Predviđaju li ehokardiografski pokazatelji asimetrije desne klijetke i volumena desnog atrija desnostrano srčano popuštanje nakon ugradnje lijevostrane mehaničke crpke?

Preoperative right ventricular asymmetry and right atrial volume may predict right ventricular failure following left ventricular assist device implantation

Nina Jakuš*,
Ivo Planinc,
Boško Skorić,
Dora Fabijanović,
Hrvoje Jurin,
Jure Samardžić,
Željko Baričević,
Hrvoje Gašparović,
Bojan Biočina,
Davor Miličić,
Maja Čikeš

Medicinski fakultet
Sveučilišta u Zagrebu, Klinički
bolnički centar Zagreb,
Zagreb, Hrvatska
University of Zagreb School of
Medicine, University Hospital
Centre Zagreb, Zagreb,
Croatia

RECEIVED:
September 18, 2016

ACCEPTED:
October 10, 2016

KLJUČNE RIJEČI: lijevostrana mehanička potpora, zatajivanje desnog srca, ehokardiografija.

KEYWORDS: left ventricular assist device, right ventricular failure, echocardiography.

CITATION: Cardiol Croat. 2016;11(10-11):390-391. | **DOI:** <http://dx.doi.org/10.15836/ccar2016.390>

***ADDRESS FOR CORRESPONDENCE:** Nina Jakuš, Klinički bolnički centar Zagreb, Kišpatičeva 12, HR-10000 Zagreb, Croatia. / Phone: +385915605795 / E-mail: nina.jakush@gmail.com

ORCID: Nina Jakuš, <http://orcid.org/0000-0001-7304-1127> • Ivo Planinc, <http://orcid.org/0000-0003-0561-6704>

Boško Skorić, <http://orcid.org/0000-0001-5979-2346> • Dora Fabijanović, <http://orcid.org/0000-0003-2633-3439>

Hrvoje Jurin, <http://orcid.org/0000-0002-2599-553X> • Jure Samardžić, <http://orcid.org/0000-0002-9346-6402>

Željko Baričević, <http://orcid.org/0000-0002-5420-2324> • Hrvoje Gašparović, <http://orcid.org/0000-0002-2492-3702>

Bojan Biočina, <http://orcid.org/0000-0003-3362-9596> • Davor Miličić, <http://orcid.org/0000-0001-9101-1570>

Maja Čikeš, <http://orcid.org/0000-0002-4772-5549>

Uvod: Unatoč činjenici da je zatajivanje desne klijetke (ZDK) učestala komplikacija nakon implantacije lijevostrane mehaničke srčane potpore (LVAD, engl. *left ventricular assist device*), trenutno ne postoje konkretni ehokardiografski parametri kojima bismo uspješno predviđali koji će bolesnik razviti tu komplikaciju.^{1,2} Cilj ovog istraživanja jest pronaći lako prikupljive parametre, koji bi kombinirali podatke o geometriji desne pretklijetke (DP) i klijetke (DK) s hemodinamskim parametrima.

Pacijenti i metode: Ehokardiografski pregled i desnostrano srčana kateterizacija (DSK) učinjeni su kod 48 bolesnika (42 muškarca, prosječne dobi 59,1 ± 8,7 godina) kao dio pripreme za implantaciju LVAD-a (80 % HeartMate II/III, 20 % HeartWare). Standardna predoperativna priprema uključivala je ehokardiografski pregled s posebnim osvrtnom na morfologiju i funkciju

Background: Although right ventricular failure (RVF) is a common complication after left ventricular assist device (LVAD) implantation, its occurrence cannot be reliably predicted by an individual echocardiographic parameter or a simple combination of measurements.^{1,2} We aimed to identify easily obtainable measurements that may successfully predict RVF, combining markers of right atrial (RA) and right ventricular (RV) geometry with hemodynamic measurements.

Patients and Methods: Preoperative echo examinations and right heart catheterization (RHC) data were studied for 48 consecutive patients (pts) (42 male, mean age 59.1±8.7 years), who underwent continuous flow LVAD implantation (80% HeartMate II/III, 20% HeartWare). A standard preoperative echo examination was performed, assessing RV and RA geometry and function (TAPSE (tricuspid annular plane systolic excursion), FAC (fractional area change)), while haemodynamic parameters were measured by RHC (Table 1). The Index of RV asymmetry (RVAi) was used as a novel marker of RV geometry, quantified as a ratio of the difference of the medial and lateral portion of RV area in relation to the total RV area at enddiastole (Figure 1).

Results: 19% of pts presented with acute or chronic RVF following LVAD implantation. The RVAi was significantly higher (a more asymmetric RV) in nonRVF patients: 0.40±0.13 vs 0.25±0.1, p<0.005. The combination of RAvol/BSA (right atrial volume indexed to BSA) and RVAi was confirmed as a superior predictor of RVF, while the addition of PVR maximized the specificity, yet impaired the sensitivity of the testing. The traditional markers of RV function, FAC and TAPSE, failed to successfully distinguish patients that would develop RVF (Table 1).

Conclusion: Our study demonstrates that echocardiographic parameters of RV and RA geometry combined with RHC pa-

FIGURE 1. The Index of RV asymmetry (RVAi) is quantified as the ratio of the difference of the medial and lateral portion of RV area in relation to the total RV area at end-diastole. A more asymmetric RV will have a greater asymmetry factor, which is typically seen in preserved RV geometry.

ju DK (TAPSE (*tricuspid annular plane systolic excursion*), FAC (*fractional area change*)) te DSK kojom su dobiveni hemodinamski parametri (**tablica 1**). Indeks asimetrije DK (RVAi) novi je ehokardiografski pokazatelj, a radi se o omjeru razlike medijalne i lateralne površine DK i ukupne površine DK (**slika 1**).

Rezultati: 19% bolesnika razvilo je akutno ili kronično ZDK nakon implantacije LVAD-a. Vrijednost RVAi bila je značajno viša (dakle, predstavljala veću asimetriju DK) kod bolesnika koji nisu imali ZDK: $0,40 \pm 0,13$ nasuprot $0,25 \pm 0,1$, $p < 0,005$. Od testiranih varijabli kombinacija RAVol/BAS (indeksirani volumen desnog atrija) i RVAi pokazala se superiornim prediktorom ZSK. Dodatkom PVR dobiva se na specifičnosti, no pri tome pada osjetljivost testiranja. S druge strane, tradicionalni pokazatelji funkcije DK poput TAPSE i FAC, nisu pokazali zadovoljavajuću mogućnost diskriminacije bolesnika koji će razviti ZDK (**tablica 1**).

Zaključak: Ova studija demonstrira kako ehokardiografski pokazatelji geometrije DK i DP u kombinaciji s podacima o tlačnom opterećenju klijetke dobivenim DKS, mogu predskazati ZDK kod bolesnika nakon ugradnje LVAD. Napominjemo da su svakako nužna daljnja testiranja s većim populacijama bolesnika.

rameters of RV afterload may be simple yet reliable predictors of post LVAD RVF; however, limited patient numbers suggest further testing of this finding.

TABLE 1. Comparison of the ability of different measures of right heart morphology and function in predicting RVF after LVAD implantation.

	AUC	Sensitivity	Specificity	p-value
RAVol/BSA+RVAi	0.782	0.667	0.897	0.001
RAVol/BSA+RVAi+PVR	0.722	0.444	1.000	0.001
RAVol/BSA+RVAi+TPG	0.708	0.444	0.971	0.004
RAVol/BSA+RVAi+sPAP	0.708	0.444	0.710	0.004
RAVol/BSA+RVAi+C.I.	0.694	0.444	0.940	0.010
RAVol/BSA+RVAi+CVP	0.637	0.333	0.941	0.054
TAPSE	0.721	0.889	0.553	0.025
FAC	0.384	0.444	0.324	0.258
TAPSE+FAC	0.458	0.333	0.583	0.721

AUC - area under the curve; RAVol - right atrial volume; BSA - body surface area; RVAi - right volume area index; PVR - pulmonary vascular resistance; TPG - transpulmonary gradient; sPAP - systolic pulmonary artery pressure; C.I. - cardiac index; CVP - central venous pressure; TAPSE- tricuspid annular plane systolic excursion; FAC - fractional area change; P value for chi square test. Cut off values: RVAi- 0.33, RAVol/BSA - 50 mL/m², TPG 12 mmHg, sPAP 70 mmHg, PVR 5 WU, C.I. 1.8 L/min/m², CVP 12 mmHg, TAPSE 15 mm, FAC 20%. P value for chi square test.

LITERATURE

- Interagency Registry for Mechanically Assisted Circulatory Support (INTERMACS). Appendix A: Adverse event definitions: adult and pediatric patients (2013).
- Lampert BC, Teuteberg JJ. Right ventricular failure after left ventricular assist devices. *J Heart Lung Transplant*. 2015;34(9):1123-30. DOI: <http://dx.doi.org/10.1016/j.healun.2015.06.015>