Editorial Commentary

Heart failure in the young and old: insights into various therapies

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Nowadays, chronic heart failure is the most important field in cardiology and cardiovascular surgery. Whereas management of acute serious heart diseases of atherosclerotic, ischemic, infectious, toxic or inflammatory origins, have much improved through the years leading to a successful primary treatment, these patients, after overcoming such acute bouts of disease may ultimately have recurrence and veer into phases of chronic heart failure.

This has become even more prevalent, since these patients become older and sicker, thus, have more chance to develop chronic heart failure. Veritably, chronic heart failure is now the most frequent cause of death in those more than 80 years old, both in men and women (1).

This data clearly illustrates the heart failure scenery in developed countries which is in broad contrast to the underprivileged and larger part of the globe. This vast difference in socio-economic facets must be then taken into consideration.

Consequently, broad interest and enthusiasm have been invested into diagnosis and treatment of heart failure during the recent decades, which has resulted in the emergence of a number of novel pharmaceutical concepts, new rhythm stabilizing procedures and better understanding of the value and limits of organ-saving surgical procedures. These included the wide acceptance of revascularization procedures in even highly reduced left ventricular function assuming that the "hibernating", i.e., not functioning, but still vital myocardium might be revitalized next to dead tissues, scars or fibrosis, where no such measures could be successful. Recently, only indirect signs of hibernation such as preserved thickness of otherwise adynamic heart muscle are discernible on echocardiograms. The relationship of fibrotic to hibernating myocardium thus determines the amount of improvement in revascularization.

Fibrosis and hibernation are also responsible for ischemic mitral insufficiency through dysfunction of papillary muscle-bearing ventricular areas and their reversibility. Moreover, in left ventricular aneurysmectomy, the amount of functional improvement resulting from reduction of the ventricular diameter and thus decrease in myocardial strain, is determined by the quality of the remaining myocardial tissues.

With cardiovascular magnetic resonance imaging using delayed gadolinium enhancement, replacing endomyocardial biopsy as gold standard for human cardiac fibrosis identification and quantification, introduced by Iles and colleagues (2) and extensively elaborated by others (3-5), it is possible to noninvasively assess interstitial myocardial fibrosis and visualize scar tissue in patients with clinically evident cardiomyopathy. This may well be a promising tool to answer important issues in clinical intervention and improve morbidity and mortality of patients with heart failure.

We have formulated a complex of components of ischemic cardiac failure which accounts for the majority of patients with long-standing coronary artery disease most remarkable in the elderly. LOCIMAN stands for Left Ventricular failure in Obstruction of Coronary arteries, Ischemic Mitral incompetence and Aneurysm. There is a lack of studies analyzing which degree these components contribute to the clinical picture of heart failure and how much influence can be achieved by revascularization, mitral valve repair and aneurysmectomy.

Heart transplantation has endowed us a dramatic treatment modality and is now a well-developed and fascinating method to reverse chronic otherwise untreatable heart failure to a sudden normal life capacity. This means prolonging the supposedly very short life span of patients with advanced heart failure by an average of 10 to 11 years (6) and, as in my own experience, could be up to 35 years in some patients.

This phenomenon is also true in children and even newborns and infants with cardiac defects and heart failure, which prohibits life and growth.

However, since the resources of transplant are scarce, heart transplantation has remained a rare gift to a few, thus creating an enormous injustice and ethical dilemma.

Older patients who have the highest rate of heart failure are generally excluded from such a gift not only because of inferior success but because of ethical considerations as well. Likewise, children may be brought to adolescence with a transplant who, eventually would need a re-transplant, which would be denied to a dying child waiting for his first. This is an unsolvable dilemma.

Therefore, it has been the steady attempt of scientists to develop mechanical devices to support or to replace the terminally sick heart in lieu of a transplant.

Since the first clinical attempts of a permanent total artificial heart replacement ended in disasters, this field has faced general objections. It was only when such mechanical circulatory support systems, mostly ventricular assist devices, were used to keep a candidate for heart transplantation alive to be bridged to a later transplant that this concept gained wide acceptance. Bridge to transplant has eventually become the goal in the1990s and 2000s. Currently, there are increasing number of patients needing such an assist device, but only a few of them can enjoy a transplant; in fact, the remainder become a permanent assist device bearers.

Such devices are now even implanted in patients who cannot have a transplant, in general, because they are too old.

The mechanical device industries have gone around a circle by advocating devices designed for permanent use, as initially intended for in the beginning. This is quite justified, since the risk to the patient, which initially was quite substantial, has been brought down to an acceptable rate. Further improvements are on the way.

In children, this task has been taken over by extracorporeal pneumatically driven pulsatile pumps, as we have first demonstrated (7), which are miniaturization of the first generation of assist devices. They function quite well; however, they definitely limit the quality of life.

When these children grow, the devices must be exchanged to a larger size system, and eventually if they are still not transplanted, they must receive an adult implantable pump.

Hitherto all attempts to develop alternative implantable systems have failed and there is no other system in sight.

Gratifyingly, it has been observed that a certain number of children, mostly those with fulminant myocarditis, may show complete cardiac recovery within surprisingly a short time on VAD support which then can be explanted.

We have made this observation in adults with chronic dilated cardiomyopathy. We were the first to explant such a device after 5 months on a VAD support in 1995 (8). Our own experience now included more than 100 such recovery cases, however, we have not found decisive criteria in which patients such recovery can be expected and whether the heart will remain stable after recovery and explanation. Convincing studies showing the amount of fibrosis again maybe helpful to answer these questions.

The secrets of regenerations of heart muscle activity was also tackled by the concept of stem cell infusion or cell implantations to restore or replace the cardiomyocytes by cells in their earlier development phases of various origins. It was hoped to be a revolutionary tool to augment the armamentarium in heart failure therapy. Until now, it has not fulfilled its promise and is not even close to clinical success (9).

Parallel to the development of long-term implantable VADs, short-term systems were developed, some on the basis of conventional heart-lung-machine design, so-called extracorporeal membrane oxygenation (ECMO). These concepts have been refined, and in experienced hands, can be used to support patients with acute heart failure, even outside the hospital and for the eventual transport to a surgical heart failure centre. These systems are likewise capable of circulatory support to gain time to assess whether shock-stricken organism and its various organs may recover. When this happens, then a more sophisticated long-term VAD can be implanted with good outcome.

Finally, the total artificial heart has now seen a renaissance with the CARMAT TAH developed by Carpentier in France. Up to now, it was only used successfully as a bridge to transplant first by Yuriy Pya, with the well-functioning device for 243 days until transplant was made possible.

Long-term application is the ultimate goal. We must anticipate results from further investigations and increasing experience for any late complications.

In summary, we witness an exciting medium-term state of overall development of long-term devices and concepts of recovery where new insights are needed and some day they will materialize.

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