Extracorporeal membrane oxygenation support in complex clinical scenarios of refractory cardiogenic shock in adults

Valorization

This thesis highlights the incidence, results, complications and innovative management of patients submitted to ECMO because of cardiogenic shock sfrom various etiologies. The main findings of the performed research for this thesis can be summarized as follows; careful and vigilant patient selection together with aggressive management of patient himself and ECMO circuit can lead to promising results in the most complex and dim clinical scenarios. The thesis provides relevant insights about the efficacy of ECMO in several settings, including cardiac surgery and related interventions. Indeed, the favorable results obtained in complex settings, like post-cardiotomy cardiogenic shock after general cardiac surgery, confirms the efficacy of such a temporary support in case of refractory and life-threatening postcardiotomy conditions.

The focus of the analyses was not limited to postcardiotomy cardiogenic shock though; indeed, cardiogenic shock resulting from acute coronary syndromes, myocarditis, cardiomyopathies and other causes can also be managed with ECMO with encouraging outcomes.

We were able to demonstrate by means of registry big data analyses and also in meta-analytical approach, that addressing and tackling certain mortality predictors could improve the ultimate outcomes. Similarly, minimizing the invasiveness of the approach as with peripheral cannulation, employing different techniques to unload the LV and referral of patients in cardiogenic shock to experienced high volume centres, are important features of successful ECMO therapy.

Patient selection

The performed research demonstrated that proper selection of patient for the most intensive management modality can lead to better outcomes. In fact, prompt initiation of ECMO in selected patient and timely (before severe end-organ dysfunction appears) offers “appealing” survival rates. More importantly, we could show that advanced age, often considered as contraindication for ECMO or, in fact, for any MCS, should not be viewed as prohibitive or as an absolute contraindication. Factors other than age, like general condition, postcardiotomy or non-postcardiotomy shock and reversibility of the condition play more important role and should be considered first. The above information is calling, from one side, for a more focused patient selection whatever the indication; from another, an algorithm or a guideline is to be introduced, not denying MCS to the elderly subjects, as this

may be at least as effective treatment modality in this very particular group of patients. Indeed, we have provided, for a first time, a list of variables contributing to reduced survival to be considered rather than age.

Another important finding, of the conducted research is that baseline surgical status in post-cardiotomy patients, whether elective or salvage, albeit impacts the propensity for complications, does not affect mortality rates when ECMO is initiated. This, in turn, suggests that initiation of ECMO in the postcardiotomy setting has the survival predictive function outweighing every single EuroSCORE risk stratification components and should be taken account for. What needs to be addressed in the future research is, undeniably, a risk stratification tool and a scoring system for both postcardiotomy and non-postcardiotomy setting which would combine the predictive abilities of yet available scoring systems (REMEMBER, SAFE) but validated on a broader group of patients and not limited to single indications.

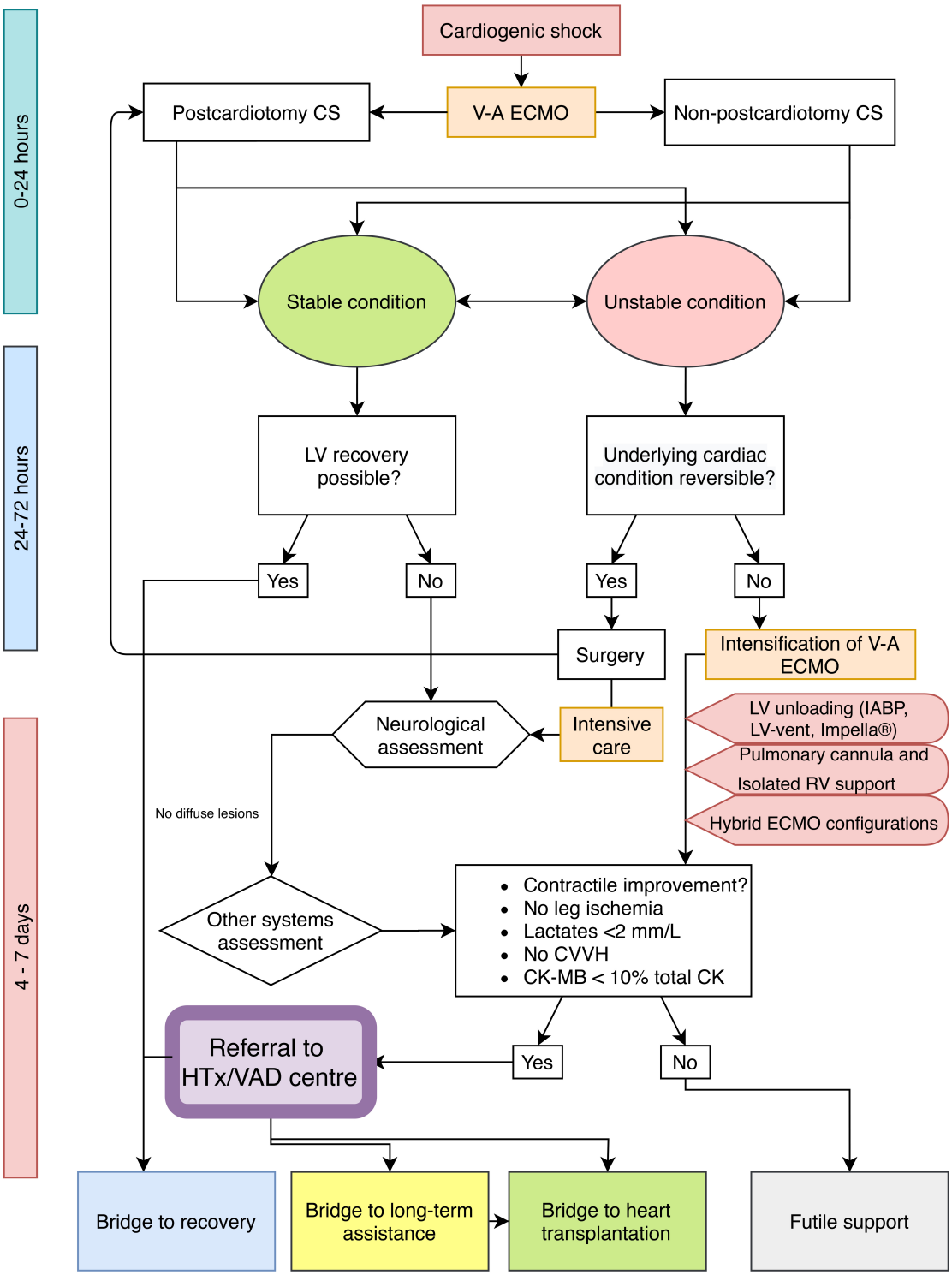
Advancements in ECMO management

As already shown, the performed research confirmed that ECMO configurations do affect the outcomes of patients in cardiogenic shock. In particular, it has been shown that the access to implement such a support may also influence the patient outcome with regards to the complication types and rate with the peripheral approach. With the biggest dataset of post-cardiotomy patient series ever analyzed, peripheral cannulation was shown to be associated with improved in-hospital survival and lower complication rates which is in line also with a recent meta-analysis by our group. Additionally, several LV unloading techniques were investigated; when applied to ECMO circuit, IABP and Impella have potential to reduce mortality in both post-cardiotomy and non-postcardiotomy shock, thereby representing an important insight for the clinical and ECMO communities. Importantly the benefit is seen also with percutaneous implantation of these devices; allowing cardiologists and intensivists for a prompt and successful application with ultrasound guidance rather than with surgical approach.

ECMO experience

Ultimately, we have also performed a set of meta-analyses based on a presumption that centres which perform VAD implantations and heart transplantations may have better outcomes in patients on MCS due to their experience in dealing with end-stage heart failure; in fact, centres in which VADs and HTXs are performed had better results in terms of complication rates in patients undergoing ECMO for postcardiotomy shock. When both

postcardiotomy and medical applications were considered, survival was as well affected with higher in-hospital survival in more experienced centres.



Central figure. Proposed algorithm of patient management: V-A ECMO in cardiogenic shock with respect to potential referral to HTx/VAD centre. V-A ECMO, veno-arterial extracorporeal membrane oxygenation; LV/RV, left/right ventricle; CVVH, continuous veno-venous hemofiltration; CK-MB, creatin kinase muscle-brain isoenzyme; HTx, heart transplantation; VAD, ventricle assist device

This means that experienced and well established ECLS program may indeed make a difference in patient outcome. With this finding, a call for appropriate personnel training and the creation of dedicated team, also in centres not performing transplant/VAD procedure, is highlighted and suggested. What is also important from clinical standpoint, is management of ECMO as a bridging therapy. It was shown that patients managed in experienced centres are more likely to be bridged to destination therapy (HTx or VAD); we have, again for a first time, proposed an algorithm taking into account ECMO duration and clinical variables in order to find a best time frame for transferring a patient from non-HTx/VAD unit to destination centre as well as to determine a best time for bridging to more advanced or longer MCS.

What needs to be addressed in the future?

The information available for ECMO has been always rather poor and limited to single-centre experiences. A tendency not to present poor outcomes is not to be missed; a thorough review, with the provision on detailed information about prevalence, in relation to the overall cardiac surgery procedural number, medical conditions, patient profiles, support modalities, complications and outcome at short or long-term are certainly precious for investigators and people involved in dealing with cardiogenic shock in such settings.