Prikaz slučaja / Case report

Poremećaji ritma i funkcija lijeve klijetke: analiza učinaka na istisnu frakciju lijeve klijetke

Rhythm changes and the function of the left ventricle: analysis of effects on the left ventricular ejection fraction

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SAŽETAK: Svrha ovog prikaza slučaja je analiza učinaka poremećaja ritma na istisnu frakciju (EF) lijeve klijetke (LV) koja se može odrediti transtorakalnom ehokardiografijom. Analizirano je pet bolesnika s različitim poremećajima ritma. Trojici od njih do konverzije je došlo spontano, kod jednog bolesnika nakon defibrilacije implantibilnim kardioverter defibrilatorom, a kod jednog bolesnika medikamentozno.

Tijekom analize poremećaja srčanog ritma uslijed hemodinamskih poremećaja moguće je uočiti potrebu hitne konverzije nekih od tih poremećaja zbog učinaka koje poremećaji ritma imaju na hemodinamsku funkciju srca. Prema podacima neki od tih hemodinamskih poremećaja LV su gotovo neznatni, kao u slučaju paroksizmalne supraventrikularne tahikardije (PSVT), dok su poremećaji naglašeni kod fibrilacije atrija (AF) s nekontroliranim ventrikularnim ritmom, a posebice kod ventrikularne tahikardije (VT). Iz ovoga je vidljiva potreba za brzom konverzijom ritma u slučaju VT, a kada je potrebno i elektrokardioverzijom. Kod AF kada nema mogućnosti konverzije u sinusni ritam, kontrola srčane frekvencije pruža važan hemodinamski učinak koji se može registrirati ehokardiografijom.

KLJUČNE RIJEČI: paroksizmalna supraventrikulska tahikardija, fibrilacija atrija, blok lijeve grane, ventrikulska tahikardija, ehokardiografija.

SUMMARY: The purpose of the case report is the analysis of the effects of rhythm changes on ejection fraction (EF) of the left ventricle (LV), which can be determined by transthoracal echocardiography. For this purpose, we have analyzed five patients with different rhythm changes. From three of them the conversion was spontaneous, one patient was converted with DC shock of ICD, and the other patient was converted medicamentosly.

While analyzing the hemodynamic changes of the heart rhythm, one can see the need and the urgency for converting some of these changes — based on the effects that rhythm changes have in the hemodynamic function of the heart. According to the data, some of hemodynamic changes of the LV are almost minimal, like in the paroxysmal supraventicular tachycardia (PSVT), while the changes are enhanced in the atrial fibrillation (AF) with an uncontrolled ventricular rhythm, and especially in the ventricular tachycardia (VT). This indicates the need for a fast conversion of the rhythm in VT and with a DC shock when required. Also in the cases of AF, in cases of inability of conversion of the rhythm in a sinus rhythm, control of the heart rate gives an important hemodynamic effect that can be seen from echocardiographic parameters.

KEYWORDS: paroxysmal supraventricular tachycardia, atrial fibrillation, left bundle branch block, ventricular tachycardia, echocardiography.

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UVOD

Poremećaji ritma su promjene koje zahvaćaju različitu populaciju Neki akutni poremećaji ritma ne stvaraju velike hemodinamske poremećaje te ih je moguće tolerirati tijekom duljeg vremskog razdoblja.

Neki poremećaji ritma koji u kratkom roku nemaju veliki hemodinamski učinak mogu dovesti do zatajivanja srca ako ih se pravilno ne liječi, kao u slučajevima tahikardijom induci-

INTRODUCTION

Rhythym changes are the changes that emerge in different populations. However, some acute rhythm changes do not affect hemodynamic changes to a great extent and can be tolerated for a longer period of time.

Some rhythm changes that have no large hemodynamic effects even in the short run, if not treated properly, can lead to heart failure like in cases of tachycardia induced car-

rane kardiomiopatije. Poremećaji ritma poput ventrikulske tahikardije (VT) zahtijevaju hitnu intervenciju u cilju spašavanja života bolesnika primjenom elektrokardioverzije. S druge strane, poremećaji kao što je blok lijeve grane (LBBB), vode do disinkronije funkcije lijeve klijetke (LV) s važnim učinkom na istisnu frakciju (EF) lijeve klijetke[1-3].

Cilj je studije analizirati poremećaj funkcije LV koji nastupa kod bolesnika tijekom poremećaja ritma te nakon njegove konverzije.

BOLESNICI I METODE

U Kliničkoj bolnici Tetovo analizirano je pet bolesnika s različitim poremećajima ritma. Svaki od bolesnika podvrgnut je analizi na isti način tijekom poremećaja ritma i nakon konverzije, s ciljem analize učinka poremećaja ritma na funkciju LV.

Ehokardiografija je učinjena s komercijalnim aparatom Philips® SONOS® 7500 s opcijom live 3D prikaza (S3 glava za skeniranje s harmonijskom Plus opcijom, Philips Healthcare, SAD), dok je jedan bolesnik sniman s X4 Matrix glavom i s opcijom za 3D ehokardiografiju.

Za analizu 2D i 3D snimki koristio se komercijalni softver (Cardiac Performance Analysis package, TomTec Imaging Systems GmbH) s opcijom oslikavanja 2D naprezanja (straina) uključujući EF. Analiza 3D snimki je napravljena sa softverom za 4D strain (4D LV Analysis, verzija 3.1) od istog proizvođača kao i kod opcije za 3D strain. Pomoću softvera je moguće analizirati EF, globalni strain, longitudinalni strain, cirkumferencijalni strain, radijalni strain, uvijanje s torzijom te izračunati indeks disinkronije. Vrijednosti EF u studiji predstavljaju vrijednosti 2D EF i 3D EF u %, generirani su od strane CPA softvera i 4D softvera. U ovoj studiji nismo koristili M mod EF vrijednosti.

REZULTATI

Analizirane su vrijednosti EF, radijalnog straina, longitudinalnog straina, dV/dT te kašnjenje gibanja stijenke koji pokazuje poremećaje kontrakcija LV za vrijeme i nakon aritmije.

Ventrikulska tahikardija kod bolesnika s implatibilnim kardioverter-defibilatorom

U **Tablici 1** prikazani su rezultati funkcije LV za vrijeme VT kod bolesnika MM, starog 65 godina, s implatibilnim kardioverter defibrilatorom (ICD) koji tijekom ehokardiografske kontrole ima napad VT te konverziju ritma pomoću defibrilacije šokom ICD tijekom praćenja. Frekvencija srca (HR) tijekom VT iznosila je 160/min, a nakon konverzije 90/min.

diomyopathy. Changes like ventricular tachycardia (VT) require urgent intervention aimed at saving the patients' life by applying DC shock. On the other hand, changes like left bundle branch block (LBBB), lead to dysynchrony of the function of the left vetricle (LV) with an important effect on the ejection fraction (EF) of the LV[1-3].

The study was designed for analysis of the LV function changes that emerge in the same patient during rhythm changes as well as its conversion.

PATIENTS AND METHODS

Five patients with different rhythm changes have been analyzed at University Hospital Tetovo. Every patient was analyzed in the same way during the rhythm changes and afterwards, aimed at rhythm changes effects in LV function analysis.

Echocardiography was made with a commercial echocardiograph Philips® SONOS® 7500 with live 3D option (S3 sceanhead with harmonic Plus option, Philips Healthcare, USA) and one patient was analyzed with X4 Matrix sceanahead, with an option of 3D echocardiography.

For analysis of 2D and 3D images, we use the commercial software (Cardiac Performance Analysis package, TomTec Imaging Systems GmbH), with a 2D strain option including EF. 3D images have been analyzed with a software for 4D strain (4D LV Analysis, version 3.1), from the same company, with an 3D strain option. Through software we can analyze EF, global strain, longitudinal strain, circumpherencial strain, radial strain, twist with torsion, as well as calculation of dysynchrony index. The EF values in the study represent 2D EF and 3D EF in %, generated from the CPA software and 4D software. We have not used M mode EF values in this study.

RESULTS

The value of EF, radial strain, longitudinal strain, dV/dT, and wall motion delay have been analyzed, which shows changes in wall contraction of the LV during and after the rhythm changes.

Ventricular tachycardia in patient with implantable cardioverter-defibrillator

Table 1 shows the results of LV function during VT in the patient MM, aged 65, with implantable cardioverter defibrillator (ICD), who had attack of VT during echocardiography control and conversion of it by applying ICD shock during the same control. Heart rate (HR) during the attack of VT was 160/min, and after the conversion HR was 90/min.

Table 1. *Ventricular tachycardia in patient with implantable cardioverter-defibrillator.*

	HR (/min)	EF (%)	dV/dt (ml/s²)	Radial strain (%)	T2P-RS (msec)	Longitudinal strain (%)	T2P-LS (msec)	Wall delay (msec)
Ventricular tachycardia	160	19	54	3.89	300	-5.40	249	170
Sinus rhythm	90	55	345	11.90	190	-13.00	190	120

HR = heart rate; EF = ejection fraction; dV/dt = rate of volume change; T2P-RS-time to peak of radial strain; T2P-LS = time to peak of longitudinal strain.

Očito je da imamo veliku razliku u funkciji LV. Tijekom VT vrijednost EF je iznosila 19% naspram 48% tijekom konverzije ritma, a EF je 55% kod sinusnog ritma. Vrijednosti dV/dT su bile 54 ml/sec^2 naspram 346 ml/sec^2 kod sinusnog ritma (SR). Tijekom VT vrijednost radijalnog straina (RS) je iznosio 3,89% naspram 11,9% kod SR. Longitudinalni strain (LS) je tijekom VT iznosio -5,4% naspram -13% kod SR. Došlo je do značajne promjene kašnjenja gibanja stijenke sa 170 msec tijekom VT-a naspram 120 msec kod SR (**Slike 1-4**).

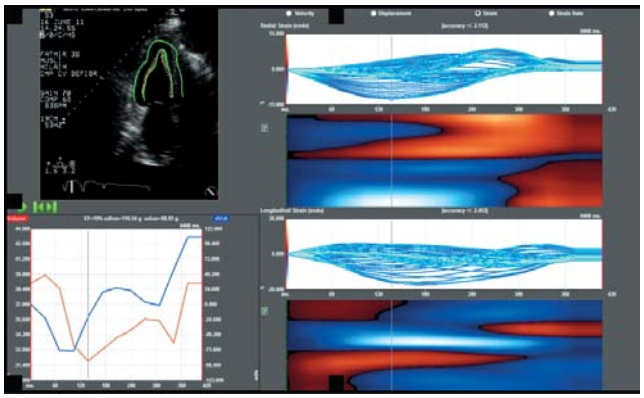

Figure 1. *Color codded M-mode of patient during ventricular tachycardia.*

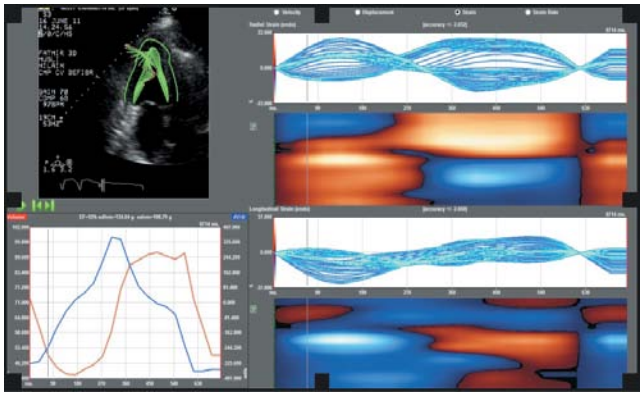

Figure 3. *Color M-mode after conversion of ventricular tachycardia.*

Bolesnici s fibrilacijom atrija

Analizirana su dva bolesnika s ovom vrstom aritmije. Prvi bolesnik SZ, star 55 godina s permanentnom fibrilacijom atrija (AF) i spontanom konverzijom u SR nakon nekoliko mjeseci. Drugi pacijent QH, star 75 godina, s paroksizmalnom AF, konvertiran primjenom amiodarona nakon nekoliko dana u SR. Oba bolesnika imali su normalan nalaz koronarografije.

It is clear that we have a big difference in the LV performance. EF during the VT is 19% vs 48% during the conversion as well as EF 55% in sinus rhythm. dV/dT values are 54 ml/sec^2 vs 346 ml/sec^2 in sinus rhythm (SR). The radial strain values (RS) during VT are 3.89% vs 11.9% in SR. The longtuidinal strain (LS) during VT is -5.4% vs -13% in SR. There is an enhanced difference in wall motion delay in VT 170 msec vs 120 msec in SR (**Figures 1-4**).

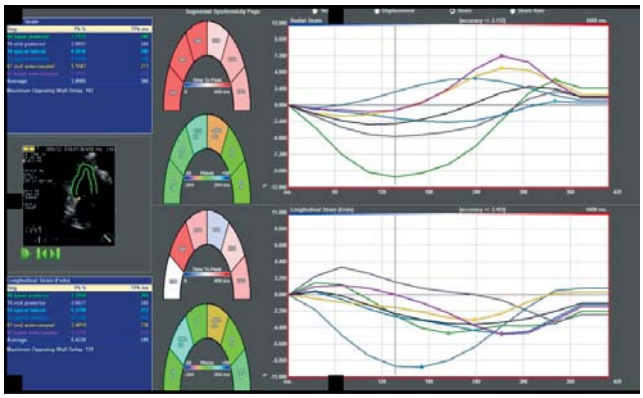

Figure 2. *Parametric mode of patient during ventricular tachycardia.*

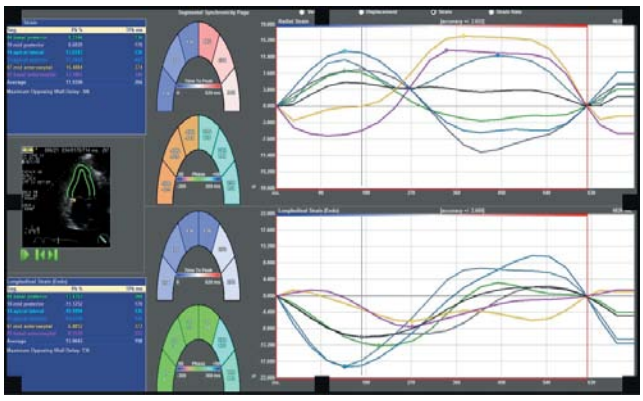

Figure 4. *Parametric mode after conversion of ventricular tachycardia.*

Patients with atrial fibrillation

Two patients have been analyzed with these rhythm changes of the heart. The first patient is SZ, aged 55, with permanent AF which was converted spontaneously after a period of several months. The second patient is QH, aged 75, with paroxysmal AF, converted with amiodarone in a period of few days. The both patients have normal coronary angiograms.

Table 2. *Patient with permanent atrial fibrillation, converted spontaneously after several months.*

	HR (/min)	EF (%)	dV/dt (ml/s^2)	Radial strain (%)	T2P-RS (msec)	Longitudinal strain (%)	T2P-LS (msec)	Wall delay (msec)
Atrial fibrillation	115	24	250	7.50	300	-4.40	238	170
Sinus rhythm	68	68	335	23	234	-19	229	64

HR = heart rate; EF = ejection fraction; dV/dt = rate of volume change; T2P-RS-time to peak of radial strain; T2P-LS = time to peak of longitudinal strain.

U **Tablici 2** prikazani su rezultati za pacijenta SZ, starog 55 godina, u AF i vrijednostima EF od 24% kod AF naspram vrijednosti EF od 68% kod SR. Vrijednost dV/dT kod AF iznosio je 250ml/sec^2 naspram 335ml/sec^2 kod SR. Vrijednosti T2p bile su 300 msec kod AF naspram 224 msec kod SR. Vrijednosti RS bile su 7,5% kod AF naspram 23% kod SR, dok je LS kod AF bio -4,4% naspram -19% kod SR. Kašnjenje gibanja stijenke kod AF bilo je 170 msec naspram 64 msec kod SR (**Slike 5-8**).

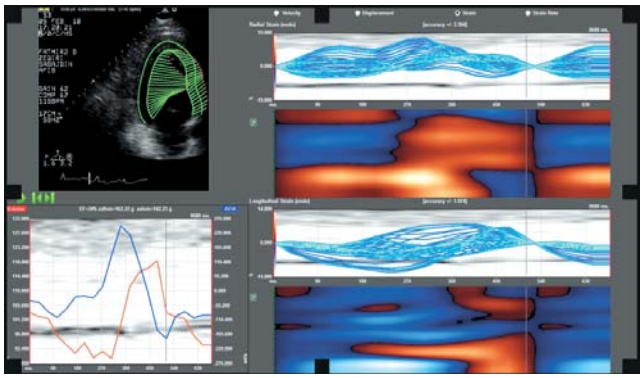

Figure 5. *Color M-mode during atrial fibrillation.*

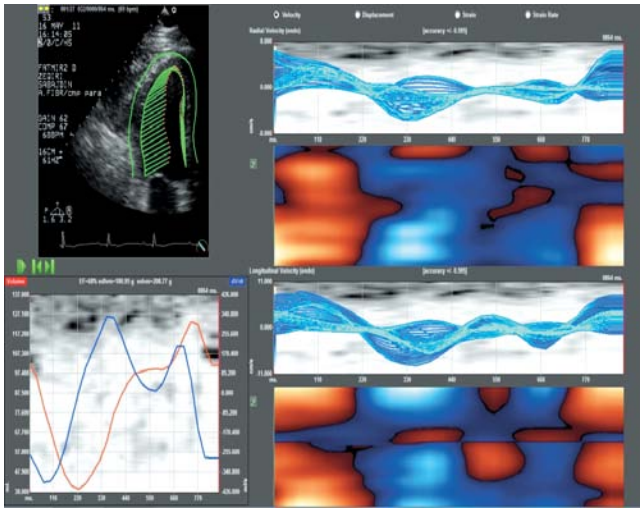

Figure 7. *Color M-mode after conversion of atrial fibrillation.*

Table 2 shows results of SZ, aged 55, with AF with EF from 24% in AF vs EF from 68% in sinus rhythm (SR). Value of dV/dT in AF is 250ml/sec^2 vs 335ml/sec^2 in SR. T2p values are 300 msec in AF vs 224 msec in SR. Values of RS are 7.5% in AF vs 23% in SR while LS in AF is -4.4% vs -19% in SR. Wall motion delay in AF is 170 msec vs 64 msec in SR (**Figures 5-8**).

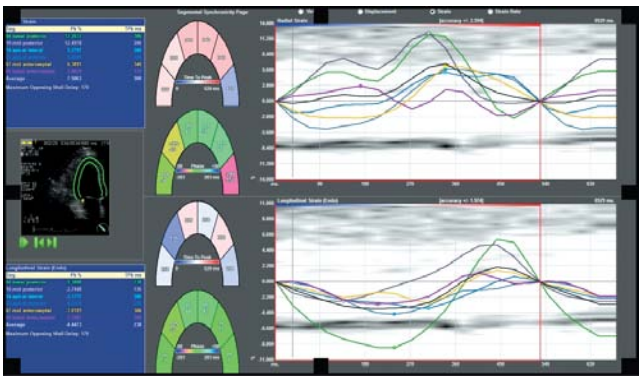

Figure 6. *Parametric mode during atrial fibrillation.*

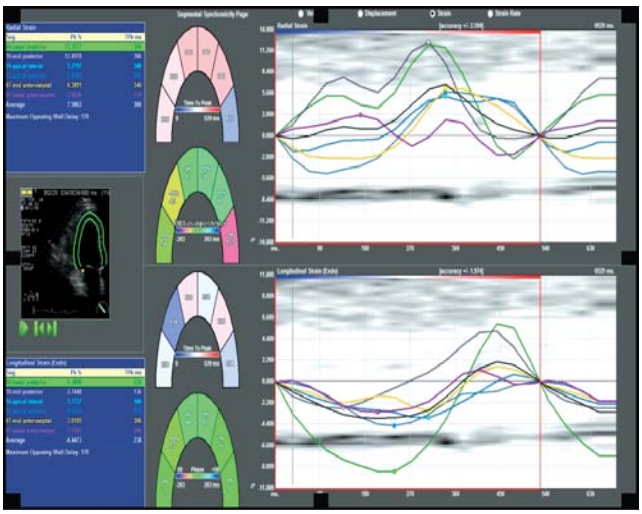

Figure 8. *Parametric mode after conversion of atrial fibrillation.*

Table 3. *Patient with paroxysmal atrial fibrillation, converted in sinus rhythm with amiodarone in a period of few days.*

	EF (%)	Global strain (%)	LV twist (‘)	LV torsion (‘/cm)	Dysychrony index (%)	Index of electromechanical dysynchrony (%)
AF without controlled of LV rhythm (139/min)	26.29	-3.41	5.8	0.85	9.04	12.93
AF with controlled LV rhythm (95/min)	39.50	-8.50	7.6	1.1	6.40	6.40
Sinus rhythm (after conversion)	56.61	-14.90	5.3	0.70	4.90	2.05

AF = atrial fibrillation; LV = left ventricle; EF = ejection fraction.

U **Tablici 3** su prikazane vrijednosti za bolesnika QH, starog 75 godina, muškarca, s paroskizimalnom AF konvertiranim u SR primjenom amiodarona. Prikazane su vrijednosti podijeljene u: AF s nekontroliranom frekvenciji klijetki, FA s kon-

Table 3 shows values of QH, aged 75, male, with paroxysmal AF converted in SR with amiodarone. The presented values are divided in: AF without a controlled frequency of the LV, FA with controlled frequency of LV and values after

troliranom frekvencijom te vrijednosti nakon konverzije u SR. Vrijednost EF za vrijeme AF s nekontroliranom frekvencijom bila je 26,29 naspram 39,5% kod AF s kontroliranom frekvencijom, a 55,61% kod SR, dok globalni longitudinalni strain (GLS) tijekom AF bez kontrole ritma LV iznosi -3,41% naspram -8,50% kod AF s kontroliranom frekvencijom naspram -14,90% nakon konverzije u SR. Indeks sistoličke disinkronije (SDI I) kod AF bez kontrolirane frekvencije iznosio je 9,04% naspram 6,40% kod AF s kontroliranim ritmom te 4,90% kod SR. Indeks sistoličke elektromehaničke disinkronije (SDI II) kod AF bez kontrolirane frekvencije iznosio je 12,93% naspram 6,40% kod AF s kontroliranim ritmom LV naspram 2,05% kod SR (**Slike 9-14**).

the conversion in SR. The value of EF during AF without control on the LV rhythm is 26,29 vs 39.5% in AF with a controlled frequency of LV vs 56.61% in SR, while global longitudinal strain (GLS) during AF without control of LV rhythm is -3.41%, vs -8.50% in AF with a controlled rhythm of LV vs -14.90% in SR. The systolic dysychrony index (SDI I) in AF without control of LV rhythm is 9.04% vs 6.40% in AF with controlled LV rhythm vs 4.90% in SR. The index of systolic electromechanical dysychrony (SDI II) in FA without control of LV rhythm is 12.93% vs 6.40% AF with controlled LV rhythm vs 2.05% in SR (**Figures 9-14**).

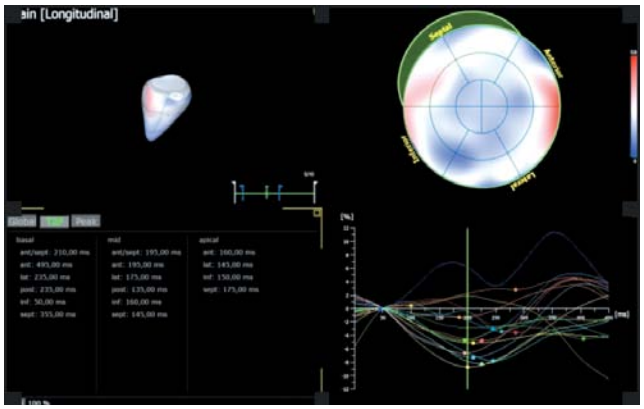

Figure 9. *Patient in atrial fibrillation without controlled ventricular rhythm (time to peak mode).*

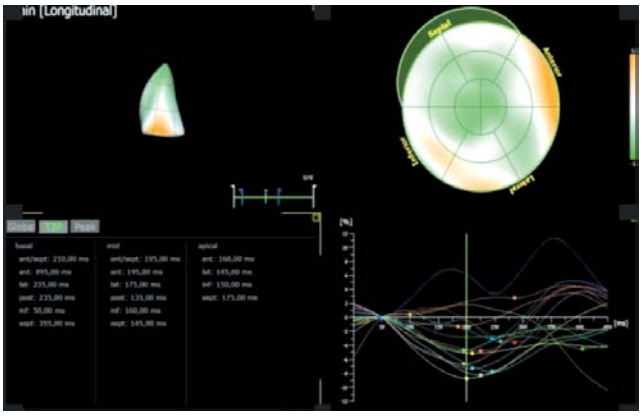

Figure 10. *Patient in atrial fibrillation without controlled ventricular rhythm (longitudinal strain mode).*

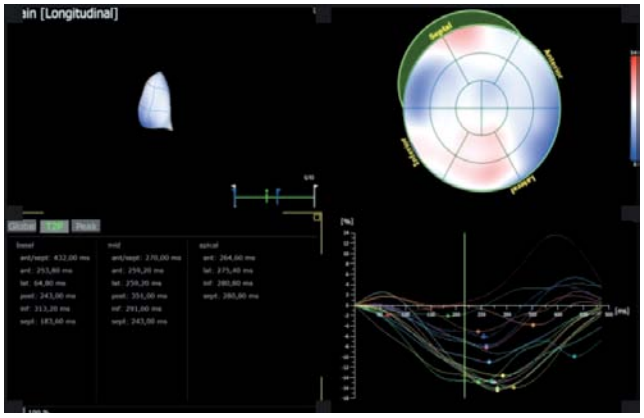

Figure 11. *Patient in atrial fibrillation with controlled ventricular rhythm (time to peak mode).*

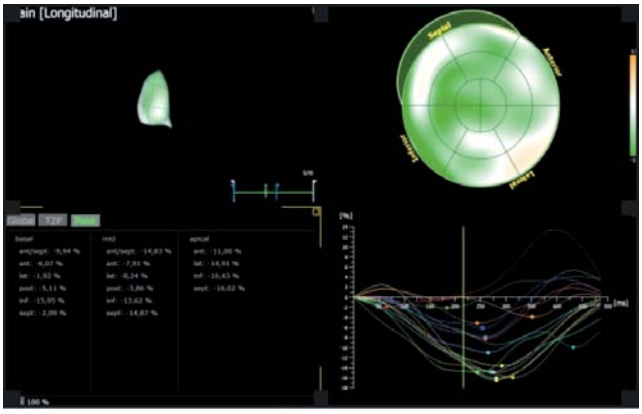

Figure 12. *Patient in atrial fibrillation with controlled heart rate (longitudinal strain mode).*

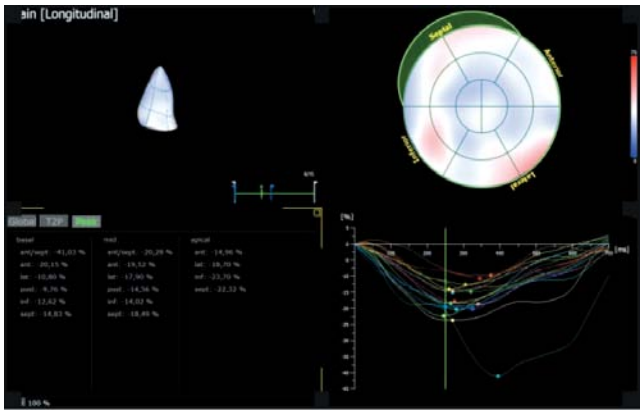

Figure 13. *Patient after conversion of atrial fibrillation in sinus rhythm (time to peak mode).*

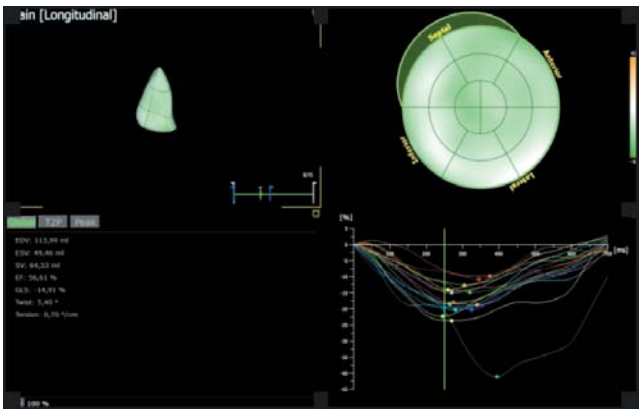

Figure 14. *Patient after conversion of atrial fibrillation in sinus rhythm (longitudinal strain mode).*

Bolesnik s blokom lijeve grane

U **Tablici 4** prikazani su rezultati za bolesnika DZ, starog 65 godina, s LBBB (**Slike 15 i 16**) kod kojeg je nastupila spontana konverzija LBBB tijekom praćenja (**Slike 17 i 18**).

Patient with left bundle branch block

Table 4 shows the results of the patient DZ, aged 65, with LBBB (**Figures 15 and 16**) in whom the spontaneous conversion of LBBB occurred during the same control (**Figures 17 and 18**).

Table 4. *Patient after spontaneously withdrawn from left bundle branch block.*

	HR (/min)	EF (%)	dV/dt of LV (ml/s^2)	Radial strain (%)	T2P-RS (msec)	Longitudinal strain (%)	T2P-LS (msec)	Wall delay (msec)
LBBB	106	16	244	8.50	143	-6.30	253	429
After withdrawn of LBBB	107	34	301	11.18	204	-8.30	312	306

LBBB = left bundle brach block; HR = heart rate; EF = ejection fraction; dV/dt of LV = rate of volume change of left ventricle; T2P-RS-time to peak of radial strain; T2P-LS = time to peak of longitudinal strain.

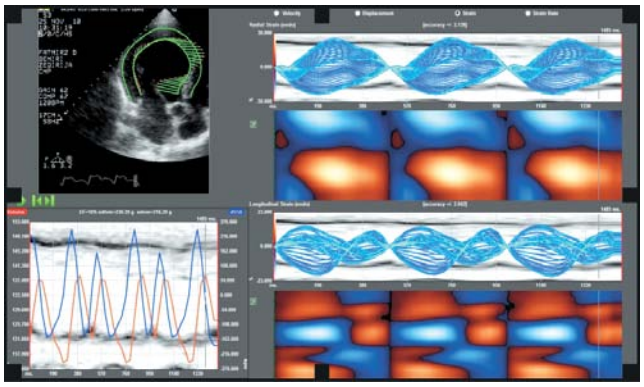

Figure 15. *Color codded M-mode of patient with left bundle branch block.*

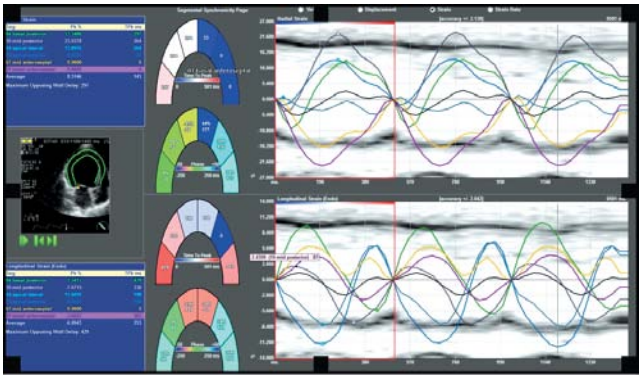

Figure 16. *Parametric mode of patient with left bundle branch block.*

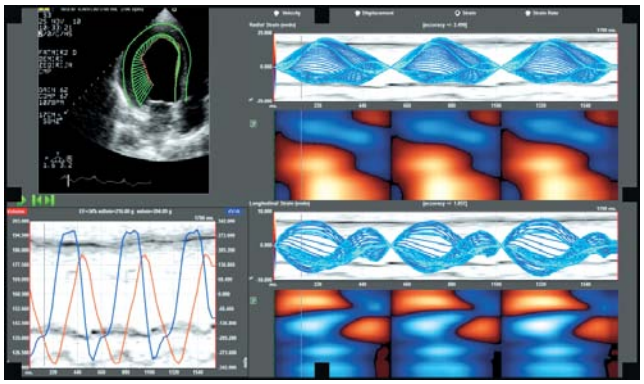

Figure 17. *Color codded M-mode of patient after spontaneously withdrawn of left bundle branch block.*

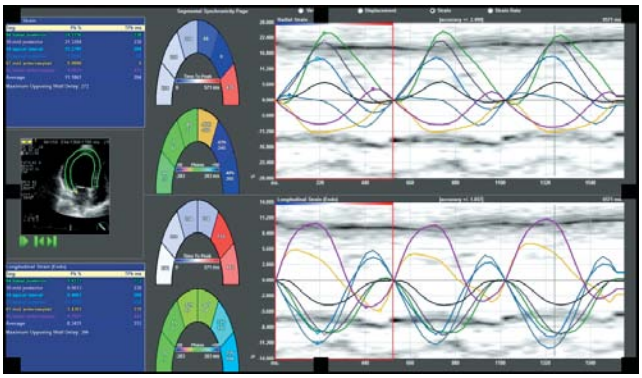

Figure 18. *Parametric mode of patient after spontaneously withdrawn of left bundle branch block.*

Vrijednost EF kod bolesnika s LBBB iznosila je 18% naspram 34% nakon konverzije LBBB. Vrijednost dV/dT s LBBB bila je 244 ml/sec^2 naspram 301 ml/sec^2 nakon konverzije. Radijalni strain tijekom LBBB bio je 8,5% naspram 11,18% bez LBBB. Longitudinalni strain kod LBBB iznosio je -6,30% naspram -8,30% bez LBBB, dok je kašnjenje gibanja stijenke kod LBBB iznosilo 429 msec naspram 306 msec bez LBBB.

The EF in the patient with LBBB is 18% vs 34% after the conversion of the LBBB. The value of dV/dT in patient with LBBB is 244 ml/sec^2 vs 301 ml/sec^2 after the conversion of LBBB. The radial strain during LBBB is 8.5% vs 11.18% without LBBB. The longitudinal strain in LBBB is -6.30% vs -8.30% without LBBB, while the wall motion delay in LBBB is 429 msec vs 306 msec without LBBB.

Bolesnik s paroksizmalnom supraventrikulskom tahikardijom

Bolesnik ML, star 50 godina s paroksizmalnom supraventrikulskom tahikardijom (PSVT) kod koje je nastupila spon-

Patient with paroxysmal supraventricular tachycardia

The patient ML, aged 50, with paroxysmal supraventricular tachycardia (PSVT) which was converted spontaneously.

tana konverzija. Tijekom PSVT frekvencija je bila 153/min, a nakon konverzije 82/min.

Iz vrijednosti prikazanih u **Tablici 5** jasno je vidljivo da se tijekom i nakon PSVT ne registriraju velike razlike u funkciji LV. Vrijednost EF tijekom PSVT je iznosila 62% naspram 65% kod SR, a uočena je velika razlika u vrijednosti dV/dT koje su iznosile 451ml/sec^2 kod SR u usporedbi s 365 ml/sec^2 tijekom PSVT. Prikazane su i vrijednosti za RS od 23,02% tijekom PSVT naspram 22,10% kod SR, a LS je iznosio -17% tijekom PSVT naspram -18,30% kod SR. Kašnjenje gibanja stijenke tijekom PSVT je iznosilo 64 msec naspram 66 ms kod SR, što pokazuje normalnu funkciju LV kod SR i tijekom PSVT, što se može jasno vidjeti (**Slike 19-22**).

The HR during the PSVT was 153/min and after the conversion it was 82/min.

From the values presented in **Table 5**, one can clearly see that big differences are not registered in LV function during the PSVT and after it. EF during the PSVT was 62% vs 65% in SR, while we have a big difference in the dV/dT values which is 451ml/sec^2 in SR compared to 365 ml/sec^2 in PSVT. The given values in radial strain are 23.02% in PSVT vs 22.10% in SR, in longitudinal strain it is -17% in PSVT vs -18.30% in SR. The characteristics of the wall motion delay are 64 msec in PSVT vs 66 msec in SR, which shows regular synchronization of LV function like in SR and through PSVT, which can be clearly seen (**Figures 19-22**).

Table 5. *Patient after spontaneously conversion of paroxysmal supraventricular tachycardia.*

	HR (/min)	EF (%)	dV/dt of LV (ml/s^2)	Radial strain (%)	Longitudinal strain (%)	T2P-LS (msec)	Wall delay (msec)
PSVT	153	62	365	23.03	-17.00	192	64
Sinus rhythm	82	65	451	22.10	-18.30	304	66

PSVT = paroxysmal supraventricular tachycardia; HR = heart rate; EF = ejection fraction; dV/dt of LV = rate of volume change of left ventricle; T2P-LS = time to peak of longitudinal strain.

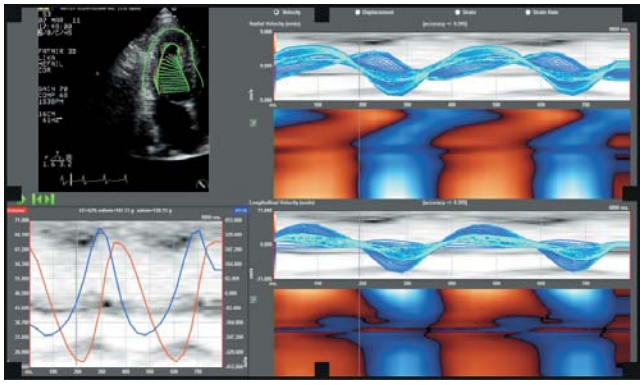

Figure 19. *Color M-mode of patient in paroxysmal supraventricular tachycardia.*

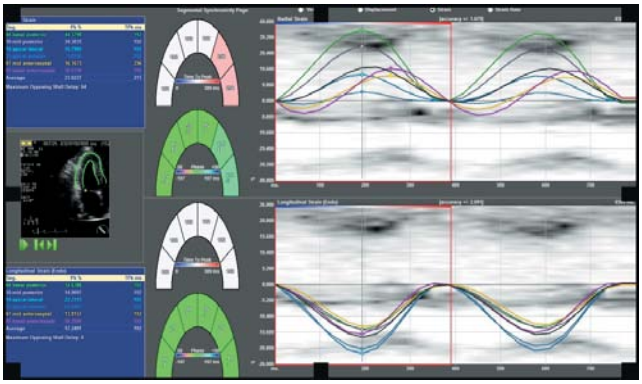

Figure 20. *Parametric mode of patient in paroxysmal supraventricular tachycardia.*

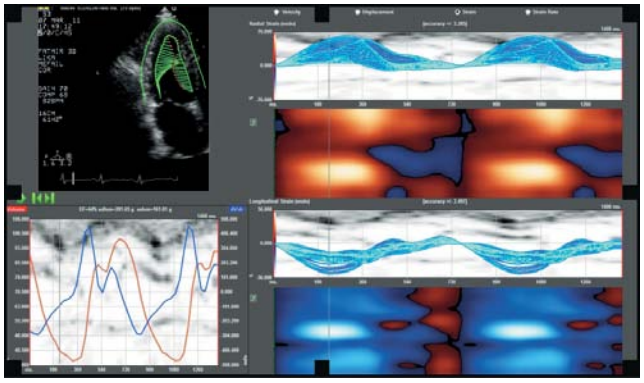

Figure 21. *Color M-mode after conversion of paroxysmal supraventricular tachycardia.*

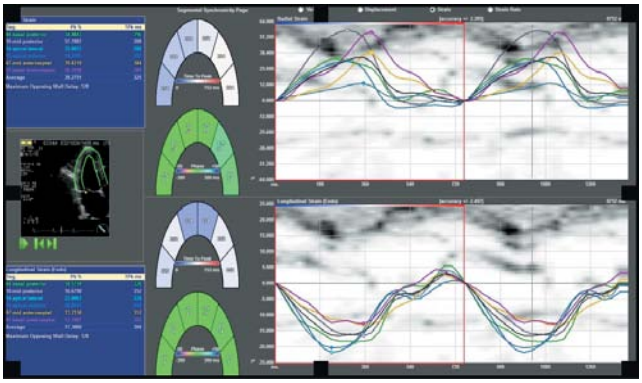

Figure 22. *Parametric mode after conversion of paroxysmal supraventricular tachycardia.*

DISKUSIJA

Neki akutni poremećaji ritma ne stvaraju velike hemodinamske promjene te ih je moguće tolerirati tijekom duljeg vremenskog razdoblja. No, postoje i oni poremećaji ritma koji

DISCUSSION

Some acute rhythm changes do not affect extensive hemodynamic changes and can be tolerated for a longer period of time. Contrary to such rhythm changes, there are rhythm

imaju velik utjecaj na funkciju LV te zahtijevaju njihovu hitnu korekciju. Bolesnici iz ove studije prikazuju različite poremećaje ritma s različitim učinkom na funkciju LV.

Kod prvog slučaja (**Tablica 1**), bolesnika s implantiranim ICD uređajem s epizodama VT defibriliranim s ICD jasno se vide dramatični poremećaji hemodinamskih varijabli srca, izraženih kroz vrijednost EF nakon konverzije, gdje EF raste s 19% tijekom VT na 55% kod SR[4]. Također, uočen je porast vrijednosti dV/dT od 600%, kao i porasti vrijednosti radijalnog naprezanja i LS koji nadilazi 400% (3,89% na 11,9%) za RS te 250% (-5,4% na -13,4%) za LS vrijednost. Nakon konverzije VT u SR jasno se vidi vrlo dobra sinhronizacija LV s smanjenjem vrijednosti kašnjenja gibanja stijenke. Na osnovu ovih hemodinamskih vrijednosti moguće je uočiti potrebu za hitnom konverzijom VT. U takvom slučaju neophodna je primjena DC šoka, budući da poboljšanje funkcije od 400% opravdava njegovo korištenje.

U **Tablici 2** prikazane su vrijednosti bolesnika s permanentnim AF, spontano konvertiranim nakon nekoliko mjeseci. Od prikazanih podataka uočljivo je veliko poboljšanje vrijednosti EF kao i vrijednosti dV/dT[2,5-7]. Može se potvrditi dodatno poboljšanje vrijednosti radijalnog i longitudinalnog straina, ali međutim jedna o najizraženijih značajki je poboljšanje disinkronije što se može vidjeti s poboljšanjem vrijednosti kašnjenja gibanja stijenke koja se poboljaša s 170 msec na 64 msec.

U **Tablici 3** analizirane su vrijednosti funkcije srca kod bolesnika s paroksizmalnom AF. Na osnovu tih vrijednosti i mjerenja EF u 3D, moguće je potvrditi veliko poboljšanje vrijednosti globalnog straina[3,5,7]. Može se potvrditi naglašeno poboljšanje SDI I indeksa te indeksa sistoličke elektromehaničke disinkronije izraženog kao SDI II, koji pokazuje značajno poboljšanje. U ovoj tablici je jasno da dobra kontrola ritma LV pokazuje bitno poboljšanje vrijednosti EF sa 26% na 39%, izraženo kroz poboljšane vrijednosti straina te indeks uspostave ritma SDI i SDII[5,6].

U **Tablici 4** prikazane su vrijednosti EF kod LBBB koji se spontano povukao za vrijeme praćenja. Na osnovu tih podataka, udvostručila se vrijednost EF kao i RS te LS, a zabilježeno je smanjenje izrazite disinkronije kroz kašnjenje gibanja stijenke, što ide u prilog boljoj uspostavi ritma LV nakon spontanog povlačenja LBBB[8,9].

U posljednjem slučaju bolesnika s PSVT jasno možemo vidjeti da nema velike razlike u funkciji LV tijekom PSVT naspram SR[1]. Prikazane vrijednosti u **Tablici 5**, kao što su EF, dV/dT, radijalni strain, longitudinalni strain kao i kašnjenje gibanja stjenke su približno iste, što znači da kod bolesnika sa PSVT nije registriran veliki hemodinamski učinak. To objašnjava toleranciju bolesnika na PSVT, jer u većini slučajeva ne dolazi do poremećaja globalne funkcije srca.

ZAKLJUČCI

Iz prikazanih podataka može se zaključiti sljedeće:

1. Najveći utjecaj na vrijednost EF lijeve klijetke ima VT, dok gotovo normalne raspone vrijednosti ima PSVT. Jasno je da je učinak DC šoka u slučaju VT ogroman. AF predstavlja također aritmiju koji dovodi do hemodinamskih poremećaja te ga je također potrebno pokušati konvertirati u SR. U dva slučaja dokazana je činjenica da je u njima primjena DC šoka bila korisna. Kod VT, u slučaju hemodinamske nestabilnosti potrebno je odmah primijeniti DC šok.

2. U slučaju bolesnika s AF, gdje nema kontraindikacija, DC šok je moguće primijeniti u cilju konverzije ritma u SR. Druga

changes which exert extensive impact on LV function and require their urgent correction. The patients in this study show different rhythm changes with the different effect on LV function.

In the first case, the patient with implanted ICD, with VT episodes converted by ICD, with the data presented in **Table 1**, we can clearly see the dramatic changes of hemodynamic variables of the heart, expressed with EF after conversion, where EF icreases from 19% during VT to 55% in SR[4]. Also the increase of the value of dV/dT is recorded which a change of 600%, as well as an increase of the radial values and the LS that go beyond 400% (3.89% to 11.9%) in RS until 250% (-5.4% to -13.4%) in LS. A very good synchronization of the LV can be clearly seen after the conversion of the VT in SR, with a decrease in the wall delay values. These hemodynamic values indicate the requirement for urgency for conversion of VT. The application of the DC shock is extremely necessary because the improvement of the heart performance from 400% in this case, justifies the use of the DC shock.

Table 2 shows values of the patient with a permanent AF which after several months were converted spontaneously. The data show a great improvement of EF as well as of the values of dV/dT[2,5-7]. An enhanced improvement of the radial and longitudinal strain values can be verified, however one of the most pronounced characteristic is the improvement of dysychrony which is characterized by a decrease in the wall motion delay which was improved from 170 msec to 64 msec.

In **Table 3** values of the heart function have been analyzed in patient with paroxysmal AF. Based on these values and measurements of the EF in 3D a significant improvement of the global strain values[3,5,7] can be verified. An emphasized improvement of the SDI I can be verified as well as of the index of systolic electromechanical dysychrony indicated as SDI II which shows a significant improvement. In this table it is clear that a good control of the LV rhythm shows an enhanced improvement of EF from 26% to 39% indicated by an improvement of the strain values as well as of myocardium synchronization indexes SDI and SDII[5,6].

In **Table 4** the EF values have been given with LBBB which withdrew in a spontaneous way during the same control. Based on such data, the improvement of EF has doubled, as well as RS and LS and the decrease of pronounced dysychrony like a wall motion delay was recorded, which speaks in favor of better synchronization of LV in the patients after the spontaneous withdrawal of the LBBB[8,9].

In the latter case, the patient with PSVT, we can clearly see that there is no great difference in LV function during the attack of PSVT vs sinus rhythm[1]. The shown values in Table 5, like those with EF, dV/dT, radial strain, longitudinal strain as well as wall motion delay are approximate, which means that in this case of PSVT there is no big hemodynamic effect. This explains the sustainability of the patient during PSVT, because in most of the cases the global function of the heart is not changed.

CONCLUSIONS

From the data presented in these cases, one can conclude the following:

1. VT exerts the greatest impact on EF of LV, while PSVT has almost normal ranges of values. It is clear that in the case with VT, the effect of DC shock is great. The other

alternativa u slučajevima s AF je maksimalna uporaba farmakološkog liječenja za konverziju u SR.

3. U slučajevima neuspjele konverzije AF u SR potrebna je kontrola srčanog ritma zbog hemodinamskih poboljšanja do kojih ona dovodi.

4. Učinak LBBB na EF lijeve klijetke, na temelju analize slučaja gdje dolazi do spontane konverzije, jasno pokazuje činjenicu da LBBB pojačava poremećaj EF lijeve klijetke.

5. Svaki od spomenutih poremećaja ritma, osim PSVT, stvara značajan poremećaj sinhronizacije miokarda, što znatno utječe na globalnu funkciju LV.

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rhythm change that leads to hemodynamic changes, is AF, which we should also try to convert to sinus rhythm. These two cases prove the fact that the application of DC shock is beneficial in these cases. In VT, DC shock should be immediately used in cases with hemodynamic instability.

2. In case with AF, where there is no contraindication, DC shock can be used for its conversion to SR. The other alternative in cases with AF is maximal usage of medical therapy for conversion to SR.

3. But in cases when the conversion of AF to SR is unsuccessful, controlled ventricular rhythm has to be considered due to a hemodynamic improvement caused by it.

4. LBBB effect on EF of LV, based on the case study where a spontaneous conversion is made without therapeutical intervention, clearly shows the fact that LBBB causes an enhanced change in EF of the LV myocardium.

5. Each of these rhythms, except for PSVT, causes an enhanced change of myocardial synchronization, which significantly affects the global function of the LV.

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