Исходы алкогольной септальной абляции у пациентов с обструктивной гипертрофической кардиомиопатией в зависимости от выраженности градиента и толщины межжелудочковой перегородки

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Ключевые слова: алкогольная септальная абляция; обструкция выводного тракта левого желудочка; гипертрофическая кардиомиопатия; резидуальная обструкция

Резюме

Целью данного исследования была оценка краткосрочных и долгосрочных эффектов этаноловой септальной абляции (ЭСА) среди различных групп пациентов с обструктивной гипертрофической кардиомиопатией (оГКМП): в зависимости от выраженности градиентов выводного тракта левого желудочка (ВТЛЖ), а также выраженности гипертрофии межжелудочковой перегородки (МЖП).

Материал и методы. В данное исследование включены 212 пациентов с оГКМП: средний возраст составил 52±15 лет; женщин было 107 (50,7%). Пациенты были разделены на 4 группы в зависимости от паттерна септальной гипертрофии и выраженности градиента ВТЛЖ в покое: группа 0 – пациенты без выраженного градиента ВТЛЖ в покое (<50 мм рт.ст.) и без выраженной базальной гипертрофии (<20 мм); группа 1 – пациенты с выраженным градиентом ВТЛЖ в покое (≥50 мм рт.ст.) и без выраженной базальной гипертрофии (<20 мм); группа 2 – пациенты без выраженного градиента ВТЛЖ в покое (<50 мм рт.ст.) и с выраженной базальной гипертрофией (≥20 мм); группа 3 – пациенты с выраженным градиентом ВТЛЖ в покое (≥50 мм рт.ст.) и с выраженной базальной гипертрофией (≥20 мм).

Результаты. Медиана наблюдения составила 74 (38–127) мес. Отдаленная выживаемость во всей исследуемой когорте была следующей: 98,1 [95% доверительный интервал (ДИ) 96,2–100,0])%; 92,3 (95% ДИ 88,5–96,3)%; 77,2 (95% ДИ 70,1–85,0)% к 1, 5, 10 годам наблюдения. Кумулятивная частота летальных исходов в отдаленном периоде составила 41 (19,3%). Различия в выживаемости между исследуемыми группами не достигли статистической значимости (p=0,16), но при сравнении группы 3 (PG ≥50 мм рт.ст. и МЖП ≥20 мм) с другими (PG <50 мм рт.ст. и МЖП <20 мм) были выявлены статистически значимые различия (p=0,029) и отношение рисков 1,98 (95% ДИ 1,06–3,72).

Средний функциональный класс хронической сердечной недостаточности улучшился с 2,5±0,6 до 1,5±0,6. В отдаленном периоде градиент ВТЛЖ снизился с 60 (40–89) до 15 (9–124) мм рт.ст. в покое и с 108 (80–135) до 26 (16–49) мм рт.ст. после провокации. Средняя редукция перегородки составила 5±3 мм. Резидуальная обструкция наблюдалась в 42 (20%) случаях. Сравнивая пациентов с PG ≥50 мм рт.ст. с пациентами с PG <50 мм рт.ст. наблюдалась более высокая частота реопераций у пациентов с выраженным градиентом ВТЛЖ в покое [*p*=0,046, отношение рисков 2,12 (95% ДИ 1,00–4,49)].

Заключение. У пациентов с выраженными градиентами ВТЛЖ в покое исходно отмечалась бóльшая частота реинтервенций после ЭСА. Пациенты с выраженной обструкцией в покое до операции и выраженной септальной гипертрофией имели больший риск отдаленной летальности.

Финансирование. Исследование не имело спонсорской поддержки.

Конфликт интересов. Авторы заявляют об отсутствии конфликта интересов.

Для цитирования: Каштанов М.Г., Рейтблат О.М., Мишина М.О., Чернышев С.Д., Гаврилко А.Д., Крашенинин Д.В., Шлойдо Е.А. Исходы алкогольной септальной абляции у пациентов с обструктивной гипертрофической кардиомиопатией в зависимости от выраженности градиента и толщины межжелудочковой перегородки // Клиническая и экспериментальная хирургия. Журнал имени академика Б.В. Петровского. 2024. Т. 12, № 1. С. 80–89. DOI: https://doi.org/10.33029/2308-1198-2024-12-1-80-89

Статья поступила в редакцию 12.12.2023. **Принята в печать** 05.02.2024.

Alcohol septal ablation and outcomes in patients with obstructive hypertrophic cardiomyopathy depending on outflow gradient and basal hypertrophy

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Abstract

The aim of this study was to investigate the short and long-term efficiency of alcohol septal ablation (ASA) in different groups of obstructive hypertrophic cardiomyopathy (oHCM) patients with severe and non-severe gradients in the left ventricle outflow tract (LVOT) and those with severe and non-severe basal septal hypertrophy.

Material and methods. In this study, 212 oHCM patients were included. The mean age was 52±15. Female patients were 50.7% (107 patients). Patients were divided into 4 groups, according to the septal hypertrophy pattern and the severity of LVOT gradient at rest: group 0 – patients without severe LVOT gradient (<50 mmHg at rest) or severe basal hypertrophy (<20 mm); group 1 – patients with severe LVOT gradient (≥50 mmHg at rest), but without severe basal hypertrophy (<20 mm); group 2 – patients without severe LVOT gradient (<50 mmHg at rest), but with severe basal hypertrophy (≥20 mm); group 3 – patients with severe LVOT gradient (≥50 mmHg at rest) and with severe basal hypertrophy (≥20 mm).

Results. The median follow-up was 74 (38–127) months. The long-term survival rates in entire cohort were as follows 98.1 (95% CI 96.2–100.0)%, 92.3 (95% CI 88.5–96.3)%, 77.2 (95% CI 70.1–85.0)%, at 1-, 5-, 10-years of follow-up. The cumulative incidence of mortality cases in the long-term was 41 patients (19.3%). The difference in survival rates between groups in this study did not reach the statistical significance (*p*=0.16), but comparing a group 3 (PG ≥50 mmHg and IVS ≥20 mm) with the rest of patients (PG <50 mmHg and/or IVS <20 mm) the statistically significant

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Keywords:
alcohol septal ablation; left ventricle outflow tract obstruction; hypertrophic cardiomyopathy; residual obstruction

difference between survival rates was identified (p=0.029) with a hazard ratio (HR) = 1.98 (95% CI 1.06–3.72). The mean functional class of chronic heart failure improved from 2.5±0.6 to 1.5±0.6. In the follow-up, the LVOT gradient decreased from 60 (40–89) mmHg to 15 (9–124) mmHg at rest and from 108 (80–135) mmHg to 26 (16–49) mmHg after provocation. The mean IVS reduction was 5±3 mm in the follow-up. Residual obstruction was observed in 42 cases (20%) in the whole cohort. Comparing patients with PG ≥50 mmHg with those with PG <50 mmHg the higher reoperation rates were observed in patients with the severe LVOT gradient at baseline [p=0.046, HR = 2.12 (95% CI 1.00–4.49)].

Conclusion. Alcohol septal ablation showed higher reintervention rates in cases with severe resting left ventricle outflow gradient at baseline. Patients with severe resting gradient and severe basal hypertrophy at baseline had higher long-term mortality rates despite the septal reduction.

Funding. The study had no sponsor support.

Conflict of interest. The authors declare no conflict of interest.

For citation: Kashtanov M.G., Reitblat O.M., Mishina M.O., Chernyshev S.D., Gavrilko A.D., Krasheninin D.V., Shloydo E.A. Alcohol septal ablation and outcomes of patients with obstructive hypertrophic cardiomyopathy depending on outflow gradient and basal hypertrophy. Clinical and Experimental Surgery. Petrovsky Journal. 2024; 12 (1): 80–9. DOI: https://doi.org/10.33029/2308-1198-2024-12-1-80-89 (in Russian)

Received 12.12.2023. **Accepted** 05.02.2024.

Alcohol septal ablation (ASA) is a well-established procedure for patients with obstructive hypertrophic cardiomyopathy (oHCM). It is safe and less invasive compared with surgery, and the long-term survival rates after ASA seem similar to those after myectomy at 5-year follow-up at least [1, 2]. But the higher reoperation rates and the higher frequency of residual obstruction comparing with myectomy are still concerning [3, 4]. However, the residual LVOT gradients may lead to adverse outcomes [5]. Understanding of ASA effects seems crucial for better patient selection and improvement of outcomes.

This study is focusing on ASA efficiency in different groups of patients with oHCM depending on the severity of the left ventricle outflow tract (LVOT) gradient and the severity of basal septal hypertrophy.

Material and methods

Since 2001, 212 patients with oHCM underwent ASA in Sverdlovsk regional hospital No.1 and Tyumen Regional clinical hospital No.1. The diagnosis was based on typical clinical findings, electrocardiograms and comprehensive imagine [transthoracic (TTE), transesophageal echocardiography (TEE) and/or cardiac magnetic resonance (CMR)]. Indications for the septal reduction were as follows: the presence of severe left ventricle outflow obstruction (≥50 mmHg) at rest or after provocation in cases when initial maximal medical therapy was not effective enough to reduce heart failure symptoms and/or to reduce LVOT gradient. The mean age was 52±15. Female patients were 50.7% (107 patients). All relevant clinical characteristics are presented in table 1. Clinical follow-up was performed by office visit, phone contact, or structured follow-up.

Intervention

All patients underwent a classic ASA technique with echo-contrast guidance [6]. Procedures were done under local anesthesia with analgosedation during ethanol infusion. One or two arterial accesses were used to perform ASA and hemodynamics evaluation. The electrode for the temporary pacing was routinely placed in the right ventricle apex for 3–7 days depending on the AV conduction. Desiccated alcohol 96% (1–3 ml) was used. Intraoperative TTE was used to evaluate the perfusion zone of the target septal artery.

Comparison: study design

The study was performed in compliance with the Helsinki II declaration. We used 2x2 factorial design to define the ASA performance in different patient's subsets. All patients were divided in 4 groups (table 2):

- group 0 – patients without severe LVOT gradient (<50 mmHg at rest) or severe basal hypertrophy (<20 mm);
- group 1 – patients with severe LVOT gradient (≥50 mmHg at rest), but without severe basal hypertrophy (<20 mm)
- group 2 – patients without severe LVOT gradient (<50 mmHg at rest), but with severe basal hypertrophy (≥20 mm)

Table 1. Demographic data at baseline

Parameter	Group				Total (*n*=211)	*p*
	0 (*n*=26)	1 (*n*=39)	2 (*n*=52)	3 (*n*=94)		
Sex (Female)	13.0 (50.0%)	25.0 (64.1%)	23.0 (44.2%)	46.0 (48.9%)	107.0 (50.7%)	0.284[1]
Family history of SCD	1.0 (3.8%)	2.0 (5.1%)	3.0 (5.8%)	6.0 (6.4%)	12.0 (5.7%)	0.965[1]
Arterial hypertension	17.0 (65.4%)	28.0 (71.8%)	33.0 (63.5%)	51.0 (54.3%)	129.0 (61.1%)	0.256[1]
Coronary artery disease	2.0 (7.7%)	7.0 (17.9%)	9.0 (17.3%)	16.0 (17.0%)	34.0 (16.1%)	0.665[1]
Diabetes mellitus	2.0 (7.7%)	5.0 (12.8%)	1.0 (1.9%)	5.0 (5.3%)	13.0 (6.2%)	0.185[1]
Smoker	8.0 (30.8%)	7.0 (17.9%)	7.0 (13.5%)	22.0 (23.4%)	44.0 (20.9%)	0.279[1]
PM or ICD BEFORE ASA	1.0 (3.8%)	0.0 (0.0%)	0.0 (0.0%)	2.0 (2.1%)	3.0 (1.4%)	0.434[1]
NYHA class before ASA						0.958[1]
I	2.0 (7.7%)	1.0 (2.6%)	2.0 (4.0%)	4.0 (4.3%)	9.0 (4.3%)	
II	14.0 (53.8%)	16.0 (41.0%)	24.0 (48.0%)	42.0 (44.7%)	96.0 (45.9%)	
III	9.0 (34.6%)	21.0 (53.8%)	22.0 (44.0%)	44.0 (46.8%)	96.0 (45.9%)	
IV	1.0 (3.8%)	1.0 (2.6%)	2.0 (4.0%)	4.0 (4.3%)	8.0 (3.8%)	
CCS class before ASA						0.497[1]
0	20.0 (76.9%)	21.0 (55.3%)	27.0 (55.1%)	57.0 (61.3%)	125.0 (60.7%)	
1	1.0 (3.8%)	6.0 (15.8%)	11.0 (22.4%)	18.0 (19.4%)	36.0 (17.5%)	
2	5.0 (19.2%)	8.0 (21.1%)	9.0 (18.4%)	15.0 (16.1%)	37.0 (18.0%)	
3	0.0 (0.0%)	3.0 (7.9%)	2.0 (4.1%)	3.0 (3.2%)	8.0 (3.9%)	
Syncopes before ASA	3.0 (11.5%)	2.0 (5.3%)	10.0 (20.0%)	10.0 (10.8%)	25.0 (12.1%)	0.189[1]
VT	0.0 (0.0%)	1.0 (2.6%)	3.0 (5.8%)	9.0 (9.6%)	13.0 (6.2%)	0.442[1]
AF at baseline	7.0 (26.9%)	3.0 (7.7%)	4.0 (7.7%)	7.0 (7.4%)	21.0 (10.0%)	0.023[1]
Age						0.541[2]
Mean (*SD*)	54.2 (11.0)	55.0 (12.5)	51.8 (14.0)	51.3 (16.7)	52.5 (14.7)	
Range	34.0–78.0	23.0–77.0	11.0–78.0	11.0–92.0	11.0–92.0	
LVEF before ASA						0.068[2]
Mean (*SD*)	70.3 (6.9)	68.8 (8.5)	70.1 (7.5)	72.4 (7.8)	70.9 (7.8)	
Range	52.0–85.0	53.0–88.0	56.0–84.0	52.0–88.0	52.0–88.0	
PG max before ASA						<0.001[2]
Mean (*SD*)	32.3 (11.3)	84.7 (20.5)	34.7 (9.4)	87.5 (32.2)	67.2 (35.0)	
Range	14.0–49.0	52.0–143.0	15.0–51.0	42.0–191.0	14.0–191.0	
PG after provocation before ASA (mmHg)						<0.001[2]
Mean (*SD*)	100.1 (36.4)	110.6 (32.7)	87.5 (27.1)	129.7 (47.3)	112.1 (42.7)	
Range	53.0–171.0	11.0–182.0	52.0–186.0	52.0–250.0	11.0–250.0	
IVSd before ASA						<0.001[2]
Mean (*SD*)	17.7 (1.2)	17.8 (0.9)	24.4 (4.5)	24.4 (3.8)	22.4 (4.6)	
Range	15.0–19.0	16.0–19.0	20.0–37.0	20.0–37.0	15.0–37.0	
LVEDD before ASA						0.005[2]
Mean (*SD*)	48.8 (5.1)	46.2 (5.6)	44.5 (6.2)	44.1 (6.7)	45.2 (6.4)	
Range	41.0–60.0	34.0–61.0	33.0–59.0	26.0–65.0	26.0–65.0	
LA before ASA						0.574[2]
Mean (*SD*)	42.3 (6.0)	42.3 (5.3)	42.8 (7.5)	43.8 (6.5)	43.1 (6.5)	
Range	34.0–55.0	32.0–56.0	28.0–63.0	29.0–57.0	28.0–63.0	
RV before ASA						0.198[2]
Mean (*SD*)	34.8 (4.3)	33.2 (2.8)	32.3 (5.0)	33.7 (4.0)	33.5 (4.0)	
Range	29.0–46.0	27.0–38.0	17.0–43.0	23.0–47.0	17.0–47.0	

Note. SCD – sudden cardiac death; PM – permanent pacemaker; ICD – implantable cardioverter-defibrillator; NYHA – New York Heart Association; CCS – Canadian Cardiovascular Society; ASA – Alcohol septal ablation; VT – ventricular tachycardia; AF – atrial fibrillation; SD – standard deviation; LVEF – left ventricle ejection fraction; PG – peak gradient; IVSd – interventricular septal diameter; LVEDD – left ventricle end-diastolic diameter, LA – left atrium; RV – right ventricle diameter. [1] – Pearson's Chi-squared test; [2] – Linear Model ANOVA.

- group 3 – patients with severe LVOT gradient (≥50 mmHg at rest) and with severe basal hypertrophy (≥20 mm).

Clinical, echocardiographic data were collected at baseline, in the mid-term (<1 year) and in the long-term follow-up (≥1 year).

Definitions

A criterion of residual obstruction was maximal PG ≥50 mmHg after provocation. The term "severe obstruction" in this study was defined as LVOT obstruction with PG ≥50 mmHg at rest. "Severe hypertrophy" in this study meant the basal thick-

Table 2. Residual obstruction rates in different groups of patients after ASA

Parameter		Residual obstruction		
Severe gradient and/or hypertrophy		No	Yes	Total
Group 0 (PG <50 mmHg, IVS <20 mm)	Observed	23	3	26
	% within row	88.5 %	**11.5 %**	100.0 %
	% of total	11.0 %	1.4 %	12.4 %
Group 1 (PG ≥50 mmHg, IVS <20 mm)	Observed	32	7	39
	% within row	82.1 %	**17.9 %**	100.0 %
	% of total	15.2 %	3.3 %	18.6 %
Group 2 (PG <50 mmHg, IVS ≥20 mm)	Observed	44	7	51
	% within row	86.3 %	**13.7 %**	100.0 %
	% of total	21.0 %	3.3 %	24.3 %
Group 0 (PG ≥50 mmHg, IVS ≥20 mm)	Observed	69	25	94
	% within row	73.4 %	**26.6 %**	100.0 %
	% of total	32.9 %	11.9 %	44.8 %
Total	Observed	168	42	210
	% within row	80.0 %	20.0 %	100.0 %
	% of total	80.0 %	20.0 %	100.0 %
Pearson's Chi-squared test		***p***	**0.17**	

Note. PG – peak gradient; IVS – interventricular septum. A criterion of residual obstruction was maximal PG >50 mmHg after provocation

ness of IVS ≥20 mm. The combined endpoint was defined as death, stroke, myocardial infarction, new-onset atrial fibrillation. Reoperation was defined as repeated ASA or mitral replacement and/or surgical myectomy.

Outcomes and study endpoints

In this study dealing with different groups (with or without severe hypertrophy or gradient) we aimed to determine (1) frequency of residual obstruction after ASA in each subset of patients; (2) freedom from reoperation in the long-term; (3) the difference in the long-term survival rates; (4) freedom from combined endpoint including all-cause death, stroke, myocardial infarction, and new-onset atrial fibrillation.

Mortality data were collected from State Insurance Fund and via direct calls to relatives. The local regional database was used to assess the frequency of residual obstruction, reoperations, hospital deaths, stroke, myocardial infarction, and new-onset atrial fibrillation.

Statistical analysis

Data were analyzed using IBM SPSS v26.0. Graphs were created in R 4.0.4 package using the "survminer" application. The Shapiro-Wilk test was used to test continuous variables for normality. Continuous data are presented as a mean ± standard deviation for variables with normal distribution and median (25^{th}–75^{th} percentile) for variables with non-normal distribution. Categorical data are described as absolute numbers and relative frequencies. Non-categorical variables are summarized using means and were compared using ANOVA or Kruskal–Wallis tests according to normality of distributions. The Kaplan–Meier method was applied to construct survival curves. The survival rate was presented with a 95% confidence interval. A *p*-value <0.05 was considered statistically significant.

Results

In the short-term one patient died from sepsis (0.5%). Technical success was achieved in 99.5%. One patient required emergent coronary artery bypass grafting due to left main dissection. A permanent pacemaker was implanted for 11.8% (25) patients in 30 days. The mean of the heart failure functional class improved from 2.5±0.6 to 1.5±0.6. The LVOT gradient decreased from 60 (40–89) mmHg to 15 (9–124) mmHg at rest and from 108 (80-135) mmHg to 26 (16–49) mmHg after provocation. The mean IVS reduction and residual obstruction rates were assessed at 1-year follow-up after ASA. The mean IVS reduction was 5±3 mm in the last follow-up.

Residual obstruction was observed in 42 (20%) cases in the whole cohort. Data about residual obstruction rates in groups after ASA are summarized in table 2. The highest rate of residual obstruction was observed in group 3 (gradient ≥50 mmHg, hypertrophy ≥20 mm) – 27% (25/69 patients).

Long-term results

The median of follow-up was 74 (IQR 38–127) months. Total number of mortality cases in the long-term was 41 patients. Long-term survival rates were as follows 98.1 (95% CI 96.2–100.0)%, 92.3 (95% CI 88.5–96.3)%, 77.2 (95% CI 70.1–85.0)%, at 1-, 5-, 10- and follow-up, respectively. Causes of long-term

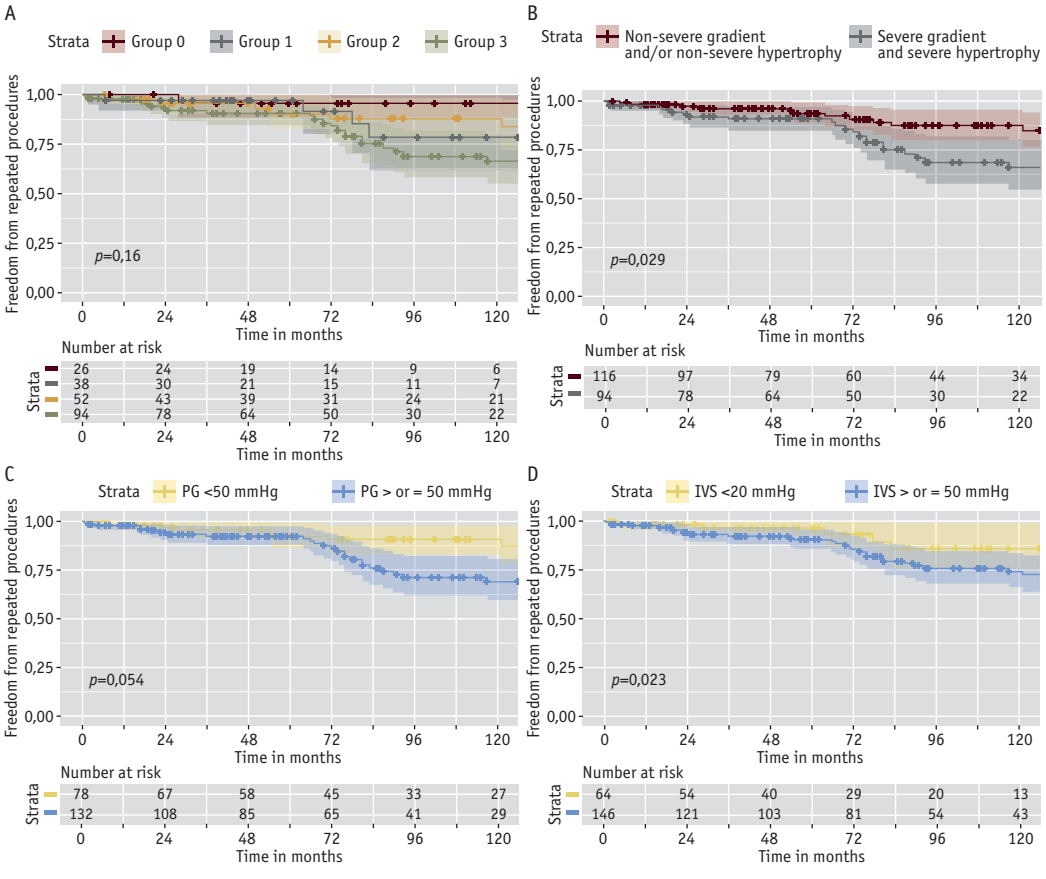

Fig. 1. Survival curves in groups: A. The Kaplan–Meier curves in different groups of patients after ASA; B. Survival rates in a group 3 (PG ≥50 mmHg and IVS ≥20 mm) vs the rest patients; C. Survival rates in patients with PG <50 mmHg vs those with PG ≥50 mmHg; D. Survival rates in patients with IVS <20 mm vs those with IVS ≥20 mm)

death were as follows: stroke (5 patients, 2.3%); myocardial infarction (3 cases, 1.4%); heart failure (4 patients, 1.8%); sudden death (6 cases, 2.8%), cancer (4 patients, 1.8%); COVID-19 (2 cases, 0.9%); unknown causes (15 cases, 7%).

Freedom from the combined endpoint in whole cohort was 95.2 (95% CI 92.3–98.1)%, 82.1 (95% CI 76.6–87.9)%, 61.9 (95% CI 53.9–71.0) %, at 1-, 5-, 10- and follow-up, respectively

Multivariable analyses (Cox regression) identified 3 independent predictors of long-term death: PG ≥50 mmHg at rest before ASA (HR 2.09, 95% CI 1.04–4.20), stroke in the follow-up (HR 3.1, 95% CI 1.27–7.55), and age (HR 1.03, 95% CI 1.00–1.05). C-statistic was 0.64.

The statistical difference in survival rates between groups was not reached in this study (p=0.16) (fig. 1A), but comparing a group 3 (PG ≥50 mmHg and IVS ≥20 mm) versus the rest of patients (PG <50 mmHg and/or IVS <20 mm) the statistically significant difference in survival rates was identified (p=0.029) with a hazard ratio (HR) = 1.98 (95% CI 1.06–3.72) **(**fig. 1B).

No significant difference was found between groups in terms of freedom from the combined endpoint in the follow-up (p=0.5) (fig. 2).

Observed reoperation rates in the entire cohort were as follows: 36 (17.1%) events. The difference in reoperation rates (freedom from myectomy, mitral replacement, or repeated ASA) between study groups in the follow-up was not identified (p=0.12) (fig. 3A). Comparing a group 3 (PG ≥50 mmHg and IVS ≥20 mm) versus the rest of patients (PG <50 mmHg and/or IVS <20 mm) the statistically significant difference in reoperation rates was not observed (p=0.2) (fig. 3B). Comparing patients with PG ≥50 mmHg versus those with PG <50 mmHg the higher reoperation rates were observed in patients with severe LVOT gradient at baseline (p=0.046) (HR=2.12; 95% CI 1.00–4.49) (fig. 3C). In contrast, patients with IVS ≥20 mm versus those with IVS<20 mm had similar freedom from reoperations in the long-term period (p=0.52) (fig. 3D).

Long-term effects of ASA on common echocardiographic measures are presented below (fig. 4).

Discussion

Findings and its explanation

The essential findings are as follows: (1) the mean effect size of alcohol ablation on septal reduction is 5 mm in this study; (2) alcohol ablation works perfectly in patients with severe hypertrophy as well as non-severe septal hypertrophy, but it is less efficient in terms of the frequency of residual

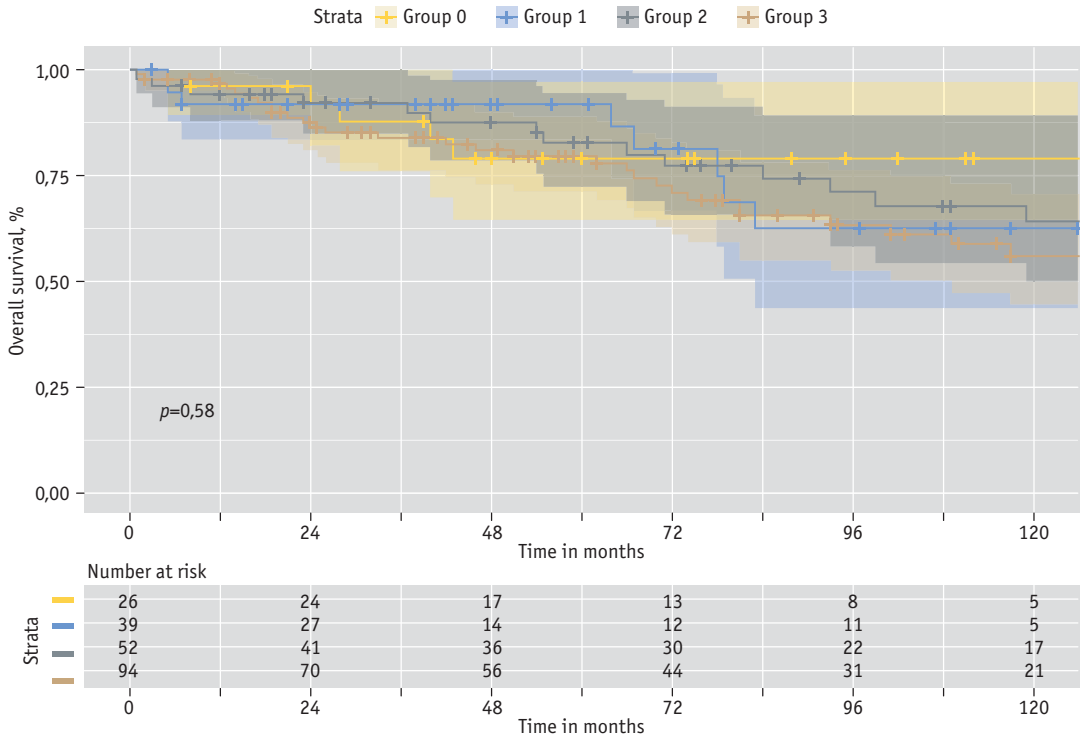

Fig. 2. Freedom from combined endpoint in different groups of patients after ASA

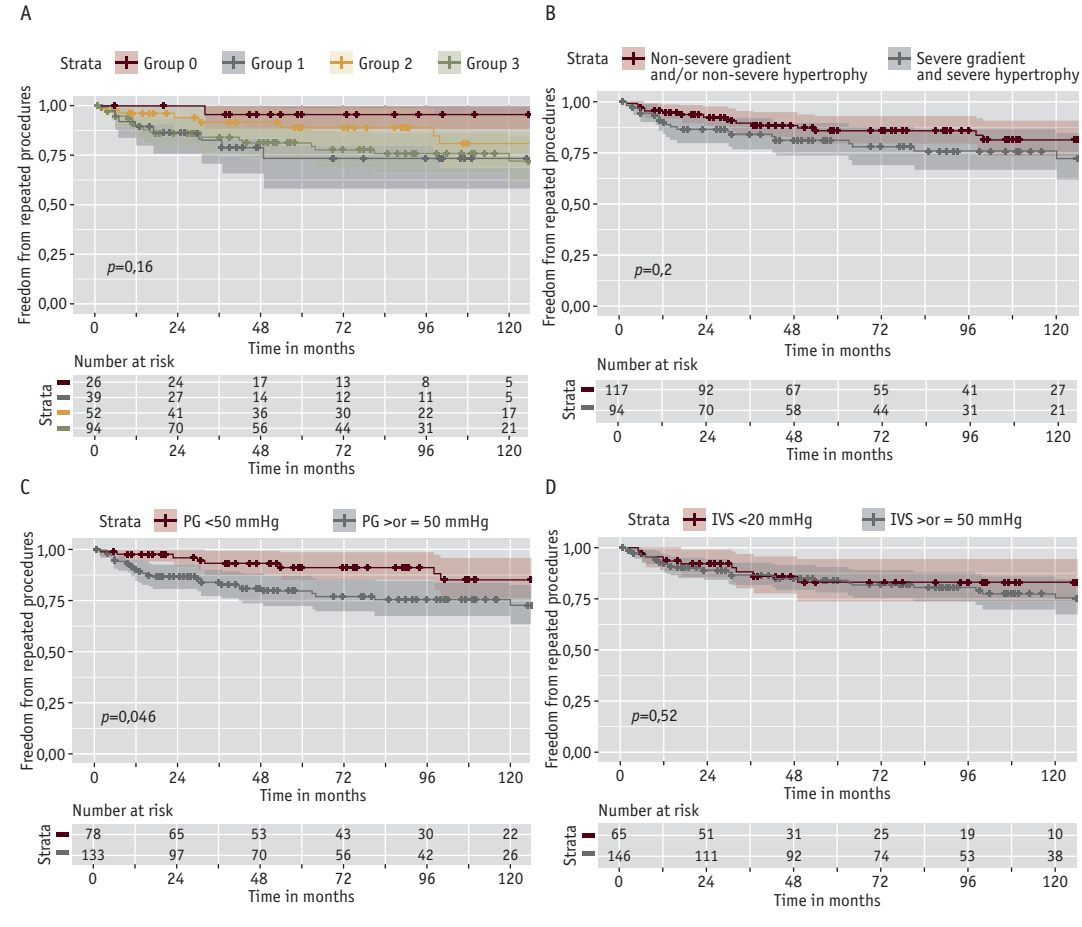

Fig. 3. Reoperation rates in groups (repeated ASA, surgical myectomy, mitral replacement): A. Freedom from myectomy, mitral replacement and reASA; B. Freedom from reoperations in group 3 versus the rest patients; C. Freedom from reoperation in patients with PG <50 mmHg vs those with PG ≥50 mmHg; D. Freedom from reoperation in patients with IVS <20 mm vs those with IV ≥20 mm

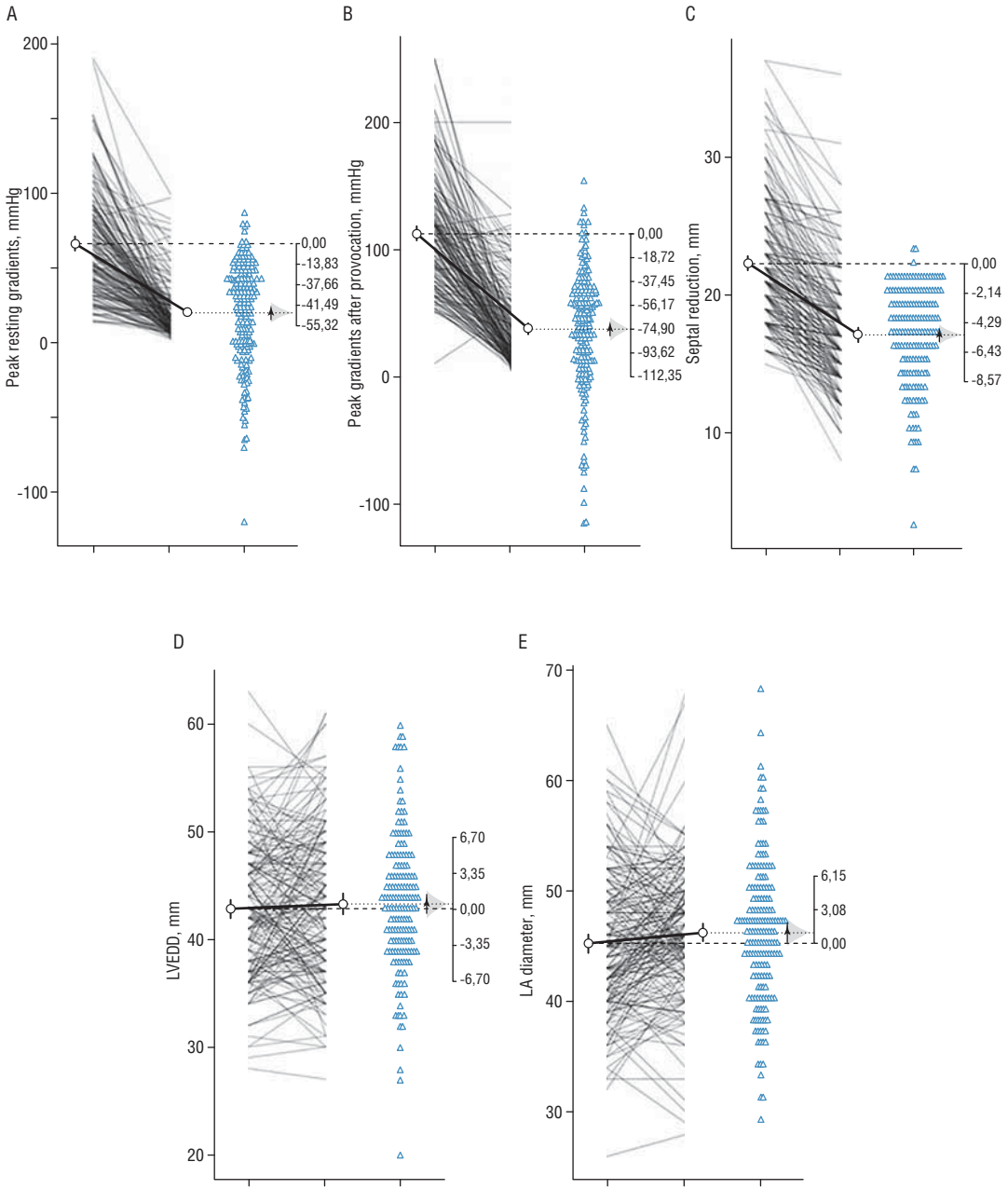

Fig. 4. Visualization of the ASA's long-term effects on echocardiographic measures:
A. The difference of peak resting gradients at baseline vs in the long-term;
B. The difference of peak exertional gradients at baseline vs in the long-term;
C. Effect size of the IVS reduction;
D. No difference in LVEDD between the baseline and the follow-up measures;
E. No difference between the baseline LA diameter and LA diameter in the follow-up

obstruction in patients with high gradients in LVOT (≥50 mmHg) at baseline; (3) the higher mortality rates were observed in the long-term after ASA in patients with oHCM with both PG ≥50 mmHg and IVS ≥20 mm.

First, selecting patients for ablation, we should understand its effects and which patients will get benefit from this kind of intervention. Data from large ASA registry (Euro-ASA) showed exactly the same mean value of septal reduction (5 mm) as we found [7]. What does it mean for practice? In reports from experienced surgical teams the average depth of IVS resection after myectomy ranges from 5 to 10 mm [8, 9]. However, the septal reduction after ASA seems limited comparing with surgery. It means that we should clearly understand for which patients this "moderate" effect will be sufficient enough in terms of the LVOT gradient abolishment and the long-term prognosis.

Second, our data showed that ASA is seemed very effective in cases of small resting gradients (<50 mmHg) and its efficiency less depends on septal thickness as it was considered previously [10]. Anyway, our finding goes in line (are consistent) with data from J. Veselka et al. [11]. They showed the similar reoperation rates after ASA in HCM patients with septum ≥30 mm and <30 mm.

Third, the group 3 (PG ≥50 mmHg and IVS ≥20 mm) demonstrated the highest mortality rates in the long-term comparing to the rest patients

undergoing ASA. Comparing patients with PG ≥50 mmHg versus those with PG <50 mmHg the statistical difference in the long-term survival rates did not reach, but seemed borderline (p=0.054). In contrast, patients with IVS ≥20 mm versus those with IVS <20 mm showed no impact on the long-term survival (p=0.229).

However, in our cohort the IVS thickness alone was less impactful on the long-term prognosis than the LVOT gradient or than a combination of two variables: the basal hypertrophy thickness and the LVOT gradient.

Guidelines and previous studies

The last HCM guidelines 2020 recommended surgical myectomy as a preferred option especially in cases of associated disorders (associated anomalous papillary muscle, markedly elongated anterior mitral leaflet, intrinsic mitral valve disease, multivessel CAD, valvular aortic stenosis), but there are no recommendations regarding the ASA performance in different anatomical settings [15]. However, just a few studies were addressed to these issues.

C. Van der Lee et al. showed that myectomy combined with mitral valve plasty results in better outcomes than ASA in patients with oHCM and elongated anterior mitral leaflet [12].

To the best of our knowledge, the only one previous study demonstrated the impact of baseline gradients on patients' outcomes after ASA. The research from P. Sorajja et al. showed that PG >100 mmHg at baseline is an independent predictor of long-term death in patients undergoing ASA [14].

Groups reasoning

Our multivariable analysis identified 3 predictors of the long-term all-cause death: PG ≥50 mmHg at baseline, age, stroke during follow-up. C-statistic was 0.64. However, it is reasonable to study this Cox model in terms of its validity in different patients' cohorts or to build the survival curves depending on a presence of 1 or 2 or all 3 variables as it was done in a research form P. Sorajja et al [14]. But this study was designed to assess the ASA performance in different groups of patients in a factorial way. We chose two factors (PG ≥50 mmHg, and IVS ≥20 mm) to divide patients into 4 groups. The factor of "IVS ≥20 mm" was chosen empirically because the mean of the basal septal thickness in this study was 21 mm.

Value of findings for practice

This study adds a better understanding in terms of patient's selection and which of them will receive a benefit from this kind of intervention.

So-called mitral abnormalities (septal elongations, hypertrophy of papillary muscles, displacement of papillary muscles, etc.) in HCM and its impact on the LVOT obstruction were already studied previously [12, 16]. However, the obstruction is a consequence of 2 anatomical structures – septum and mitral valve, which lead to the occurrence of mitral-septal contact. To the best of our knowledge, the longevity in the time of this contact is linearly related to the LVOT obstruction severity. In general, the longer contact means the higher gradient. The continuous in-time contact may be created predominantly by the thick septum or the long mitral leaflet or even both. However, even in cases of the thin basal septum, long mitral leaflet may cause severe or long mitral-septal contact and the severe gradient as a consequence. Mitral valve in such cases is looking like a predominant cause of the LVOT obstruction and, however, septal reduction alone may not be so efficient option.

It was shown that the mitral valve surgery or mitral chords cutting may be an efficient enough to abolish the LVOT gradient in patients with the thin septum [13].

This retrospective, observational study has its own inherent limitations that should be considered prior to generalization of the results. This study was not initially designed or powered to assess the survival among the different ASA groups. Future studies are needed to assess this matter.

Conclusion

Alcohol septal ablation showed higher reintervention rates in cases with severe resting left ventricle outflow gradient at baseline. Patients with severe resting gradient and severe basal hypertrophy at baseline had higher long-term mortality rates despite of the septal reduction.

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