patients extubated up to 8 hours after surgery	41 (74.55 %)
Duration of staying in intensive care unit, days	4.84 ± 0.33
Duration of staying in hospital, days	16.98 ± 0.91

Due to the normal distribution, statistical data are presented as mean and standard deviation. Mean values were compared using Student's t-test. The difference at $p < 0.05$ was considered as statistically significant.

Results and discussion

Complete circulatory arrest with hypothermia up to 22 °C with parallel cerebral perfusion was observed. It was necessary in some patients to form a distal anastomosis. This proportion was 10 (18.18 %) patients with a duration of 9.40±0.43 min *(Table 2)*.

The mean duration of hospital staying was 16.98 ± 0.91 days, intensive care unit – 4.84 ± 0.33 days. The number of patients extubated up to 8 hours after surgery was 41 (74.55 %) patients.

We performed also concomitant operations with Bentall procedure: CABG in 3 patients (5.45 %), mitral valve repair in 4 patients (7.27 %).

We analyzed quality of life before and after operation *(Table 3)*. The presence of pathology caused complaints such as bad health, rapid fatigue, and fear of pain, creating an obstacle to a well-balanced life. Besides, patients had complaints on presence of an artificial heart valve, need to control INR test and using of anticoagulants. Speaking about preoperative quality of life, patients described low all indicators. They had such complaints like dyspnea, pain, dizziness, which prevented normal physical activity. Only the thought of the presence of such a pathology prevented normal communication and lowered the emotional state.

The performed operation significantly improved the quality of life indicators in all domains. Already after being transferred from the intensive care unit, the patients felt a clear improvement, which was manifested in positive emotions, a desire for communication, and minor physical activity.

Table 3
Quality of life before and in mid-term period after operations

Scale	Before operation	After operation	p
Physical functioning, PF	35.00 ± 0.80	79.63 ± 0.95	0.000
Role limitations due to physical health, RF	45.00 ± 0.91	82.37 ± 0.73	0.000
Role limitations due to emotional problems, RE	38.88 ± 0.33	78.97 ± 0.99	0.000
Vitality, VT	34.36 ± 1.31	78.97 ± 0.99	0.000
Mental health, MH	44.75 ± 0.79	82.50 ± 0.86	0.000
Social functioning, SF	42.13 ± 0.43	84.13 ± 0.56	0.000
Body pain, BP	62.13 ± 1.25	81.88 ± 0.98	0.000
General health, GH	35.50 ± 0.69	81.50 ± 0.84	0.000

Our report indicates that early and mid-term results of Bentall technique are good, providing a safe surgery option for patients with aortic root disease [8]. Bentall procedure remains a standard treatment in patients with aortic root aneurysms and anatomically altered aortic valve leaflets [12-13]. Also, due to lower cross-clamp time it must be considered in patients with kidney failure.

Conclusions

Patients after Bentall procedure have low overall in-hospital mortality and 30-day mortality (1 (1.89 %)). The 5-year survival rate was 94.61 ± 3.10 %. All three case of death during follow-up period were due to non-cardiac causes. Due to excellent mid-term results, Bentall procedure must be a routine surgery for patients with aortic root aneurysm, mixed aortic valve pathology and anatomically altered aortic valve leaflets. The operation significantly improves quality of life of patients in all domains.

Prospects for future research. We need to compare preoperative, intraoperative, early postoperative period, long term results and quality of life in patients after Bentall procedure and David I procedure.

Compliance with ethical requirements. The present study was conducted in accordance with the basic principles of the European Convention of Human Rights and Biomedicine, World Medical Association Declaration of Helsinki on the ethical principles for medical research involving human subjects and current Ukrainian regulations. The study protocol was approved by the local ethics committee. The written informed consent was obtained from all the patients.

Funding and conflict of interest.

The authors declare no conflict of interest related to this paper. The study was conducted as a fragment of the complex scientific project of the Department of Cardiac Surgery, Endovascular and Extracorporeal Technologies (Shupyk National Healthcare University of Ukraine) «A Multidisciplinary Approach to Surgical Treatment of Heart and Trunk Pathology» (state registration number 0121U113336; term: 2021–2025).

Authors' participation: research project – I.S., B.T., L.S.; critical review of the content, editing of the article – O.Z., I.M., V.Z.; collection of material – I.S., O.Z., V.D.; data analysis, article writing – I.S., V.D., V.Z.; literature review – I.N.

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ОРИГІНАЛЬНІ ДОСЛІДЖЕННЯ

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Середньовіддалені результати та якість життя хворих після операції Бенталла: досвід одного центру

Мета роботи – оцінити середньострокові результати та якість життя пацієнтів, яким виконано операцію Бенталла.

Матеріали і методи. Обстежено 55 пацієнтів, які перенесли планове оперативне лікування в ДУ «Інститут серця МОЗ України» у період 2015–2023 рр. Середній вік пацієнтів (53 (96,36 %) чоловіки), яким була проведена операція Бенталла (композитне протезування кореня аорти), становив (52,36 ± 1,56) року. Проаналізовано основні характеристики хворих, інтраопераційні та післяопераційні дані. Якість життя оцінювали до операції та в середньовіддалений період після операцій за допомогою опитувальника Medical Outcomes Study Short Form 36 (MOS SF-36).

Результати. Середня тривалість періоду спостереження становила (3,61 ± 0,28) року в діапазоні від 1 до 9 років. Загальна внутрішньолікарняна та 30-денна смертність становила 1,89 % (n = 1). Причиною смерті став гострий респіраторний дистрес-синдром. 5-річний показник виживання становив (94,61 ± 3,10) % для всіх пацієнтів. Треба сказати, що всі три пацієнти померли переважно від несерцевих причин. Докладно про причини смерті: інсульт, злоякісні новоутворення, гострий живіт. За тривалістю операцій середня тривалість операцій становила (244,48 ± 7,67) хв, загальна тривалість штучного кровообігу – (138,73 ± 6,47) хв, час перетискання аорти – (95,82 ± 4,00) хв. Середня тривалість перебування в стаціонарі – (16,98 ± 0,91) доби, у відділенні інтенсивної терапії – (4,84 ± 0,33) доби. 41 (74,55 %) пацієнта було екстубовано в період до 8 годин після операції. Операція поліпшує якість життя: усі 8 шкал – фізичне функціонування (PF), рольові обмеження через фізичне здоров'я (RP), біль у тілі (BP), загальний стан здоров'я (GH), життєздатність (VT), соціальне функціонування (SF), рольові обмеження через емоційні проблеми (RE) і психічне здоров'я (MH) – мали статистично значущі зміни після операції.

Висновки. Пацієнти після операції Бенталла мають низьку загальну внутрішньолікарняну та 30-денну смертність (1 (1,89 %)). 5-річний показник виживання становив (94,61 ± 3,10) % для всіх пацієнтів. Усі 3 пацієнти померли протягом періоду спостереження від несерцевих причин. Процедура Бенталла через відмінні середньострокові результати повинна бути рутинною операцією для пацієнтів з аневризмою кореня аорти, комбінованою патологією аортального клапана та анатомічно зміненими стулками аортального клапана. Операція суттєво змінює якість життя пацієнтів після операції за всіма шкалами.

Ключові слова: якість життя, процедура Бенталла, аортальний клапан, висхідна аорта, аневризма кореня аорти, аневризми аорти, патологія клапанів.