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news

A NEW STRATEGY FOR TREATMENT OF
MITRAL VALVE INSUFFICIENCY

NOVA STRATEGIJA ZA TRETMAN
MITRALNE INSUFICIENCIJE

Correspondence to:
Uroš Babić

Kardiohirurgija Institut za Kardiovaskularne
Bolesti Klinički Centar Srbije /
Department of Cardiac Surgery
Institute for Cardiovascular Diseases
Clinical Center of Serbia

e-mail: ubabic@yahoo.com

Miljko Ristić, Goran Panić, Svetozar Putnik, Dejan
Marković, Ivan Divac, Uroš Babić

Department of Cardiac Surgery Institute for Cardiovascular Diseases
- Clinical Center of Serbia/ Kardiohirurgija Instituta za kardiovasku-
larne bolesti Kliničkog Centra Srbije

Since doctor Carpentier (1) pioneered the reconstructive mitral surgery numerous modifications of his original technique emerged (2, 3, 4). Traditionally, mitral repair includes annuloplasty, reconstructive leaflet surgery and chordal transposition and /or replacement (5). The advantages of the mitral repair over the mitral valve replacement with prosthetic or biologic valves are indisputable (no need for systemic anticoagulation, no blood trauma etc). With the growing experience the mitral repair becomes the dominant

Od Carpentierovog pionirskog uvođenja tretmana mitralne regurgitacije rekonstruktivnom hirurgijom (1) pojavile su se mnoge modifikacije njegovog originalnog pristupa (2,3,4). Uobičajeno, mitralna rekonstrukcija podrazumeva anuloplastiku, rekonstruktivnu hirurgiju listića i transpoziciju i/ili implantaciju veštačkih hordi (5). Prednosti mitralne rekonstrukcije nad implantacijom veštačkih metalnih ili bioloških valvula je neosporna (nema potrebe za antikoagulacijom, trauma krvnih elemenata itd.).

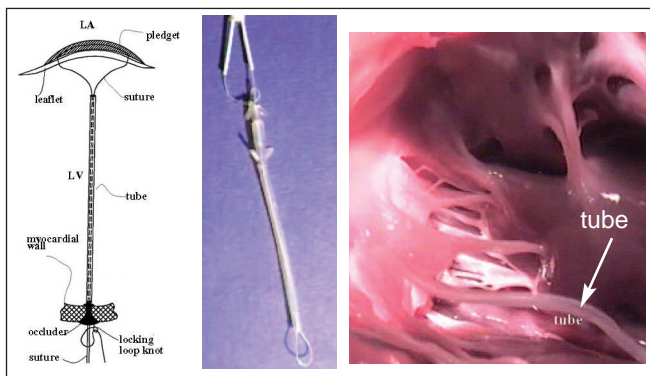


Fig.1A The new concept: "Tourniquet" tightening mechanism replaces the intracardiac knot ; B atraumatic, tissue friendly polymer implant; C Neochordae and native chordae in situ.

Slika 1. A - Novi koncept "turnike" mehanizam fiksacije konaca za mitralni list zamenjuje intrakardijalni čvor; B- netraumatski polimer implant; C- neochordae i nativna chordae in situ.

method of mitral insufficiency treatment in experienced centers. However, even in western countries, only a small number of surgeons gain the necessary level of proficiency in this field. A simplification of the mitral repair procedure would contribute to its extensive application.

A new implant assembly and strategy for implantation of artificial chordae was developed and experimentally (6, 7) and clinically (8) applied for simplified treatment of prolapsed/flail leaflet in Belgrade between 2001 and 2007.

The Implant (Fig. 1A , B, and C) consists of a suture loop with or without a pledget, polymer tube, and myocardial entry site polymer occluder with integrated separate locking loop knot.

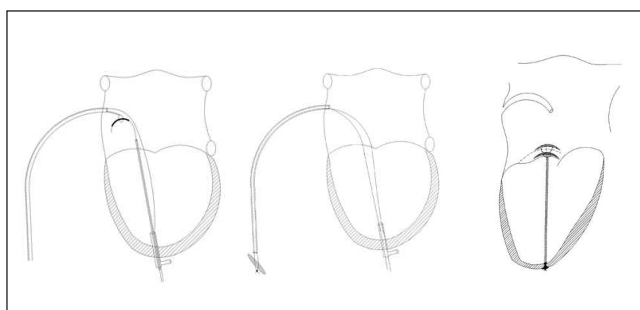


Fig.2 The schematic representation of the loop installation and the procedure completed.

Slika 2. Šematski prikaz instalacije duplikature konca i kompletirane procedure.

As rastućim iskustvom rekonstrukcija postaje dominantan metod lečenja mitralne insuficijencije u kompetentnim centrima. Međutim, čak i u razvijenim zemljama zapada, samo manji broj kardiohirurga stekao je zadovoljavajući stepen stručnosti u ovoj oblasti.

Pojednostavljenje tehnike rekonstrukcije može doprineti zasluženoj široj primeni. Originalan implantat komplet i strategija za implantaciju veštačke mitralne chordae razvijena je i eksperimentalno (6, 7) i klinički (8) primenjena za pojednostavljen tretman prolapsa mitralnog lista u Beogradu između 2001 i 2007 godine.

Implantat (Slika 1. A, B i C) sačinjava hirurški konac sa ili bez pledgeta, polimersko crevo, i polimerski okluder ulaznog mesta na slobodnom zidu myocarda sa integrisanim preformiranim zateznim sigurnosnim čvorom.

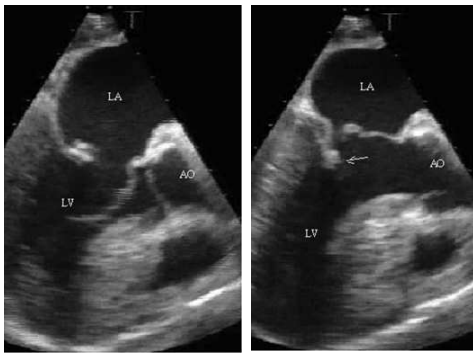


Fig.3 A and B TEE frames after open surgical loop placement.

Slika 3. A i B TEE slika posle hirurškog instaliranja duplikature konca kroz mitralni list.

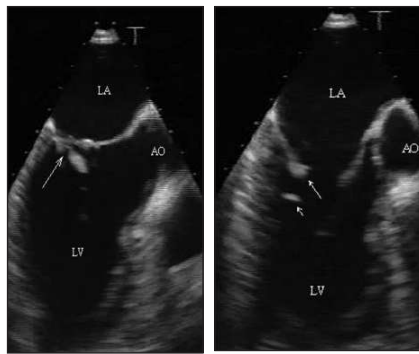


Fig.4 The posterior leaflet Neochordae implanted.

Slika4. TEE slika-Implantirana neochorda za posteriorni mitralni list.

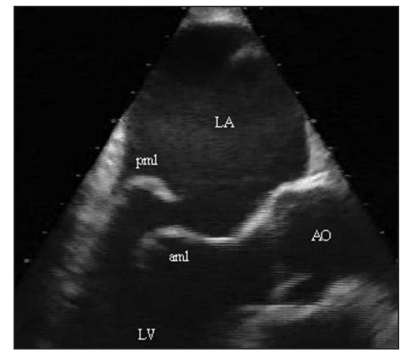


Fig.5 Transoesophageal (TEE) frame of a flail posterior mitral leaflet (P2).

Slika 5. Transesofagealni (TEE) echo slika prolabiranog posteriornog lista (sa rupturom chordae).

THE PROCEDURE

A) Open surgical application Operating room settings

Installation of cardiopulmonary bypass; an 8 Fr sheath (secured with a pursue string suture) was placed into the posterior aspect of the left ventricular (LV) apex per Seldinger technique; aortic cross clamping; left atrial (LA) appendage opening and placement of double looped sutures with pledget through the diseased mitral leaflet segment; exteriorization of the free suture loop ends through the LV sheath; air removal and closure of the LA, release of the aortic clamping; advancement of the polymer tube longitudinally over the exteriorized suture loop ends until the

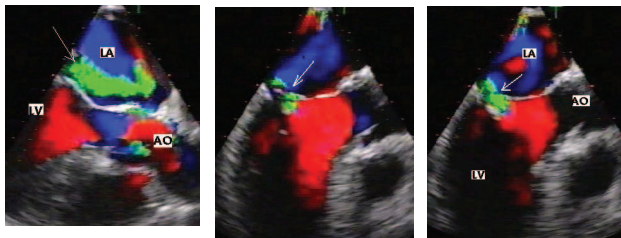


Fig.6 Color TEE frames before, immediately post, and 6 months post procedure.

Slika6. Color TEE slika pre, neposredno posle i 6 meseci posle procedure.

PROCEDURA

A) Otvorena hirurška primena U operacionoj sali

Instalacija kardiopulmonalnog bajpasa Seldingerovom tehnikom; 8Fr sheath se plasira (osiguran sa duvankesom šavom) u dorzalni aspect leve komore (LV); klemovanje aorte; otvaranje levo atrialne (LA) auricule i plasiranje dup-

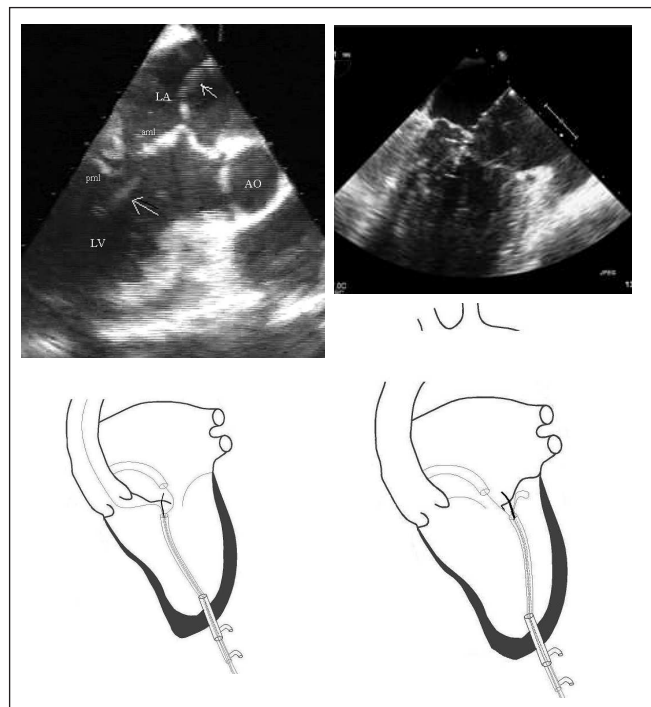


Fig.7 TEE frame (A) and schematic representation (B) of the world's first in-Man "beating heart" puncture of anterior mitral leaflet in a surgical operating room (Belgrade 2007- Babic U, Ristic M, Putnik S, Panic G, Markovic D, Divac I); and the first in-Man puncture of the posterior mitral leaflet in a catheterization laboratory (C and D) .

Slika 7. TEE slika (A) i šema (B) na svetu prve punkcije mitralnog lista na "kucajućem ljudskom srcu" urađene u operacionoj sali (Beograd 2007- Babic U.,Ristic M,Panic G,Putnik S,Markovic D, Divac I.) i prva na svetu punkcija posteriornog mitralnog lista na kucajućem ljudskom srcu urađena u kateter-skoj laboratoriji (C i D).

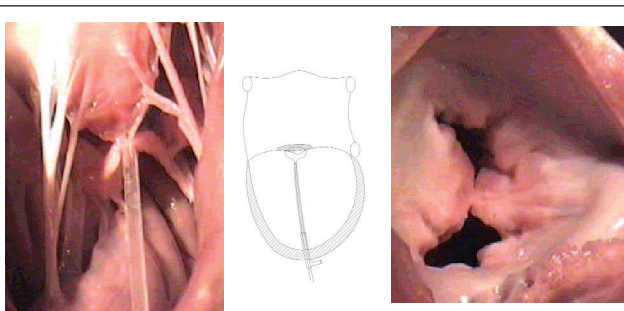


Fig.8 Singled bicuspid neochordae in situ (A), Schema (B) and LA aspect (C).

Slika 8. Zajednička singularna bikuspidna neochorda in situ(A), šema (B) i LA aspect (C).

”tourniquet-type” tightening to the leaflet is achieved (Fig.2); advancement of the polymer free myocardial wall occluder over the exteriorized suture loop ends; adjustment of the tensioning length of this unit by pulling and releasing maneuvers from the epicardial site on beating heart as controlled by the transesophageal echo (TEE) (Fig.3A and B); definitive tightening of the unit at the appropriate level to the exterior of the myocardial free wall occluder (Fig.4).

In 2007, eight patients with acute mitral insufficiency due to prolapsed/flail leaflet (Fig.5) of degenerative etiology were treated with this technique. Aortic cross clamping time ranged between 5 to 10 minutes. A significant reduction of regurgitation jet was achieved in all patients (Fig.6). No significant annular dilatation was present in any of these patients. At the follow-up of up to two years, one patient underwent reoperation because of mitral disease progression, all remaining patients had an event-free follow-up.

B) Catheter-based procedure

Cardiac catheterization settings

General anesthesia; LV apical puncture either after exposure or percutaneously; transseptal placement of an 11 Fr sheath into the LA; creation of a flow directed guiding wire continuous track from the femoral vein-transseptally-LA-LV-out of the body through the LV apical entry site; using the created guiding track the diseased leaflet is punctured (Fig.7 A and B); creation of a suture loop from the LV apical entry site - LV aspect of the target leaflet- LA-back through the leaflet-LV and through the LV apical entry site out of the heart; advancement of a polymer tube over the exteriorized suture loop in that way that the tube covers longitudinally the exteriorized suture between the LV apical entry site and the LV aspect of the leaflet tightening the suture loop to the leaflet and thus replacing the intracardial knot by ”tourniquet technique”. The first application of this principle outside Belgrade and as a catheter-based procedure (Fig.7C and D) was performed in the cardiac catheterization laboratory in cardiovascular center Frankfurt (Babic U, Sievert H, Doss M) in June, 2009 whereby a P3 prolapse was successfully corrected without cardiopulmonary bypass and without sternotomy in a patient with significant mitral insufficiency.

DISCUSSION

The treatment of cardiovascular pathology in modern era is focused on less invasive techniques. The organic mitral valve insufficiency of degenerative etiology is one of the most common disorders in developed countries. In addition, the incidence of functional mitral insufficiency outnumbers the incidence of all valvular diseases. Doctor Alfieri contributed to simplification of mitral repair in certain group of patients (9). His procedure includes simple suturing of the middle segments of both mitral leaflets resulting in creation of double mitral orifice in which way the mitral regurgitation is diminished. Alfieri’s principle was adapted for percutaneous application. Instead of suture, a metallic clip is percutaneously inserted to keep the middle segments of the mitral leaflet closed (10). This treatment was applied for treatment of mitral insufficiency due to prolapse and also for functional regurgitation. The technique presented in this contribution enables also ”Alfieri-like” procedure: after individual punctures of middle segments of both leaflets and

likature konca sa pledgetom kroz oboleli segment lista, izvlačenje krajeva konaca kroz sheath u LV apexu van tela; odstranjenje vazduha i zatvaranje LA pristupa; otpuštanje aortne klemme; uvođenje polimerskog creva longitudinalno preko izvučenih krajeva duplikature konca tako da crevo ”turnike-tehnikom” pritegne LV aspect lista za duplikaturu konca (Slika2.); plasiranje polimerskog okludera LV ulaznog mesta preko izvučenih krajeva konca; nivelisanje dužine veštačke chordae povlačenjem i popuštanjem izvučenih krajeva konca sa epikardialne strane na kucajućem srcu pod kontrolom transesofagealnog echa (TEE) (Slika3. A i B); definitivno fiksiranje zateznog implantata za spoljni segment polimerskog okludera myocardnog zida (Slika4.).

Tokom 2007 godine, osam pacijenata sa akutnom mitralnom insuficijencijom prouzrokovanom prolapsom (Slika5.) degenerativne etiologije tretirano je opisanom tehnikom. Vreme aortnog klemovanja iznosilo je 5 do 10 minuta. Postignuta je značajna redukcija regurgitacionog jeta kod svih pacijenata (Slika6.). Ni u jednog od pacijenata nije postojala značajna anularna dilatacija. Tokom praćenja do dve godine, jedan pacijent je podvrgnut reoperaciji zbog progresije mitralne bolesti, kod svih ostalih pacijenata period praćenja bez osobenosti.

B) Kateter-bazirana procedura

U sali za kateterizaciju srca

Opsta anestezija; LV punkcija ili posle direktnog pristupa incizijom ili perkutano; transseptalno plasiranje 11Fr sheatha u LV; kreiranje tračnice žicom vodiljom od femoralne vene-transseptalno-LA-LV-kroz LV apikalno ulazno mesto ”metodom slobodnog toka krvi-floating”; uz pomoć pomenute pruge vodilje punkcija obolelog mitralnog lista sa LV apikalnog pristupa (Slika.7 A i B); uspostavljanje duplikature hirurškim koncem od LV apikalnog ulaznog mesta kroz LV aspect mitralnog lista u LA i nazad od LA kroz listić ka LV i van tela kroz isti ulazni sheath LV apeksa; navlačenje polimerskog creva preko izvučenih krajeva konca tako da crevo uzdužno pokriva duplikaturu konca fiksirajući mitralni list ”turnike tehnikom” bez intrakardialnog čvora. Prva primena ove tehnike izvan Beograda i prva kao kateter bazirana procedura (Slika7. C i D) uradjena je u Junu 2009 godine u kateterskoj laboratoriji kardiovaskularnog centra Frankfurt (Babic U, Sievert H, Doss M) kojom prilikom je uspešno korigovan P3 prolaps kod jednog pacijenta sa značajnom mitralnom regurgitacijom bez kardiopulmonalnog bajpasa i bez sternotomije.

DISKUSIJA

Tretman kardiovaskularne patologije u novijoj eri usmeren je ka minimalno- invazivnim tehnikama. Organska mitralna insuficijencija degenerativne etiologije je jedna od najčešćih valvularnih mana u razvijenim zemljama. Dodatno, incidencija funkcionalne mitralne regurgitacije premašuje incidencu svih valvularnih oboljenja. Doktor Alfieri doprineo je pojednostavljenju mitralne rekonstrukcije kod određenog profila ovog oboljenja (9). Njegova procedura se sastoji u prišivanju sredine oba listića jedan za drugi čime se kreira dupli mitralni otvor i smanjuje regurgitacija. ”Alfieri princip” prilagođen je za perkutanu aplikaciju.

passage of the suture loop, a single polymer tube is used to tighten the suture loop by "tourniquet-type" technique in which way a double orifice is created (Fig.8). The technique presented herein is aimed to simplify the complexity of mitral repair. It enables the tightening of the neochordae to the leaflet without intracardiac knot and it enables the fine dynamic tuning of the neochordal length on a beating heart as controlled by the TEE. In addition, the unit composed of suture loop covered with the tube and anchored at the solid myocardial wall occluder, contributes significantly to "shock absorbtion". Although long term results on a larger number of patients have to be obtained in order to value the real advantages of this novel technique, its simplicity might contribute to increased utilization of mitral repair even in less experienced centers. The potentiality for percutaneous application of this technique would contribute to widespread use especially if combined with recently developed catheter based coronary sinus annuloplasty. The indication for isolated chordal replacement treatment with this minimal invasive, or hybrid, or percutaneous technique could be extended to chronic mitral regurgitation since almost 20% of these patients might not need annuloplasty (11).

Umesto hirurškog konca plasira se perkutano metalna štipaljka (clip) koja drži središnje segmente mitralnih listova u zatvorenom položaju (10). Ova metoda upotrebljena je za tretman mitralnog prolapsa kao i za tretman funkcionalne mitralne regurgitacije. Naša tehnika prikazana u ovom radu omogućava takođe "Alfieri -sličnu" proceduru: posle individualne punkcije srednjih segmenata oba listića i plasiranja duplikature konca kroz oba lista navlači se polimer crevo preko izvučenih krajeva konca stiskajući središnje segmente oba lista "turnike-tehnikom" čime se kreira dupli orificium (Slika8.). Tehnika prikazana u ovom radu namenjena je pokušaju da se pojednostavi mitralna rekonstrukcija. Ona omogućava fiksiranje artificalne chordae za mitralni list bez intrakardialnog čvora, nadalje omogućeno je dinamičko podešavanje dužine veštačke chordae na kucajućem srcu a pod kontrolom TEE. Dodatno zatezni sistem sa polimer crevom plasiran uzduž zateznih konaca koji su privezani za spoljašnji segment polimerskog okludera ulaznog mesta na dorzalnom aspektu LV apexa doprinosi "apsorpciji tensionih stresova-šoka). Iako su za procenu vrednosti ove metode potrebni dugoročni rezultati na više pacijenata može se očekivati da jednostavnost ove metode doprinese široj upotrebi mitralne rekonstrukcije osobito u centrima sa manje iskustva. Mogućnost perkutane aplikacije ove metode može doprineti značajnom povećanju aplikacije mitralne rekonstrukcije osobito ako bi se kombinovala sa u novije vreme aktuelnom kateter baziranom coronar sinus anuloplastikom. Indikacije za izolirani tretman perkutanom, hibridnom ili minimalno invazivnom tehnikom implantacije artificalne chordae prikazanom u ovom radu mogle bi da budu proširene i na hroničnu mitralnu regurgitaciju za koju se pretpostavlja da u oko 20% slučajeva ne bi morala da bude tretirana sa dodatnom anuloplastikom (11).

REFERENCES

1. Carpentier A. *Cardiac valve surgery-the "French correction."* J Thorac Cardiovasc Surg. 1983;86:323-37.
2. Perier P. *A New Paradigm for the Repair of Posterior Leaflet Prolapse: Respect Rather Than Resect.* Operative Techniques in Thoracic and Cardiovascular Surgery 2005;10 (3) 180-193.
3. David TE. *Replacement of chordae tendineae with expanded polytetrafluoroethylene.* J Card Surg 1989; 4: 286-290
4. Gilinov M, Banbury KM. *Pre-Measured Artificial Chordae for Mitral Valve Repair.* Ann Thorac Surg 2007;84:2127-9.
5. Ristic M, Dotlic R, Jovanovic T, Camba VJ. *Mitralna valvula; "Klub NT"* Bepgrad 1996
6. Babic UU, Knezevic S, Babic M, Lazovic Lj. *Catheter based implantation of artificial chordae for mitral valve support: animal experimental study.* KAR-DIOLOGIJA 2007; 28 (Supplement 1) pp 55.
7. Babic UU. *Catheter based implantation of chordae tendineae for mitral repair.* Congenital&Structural Interventions, 10th international Congress, Frankfurt, 2007, Abstract book pp 157-158
8. Panic G, Ristic M, Putnik S, Markovic D, Divac I, Babic U. *A novel technique for treatment of mitral valve prolapsed/flail.* J Thorac cardiovasc Surg 2009;137:1568-70.
9. Alfieri O, Maisano F, De Bonic M, Stefano PL, Opizzi M et al. *The double orifice technique in mitral valve repair: a simple solution for a complex problems.* J Thorac cardiovasc Surg. 2001;122:674-681.
10. Feldman T, Wasserman SH, Herman CH, Gray W, Block CP, Whitlow P. et al. *Six-Month Results of the EVEREST Phase I Clinical Trial* JACC 2005; Vol. 46, No. 11; 2134-40.
11. Maisano F, La Canna G, Grimaldi A, Viganò G, Blasio a, Mignattis a, et al. *Annular to leaflet mismatch and the need for reductive annuloplasty in patients undergoing mitral repair for chronic mitral regurgitation due to mitral valve prolapsed.* Am J Cardiol 2007;9 2007;99:1434-1439.