What's New in MCS

February 2016

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Review-1:

Durability and Clinical impact of tricuspid valve procedures in patients receiving a continuous-flow left ventricular assist device. Han J, Tkeda K, Tkayama H, Kurlansky PA, Mauro CM, Colombo PC, Yuzefpolskaya M, Fukuhara S, Truby LK, Topkara VK, Garan AR, Mancini DM, and Naka Y. The Journal of Thoracic and Cardiovascular Surgery. 2016; 151: 520-527

Right ventricular dysfunction and significant tricuspid regurgitation are frequently seen in end stage heart failure patients undergoing Left Ventricular Assist Device (LVAD) implantation. Clinical impact of tricuspid valve repair at the time of LVAD implantation in patients with pre-existing significant tricuspid regurgitation has been a topic of debate for several years. Some groups have advocated for concomitant repair and reported decreased postoperative right ventricular failure and improved clinical outcomes. However, the STS database analysis by Roberston etal., showed worse early operative outcomes in the group that underwent concomitant tricuspid valve procedures. At this time, there are no guidelines or randomized controlled trials to guide management of significant tricuspid regurgitation in patient's undergoing LVAD implantation.

In this study, patients who received continuous flow left ventricular assist device (CF-LVAD) between May 2004 and December 2013 at Columbia University Medical Center were reviewed retrospectively. Patients who met study criteria were divided into to two groups. Group A included patients who received tricuspid valve procedures along with LVAD implantation (n= 76, 68 repairs and 8 replacements) and Group B (n=252) included patients who did not receive tricuspid valve procedures. Tricuspid valve procedures were performed based on presence of significant tricuspid regurgitation (defined by authors as moderate or greater degree of TR) noted during intraoperative TEE. Primary outcome variables were 2 year survival on device, freedom from heart failure admissions and degree of TR on serial echocardiography.

Pre-operative characteristics in Group A were notable for higher CVP/PCWP (0.556 ± 0.279 Vs 0.475 ± 0.258, p = 0.032), total bilirubin (1.80 ± 1.36 Vs 1.40 ± 1.09, p =0.009) and lower hemoglobin and hematocrit (10.8 ± 1.84 Vs 11.5 ± 2.06, p = 0.08 and 33.3 ± 5.55 Vs 35.1 ± 5.82, p = 0.017). Patient who underwent tricuspid valve procedures had longer cardiopulmonary bypass time (CPB) (136 ± 52. 0 Vs 83.9 ± 38.8, p < 0.0001) and increased use of platelets (13.6 ± 6.70 Vs 11.7 ± 5.92, p = 0.42). There was higher rate of returning to the OR in patients in group A and there was a non-statistically increased use of RVAD without any difference in outcomes following RVAD implantation. Two year survival was similar in both groups (73.9% Vs 74.1%; p=0.24). Marked improvement in TR grade with tricuspid valve repair was noted and improvement was persistent at 2 years of support, but readmission due to right heart failure was unaffected by TVP.

Pre-existing severe tricuspid regurgitation in end stage heart failure is often associated with post-operative right heart failure. Patients who received concomitant tricuspid valve procedures had high risk background features suggestive of underlying right heart failure (RHF). RHF is associated with congestive hepatopathy and impaired synthesis of clotting factors and places them at high risk for bleeding and use of blood products. Although, increased early morbidities were noted in the TVP group, there was no significant difference in the short-term and long-term outcomes compared to those who did not receive TVP. Serial echocardiograms demonstrated benefit of TVP in preventing the progression of TR up to 2 years on-device. Subgroup analysis showed 6 months survival benefit in patients with moderate degree of TR when treated with TVP compared to untreated group (93.3% Vs 76%) and survival was comparable to patients with no significant TR (93.3% Vs 92.5%). However, patients with at least moderate to severe TR treated with TVP demonstrated lower survival rate compared to patients with moderate TR treated with TVP (82.1% Vs 93.3%). Severe TR is associated with poor outcomes even with TVP.

This study demonstrated that TVP can be performed at the time of LVAD implantation without any increased mortality risk. However, this is a retrospective single center experience with relatively less number of patients in TVP group, which limits the statistical power. Further studies are required to understand clinical, lab and echocardiographic variables that would help select patients who would benefit with tricuspid valve procedures in this population. Prospective studies are warranted to verify the benefit of tricuspid valve repair or replacement in patients undergoing LVAD.

Pathophysiology of tricuspid regurgitation in end stage heart failure is a complex mechanism. It is affected by right ventricular architecture and geometry and presence of defibrillator lead, which may cause anatomic distortion, leaflet tethering and destruction. Degree of tricuspid regurgitation often changes with loading conditions. TVP as a means to improve clinical outcomes after LVAD implantation remains unsolved problem. Presence of significant tricuspid regurgitation (≥ moderate) is associated with poor clinical outcomes and survival. Future lies in the development of small durable right ventricular devices.

References:

Clinical Impact of Concomitant Tricuspid Valve Procedures During Left Ventricular Assist Device Implantation. Piacentino III V, Troupes CD, Ganapathi AM, Blue LJ, Mackensen GB, Swaminathan M, MD, Felker MG, Stafford-Smith M, Lodge AJ, Rogers JG, and Milano CA**. Ann Thorac Surg 2011;92:1414 –9**

Concomitant tricuspid valve surgery during implantation of continuous-flow left ventricular assist devices: A Society of Thoracic Surgeons database analysis. Robertson JO, Grau-Sepulveda MV, Okada S, O'Brien SM, Brennan JM, Shah, AS, Itoh A, Damiano RJ, Prasad S and Silvestry SC.
J HeartLungTransplant2014;33:609–617. http://dx.doi.org/10.1016/j.healun.2014.01.861

Tricuspid valve repair in patients with left-ventricular assist device implants and tricuspid valve regurgitation: propensity score adjusted analysis of clinical outcome. Oezpeker C, Zittermann A, Paluszkiewicz L, Piran M, Puehler T, Sayin AO, Ensminger S, Milting H, Morshuis M and Gummert JF**. Interactive CardioVascular and Thoracic Surgery (2015) 1–7.** doi:10.1093/icvts/ivv260

Review-2:

Comparison of Anticoagulation Strategies After Left Ventricular Assist Device Implantation. Kantorovich A, Fink JM, Militello MA, Bauer SR, Soltes EG and Moazami N. ***ASAIO Journal* 2016; 62:123–127.** DOI: 10.1097/MAT.0000000000000317.

Left ventricular assist devices (LVAD) have evolved over the past few decades and have become an acceptable durable therapy for end stage heart failure patients. Despite the advances in technology, these devices present with inherent risks of bleeding, stroke, thrombosis and infection. Bleeding remains a frequent post-operative complication and is a major source of morbidity. Less intense anticoagulation was adapted targeting low international normalized ratios (INR) by several centers to mitigate the bleeding risk in the past. Routine use of post-operative bridging with parenteral anticoagulation was discouraged. Three major LVAD centers reported higher incidence of pump thrombosis in Heart Mate II LVAD patients starting in 2011. There is growing focus on post-operative anticoagulation following LVAD implantation since emergence of these reports. Although International Society for Heart and Lung Transplantation has provided recommendations for perioperative anticoagulation in patients with continuous flow devices, these recommendations are based on limited evidence.

The group from Cleveland Clinic presented their experience of anticoagulation bridging strategies before implementing oral anticoagulation in patients who had undergone LVAD implantation and evaluated the efficacy and morbidity of these strategies. This was a non-interventional, retrospective, matched historical control cohort study. Historical cohorts were selected based on the post-operative anticoagulation strategy followed and three cohorts were derived; bivalirudin cohort (5-2012 to 12-2012, n = 35), no bridging cohort (2009 to 2012, n = 63) and heparin cohort (2-2013 to 12-2013, n = 41). Patients were followed from LVAD implantation to post-operative day 30 or discharge, whichever occurred first. Primary objective of the study was to compare the incidence of thrombotic complications defined as stroke or transient ischemic attack (TIA), venous thromboembolism (VTE), or device thrombosis. Secondary objectives included incidence of bleeding, average dose used and cost per patient bridged.

Analysis of baseline characteristics is notable for differences in device type and median INTERMACS score between cohorts. The heparin cohort (HC) included higher percentage of Heartware devices compared to the bivalirudin cohort (BC) and no bridging cohort (NBC) (31.7% Vs 5.7% Vs 6.4%; $p = 0.001$). The heparin group had significantly lower thrombotic complications compared to bivalirudin or no bridging cohorts (4.9% vs 20% Vs 27%; $p = 0.017$). The lower rate in heparin cohort is due to a reduction in the rate of deep venous thrombosis. There was statistically non-significant lower rate of bleeding is noted in the no bridging cohort (39% in HC vs 28.6% in BC vs 20.6% in NBC; $p = 0.127$). There was no significant difference between the cohorts with regards to percentage of patients with either thrombotic or bleeding events (43.9% in heparin cohort vs 40% in bivalirudin cohort vs 41.3% in no bridging cohort; $p = 0.718$). Total cost of bivalirudin bridging was $216,648 and heparin was $6,246. Average cost per patient was about $6,200 in bivalirudin group and about $150 in heparin group. Mean days to start oral anticoagulation with warfarin (2 in HC Vs 2 in BC Vs 6 in NBC; $p < 0.001$) and median days to therapeutic INR (10 days in HC Vs 8.5 in BC Vs 12.5 in NBC; $p < 0.001$) were significant between the cohorts.

Heparin was found to have lower thrombotic complications in this study dominated by lower incidence of DVTs, but may be associated with increased rates of bleeding. Bivalirudin demonstrated lower rate of bleeding compared to heparin, but did not reduce the rate of thrombotic complications. Given the reports of upsurge in pump thrombosis, it is unlikely that any center will adopt a no bridging strategy at this time. Bivalirudin is significantly expensive as compared to heparin with no substantial benefit. While heparin use was associated with an increased rate of bleeding, bleeding events were not life-threatening.

The authors concluded that heparin was the most effective bridging anticoagulant following LVAD implantation both from a pharmacologic and cost perspective. This study is limited in that it is retrospective; and therefore relies on the accuracy of the medical record documentation.
Multiple assumptions were made based on written in-patient notes. Cohorts were derived from different time periods and there were changes in the design of the pumps during these times. There were several differences in the clinical management between cohorts. Also, intensity of anticoagulation could not be standardized due to the retrospective nature of the study. The study is also not adequately powered to detect differences in the

outcomes between heparin and bivalirudin. Prospective randomized controlled trials are warranted to address the issue of effective bridging anticoagulant following LVAD implantation.

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