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Syllabus: care of end-stage heart failure-from drugs to devices

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The American Heart Association annually updates and publishes statistics on heart diseases and stroke. According to that source, heart failure is highly prevalent with 6.5 million adults currently being affected in the U.S, and one million new cases every year. One in eight death certificates list heart failure as one of the diagnoses. Risk factors include hypertensive disease, coronary artery disease, diabetes, obesity, smoking, and low socioeconomic status. Predictions are that the prevalence of heart failure will increase by 46% by the year 2030. Even though survival is improved, currently 50% of patients die within five years of heart failure diagnosis. The current total costs for heart failure are over $30 billion U.S., with estimates more than doubling this amount by 2030.

Heart failure is typically classified based on the underlying function. Primarily systolic heart failure also termed heart failure with reduced ejection fraction (HFrEF), and those patients with heart failure symptoms from diastolic dysfunction and preserved systolic function (HFpEF). While there are effective treatment options available for HFrEF, HFpEF is still associated with a poor prognosis and few treatment options are available. In order to advance research and new treatment strategies a new class of heart failure patients, heart failure with midrange EF has been defined (HFmEF, EF 40-49%).

Treatment options for HFrEF are well established and are escalated based on the severity of symptoms. Starting with preventive measures such as risk factor reduction, and advancing to treatment of underlying conditions such as hypertensive disease, dietary restrictions, to more invasive measures such as cardiac resynchronization in eligible patients, ventricular assist device support, heart transplantation, and finally supportive care. Basically all guidelines have in common that the most effective treatment includes a multidisciplinary specialized heart failure team defining individualized guideline driven care plans for an individual diagnosed with heart failure.

The cornerstones of pharmacological heart failure treatment are still ACE inhibitors, angiotensin receptor blockers, beta-blockers, as well as diuretics and aldosterone receptor antagonists in certain patient populations. However, the most recent guidelines list two newer classes of medications with promising outcomes. The angiotensin receptor-neprilysin inhibitor (valsartan/sacubitril) that opposes the upregulated RAAS, and the sinoatrial node modulator ivabradine with effects similar to beta-blockade. Valsartan/sacubitril is now indicated for patients who are symptomatic on ACE or ARBs, and scaubitril in symptomatic HF patients on beta-blockers with a heart rate of > 70 bpm. Additional recent guideline updates include the use of biomarkers such as natriuretic peptides for goal directed medical therapy, and notably the adoption of new goals for hypertension treatment to a blood pressure lower than 130/80 mmHg.

Unfortunately in patients with HFpEF still few treatment options exist; mainly the use of diuretics for symptom relieve, treatment of hypertensive disease with above mention goals, and coronary revascularization and treatment of atrial fibrillation in respective patients.

Cardiac resynchronization and prophylactic ICD implantation are additional steps applicable for certain HF patients. More specifically, prophylactic ICD placement is indicated for secondary prevention following an episode of VT/VF, or as primary prevention in symptomatic patients in ischemic or dilated cardiomyopathy with an EF < 35% despite optimal medical treatment. Cardiac resynchronization is indicated in symptomatic HF patients with a QRS > 130 ms and EF < 35%, or a high degree block requiring pacing.

Clinical signs of advanced or end-stage heart failure include frequent hospitalizations, reduced exercise stress testing values,

inotrope or medication intolerance, end-organ dysfunction, cardiac frailty, and elevated biomarkers (i.e. BNP).

Once favored for short term support in acute exacerbation or new onset of HF, the use of intra-aortic balloon pump cardiovascular support is currently decreasing. Results from prospective studies failed to show improved outcomes in patients with cardiogenic shock, and peripherally inserted short-term ventricular assist devices are showing more promising outcome results.

The use of VADs had steadily increased over the last 10 years, and leveled off in 2014. Current indications are as a rescue therapy, bridge to recovery (rare), bridge to transplant, bridge to candidacy (for transplant), and destination therapy (increasing). Basically all currently used devices are continuous flow (axial or centrifugal) devices, with ongoing miniaturization and improvements in risk reduction for thrombembolic events. The INTERMACS registry published their 8th annual update in 2017, showing 1-year survival rates of 80%, 2-year survival 70% for LVADs, 30% underwent heart transplantation within one year. However, more and more patients are receiving VADs for destination therapy with improving long-term outcomes.

A promising new rapidly evolving field is goal directed individualized HF therapy based on biosensor feedback. Biosensors are either specifically implanted for HF monitoring, for example the CardioMEMS system. Others use already implanted devices such as ICDs and derive physiological data from device specific sensors. All have in common that data can be monitored remotely, and therapy devised accordingly. Algorithms based on various biosensor modalities are being developed that provide an early warning for imminent heart failure exacerbation, possible allowing for early intervention, thus reducing hospitalizations, morbidity, and possibly even mortality.