- 50% versterben in 5 Jahren
- 24 000 Hospitalisierungen/a
- 2% Bevölkerung
- 10% bei über 70-Jährigen
- 30 Tage-Mortalität bei Hospitalisierung 10%
- 2016 186 Pat. mit HptDg Herzinsuffizienz
- PubMed 2,2 Millionen Publikationen

- 350 Millionen Euro/Jahr (3% G-Budget)


Fly
Emirates

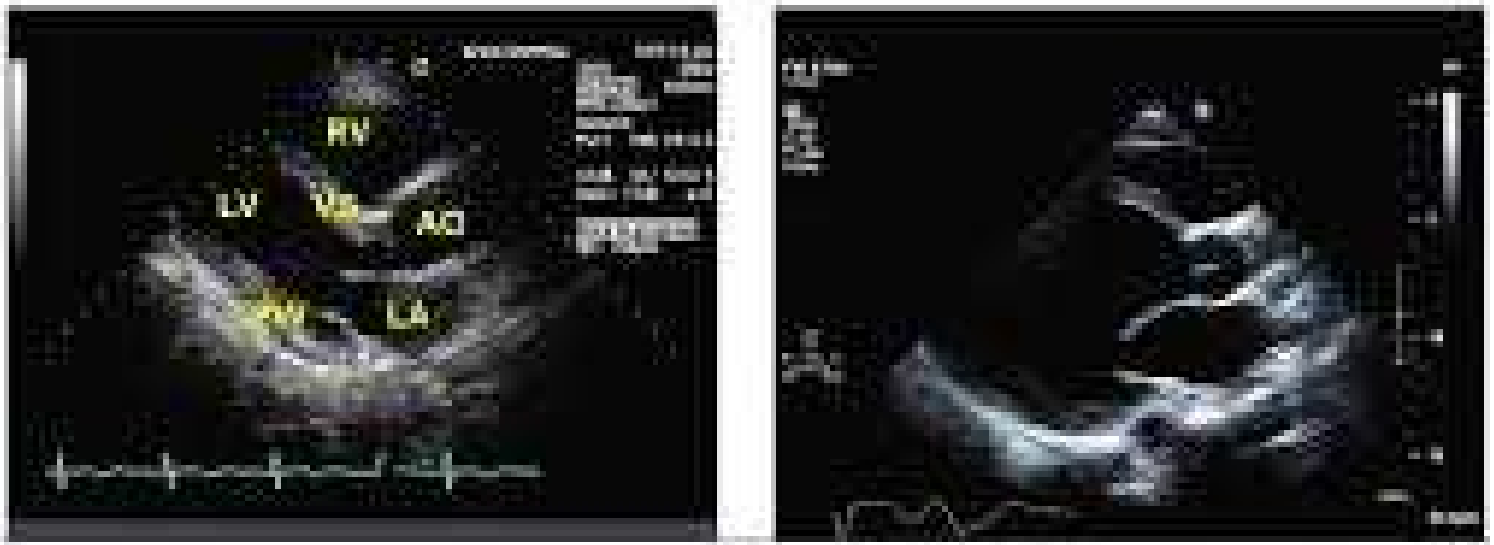

DEMBÉLÉ
7

Herzinsuffizienz

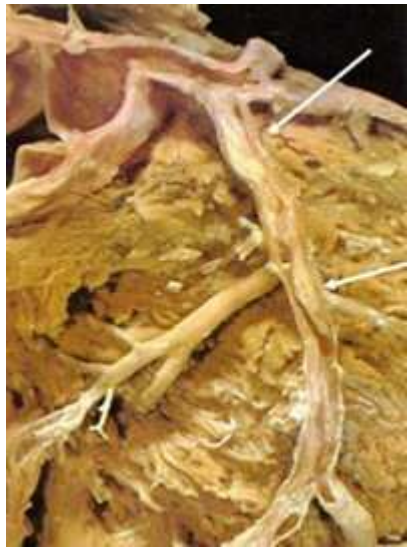
Symptomenkomplex durch strukturelle u/o funktionelle Abnormität des Herzens

Chron. Herzinsuffizienz

- HFrEF < 40%
- HFpEF > 50%
- HFmrEF 40-49%


RV
LV
AO
LA

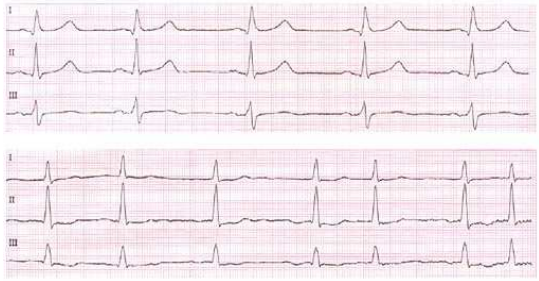
Ätiologie



- KHK
- Hypertonie
- Diabetes mellitus
- Virusinfektionen
- Alkohol
- Chemotherapie
- Tachyarrhytmien
- Klappenerkrankungen
- genetisch

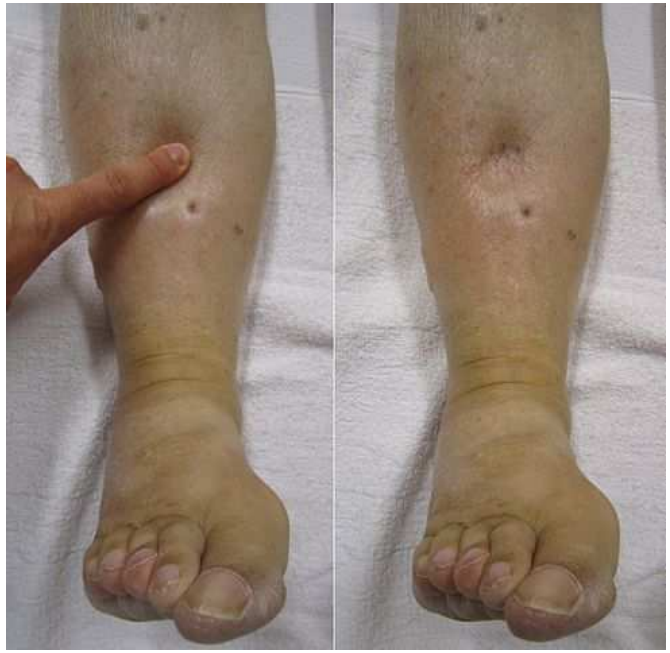
Diagnostik

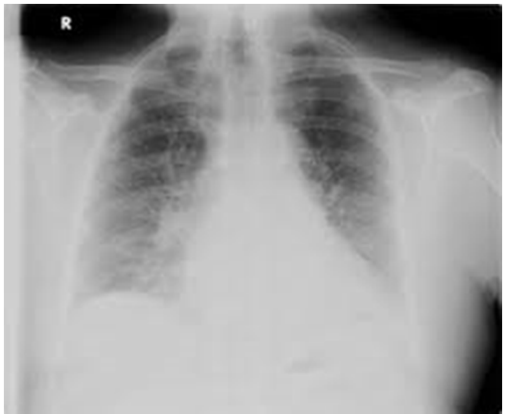
- Anamnese, klin. Status, EKG
- NT-proBNP
- Echokardiographie
- DD: Rö, CT, Labor, MR …….



Symptome der kongestiven Herzinsuffizienz

Leistungsknick
Belastungs-Dyspnoe
Orthopnoe
Paroxysmale nächtliche Dyspnoe
Ödeme
Palpitationen
Präsynkope/Synkope
Embolische Ereignisse





BNP-Erhöhung

•Nicht-kardiale Ursachen:

- Anämie
- Hyperthyreose
- Leberinsuffizienz
- Lungenembolie
- Neurologische Erkrankungen (z.B. Subarachnoidalblutung (SAB), intrazerebrale Blutung)
- Niereninsuffizienz
- Pulmonale Hypertonie
- Physiologisch bei körperlichen Belastung (Erhöhung ca. 1 h)

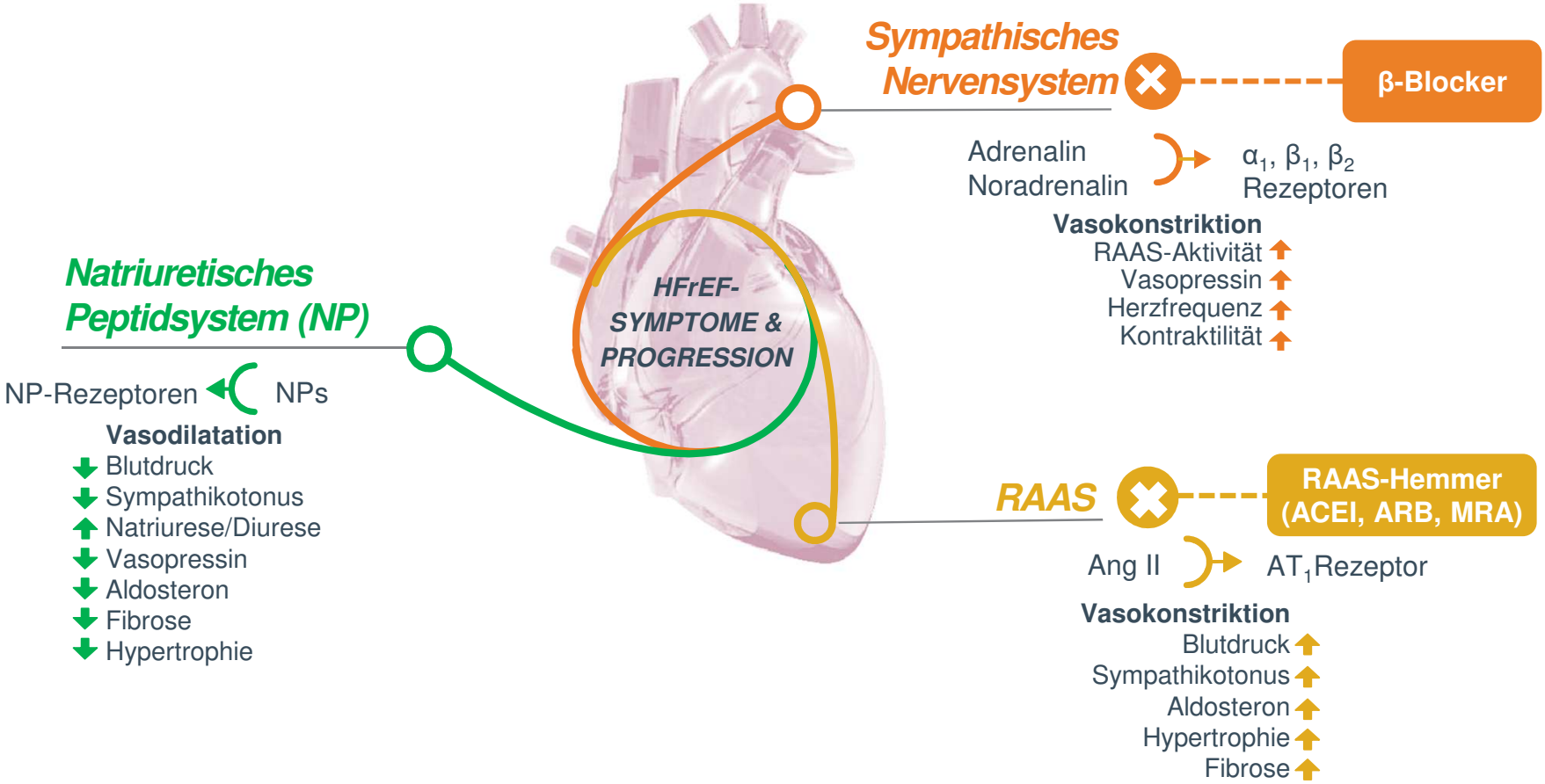

OBEN FEHLT DIE LUFT UND UNTEN SCHWELLEN DIE BEINE AN!
KLINGT, ALS WÜRDE DIE PUMPE FALSCH RUM LAUFEN!

Therapie

- HFrEF: Therapie gesichert
- HFpEF: Grunderkrankung, Training
- HFmrEF: ??

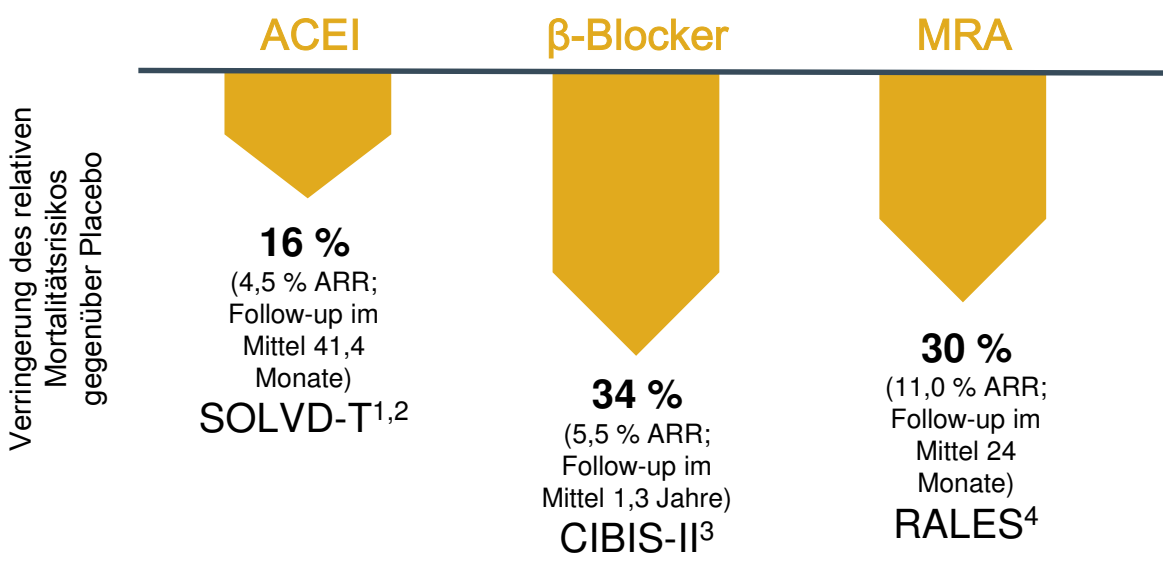
8 Wege zur Mortalitätsreduktion

- ACE-Hemmer/ARB
- Betablocker
- Aldosteronantagonisten
- ARNI(Neprilysin-Inhibitior/ARB)
- CRT
- ICD
- VAD
- HTX


Sympathisches Nervensystem
β-Blocker
Adrenalin
Noradrenalin
α1, β1, β2 Rezeptoren
Vasokonstriktion
RAAS-Aktivität
Vasopressin
Herzfrequenz
Kontraktilität
HFrEF-SYMPTOME & PROGRESSION
Natriuretisches Peptidsystem (NP)
NP-Rezeptoren
NPs
Vasodilatation
Blutdruck
Sympathikotonus
Natriurese/Diurese
Vasopressin
Aldosteron
Fibrose
Hypertrophie
RAAS
RAAS-Hemmer (ACEI, ARB, MRA)
Ang II
AT1Rezeptor
Vasokonstriktion
Blutdruck
Sympathikotonus
Aldosteron
Hypertrophie
Fibrose

Treatment, trial, year published	Population	AIM	Active drug	Comparator	n	Primary endpoint	Relative risk reduction in primary endpoint	Trial conclusion
CONSENSUS (1987)	NYHA IV	ACE inhibitor in severe heart failure	Enalapril 2x10-(20) mg/d	Placebo	253	Total mortality	40%	Mortality little reduced with high-dose ACE inhibitor
SOLVD (1991) Treatment	LVEF<35%, NYHA II-IV	ACE inhibitor in symptomatic systolic heart failure	Enalapril 2x10mg/d	Placebo	2569	Total mortality	16%	ACE inhibitor lowered mortality
SOLVD (1992) Prevention	Asymptomatic left-ventricular systolic dysfunction (LVEF<35%)	ACE Inhibitor in asymptomatic left ventricular dysfunction	Enalapril 2x10mg/d	Placebo	4228	Total mortality, cardiovascular mortality	8% / 12%	ACE inhibitor lowered new heart failure development and non-significantly reduced mortality
ATLAS (1999)	LVEF≤30%, NYHA II-IV	High-dose vs low-dose ACE inhibitor in systolic heart failure	Lisinopril 2.5-5.0mg/d	Lisinopril 32.5-35mg/d	3164	Total mortality / total mortality and NEP	8% / 12%	Mortality little reduced with high-dose ACE inhibitor
HOPE (2000)	Previous and at high risk for CVD	ACE Inhibitor in CVD prevention	Ramipril	Placebo	9297	Myocardial infarction, stroke, cardiovascular death	22%	ACE inhibitor lowered new heart failure development

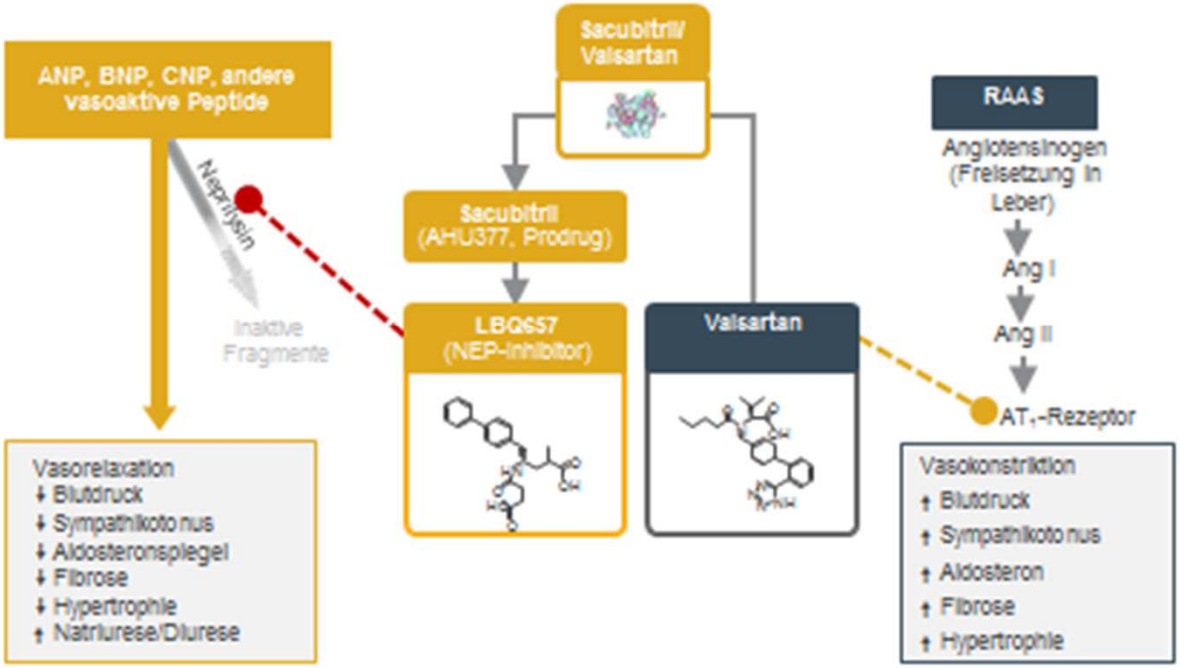
Recommendations	Class [a]	Level [b]	Ref [c]
An ACE-I[d] is recommended, in addition to a beta-blocker, for symptomatic patients with HFrEF to reduce the risk of HF hospitalization and death.	I	A	2, 163 –165
A beta-blocker is recommended, in addition an ACE-I[d], for patients with stable, symptomatic HFrEF to reduce the risk of HF hospitalization and death.	I	A	167– 173
An MRA is recommended for patients with HFrEF, who remain symptomatic despite treatment with an ACE-I[d] and a beta-blocker, to reduce the risk of HF hospitalization and death.	I	A	174, 175


Verringerung des relativen Mortalitätsrisikos gegenüber Placebo
ACEI
β-Blocker
MRA
16 %
(4,5 % ARR; Follow-up im Mittel 41,4 Monate)
SOLVD-T[1,2]
34 %
(5,5 % ARR; Follow-up im Mittel 1,3 Jahre)
CIBIS-II[3]
30 %
(11,0 % ARR; Follow-up im Mittel 24 Monate)
RALES[4]

Entresto®

- Abbau v. NP, BK u. a Peptiden verzögert
- Diurese, Natriurese, Relaxation, Remodeling
- Angiotensin II –Vasokonstriktion-Fibrose

So wirkt Sacubitril/Valsartan



Levin et al. N Engl J Med 1998;339:321–8; Nathisuwan & Talbert. Pharmacotherapy 2002;22:27–42; Schrier & Abraham N Engl J Med 1999;341:577–85; Langenickel & Dole. Drug Discovery Today: Ther Strateg 2012;9:e131–9; Feng et al. Tetrahedron Letters 2012;53:275–6

NOVARTIS PHARMACEUTICALS

Verordnung

- Trotz ACE,BB,MRA symptomatisch
- NT-pro BNP > 600/400 pg/ml
- EF< 35%
- RR> 100 mmHg
- K+ < 5,2 mmol/L
- GFR > 15 ml/min
- ACE-Hemmer 36h vorher absetzen

Dosierung und Titration

Sacubitril/Valsartan:

- Filmtablette, 2x täglich, morgens und abends
- **24/26 mg, 49/51 mg, 97/103 mg Dosis**

- **24/26 mg (2x tgl.):** für RAAS-naive Patienten, oder Patienten auf geringen Dosen von ACE-Hemmer oder ARB
- **49/51 mg (2x tgl.):** Start-Dosis für Patienten auf mittlerer/hoher Dosis von ACE-Hemmer oder ARB
- **97/103 mg (2x tgl.): Zieldosis** für HFrEF-Patienten

- Auftitration jeweils nach 2-4 Wochen, je nach Verträglichkeit

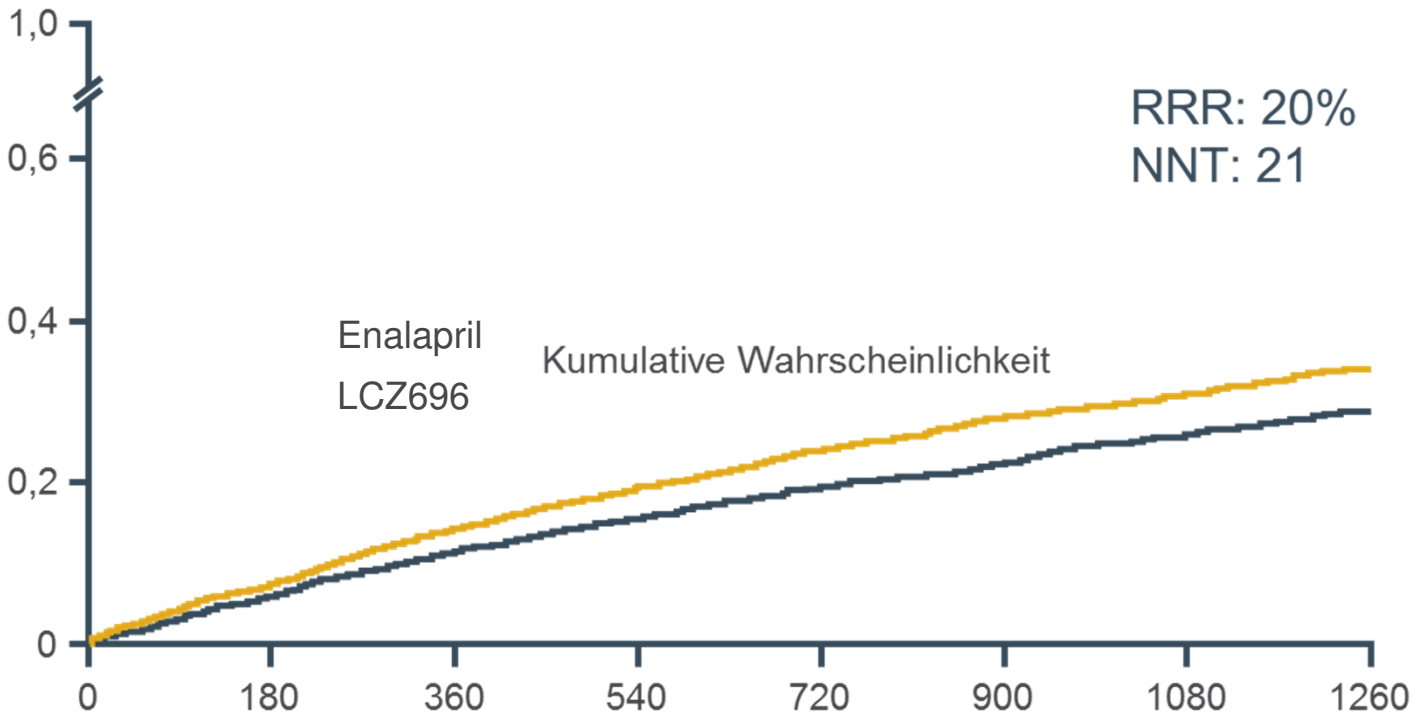
PARADIGM-HF-Studie

- Leistungsfähigkeit
- Lebensqualität
- Hospitalisierung
- Sterberate

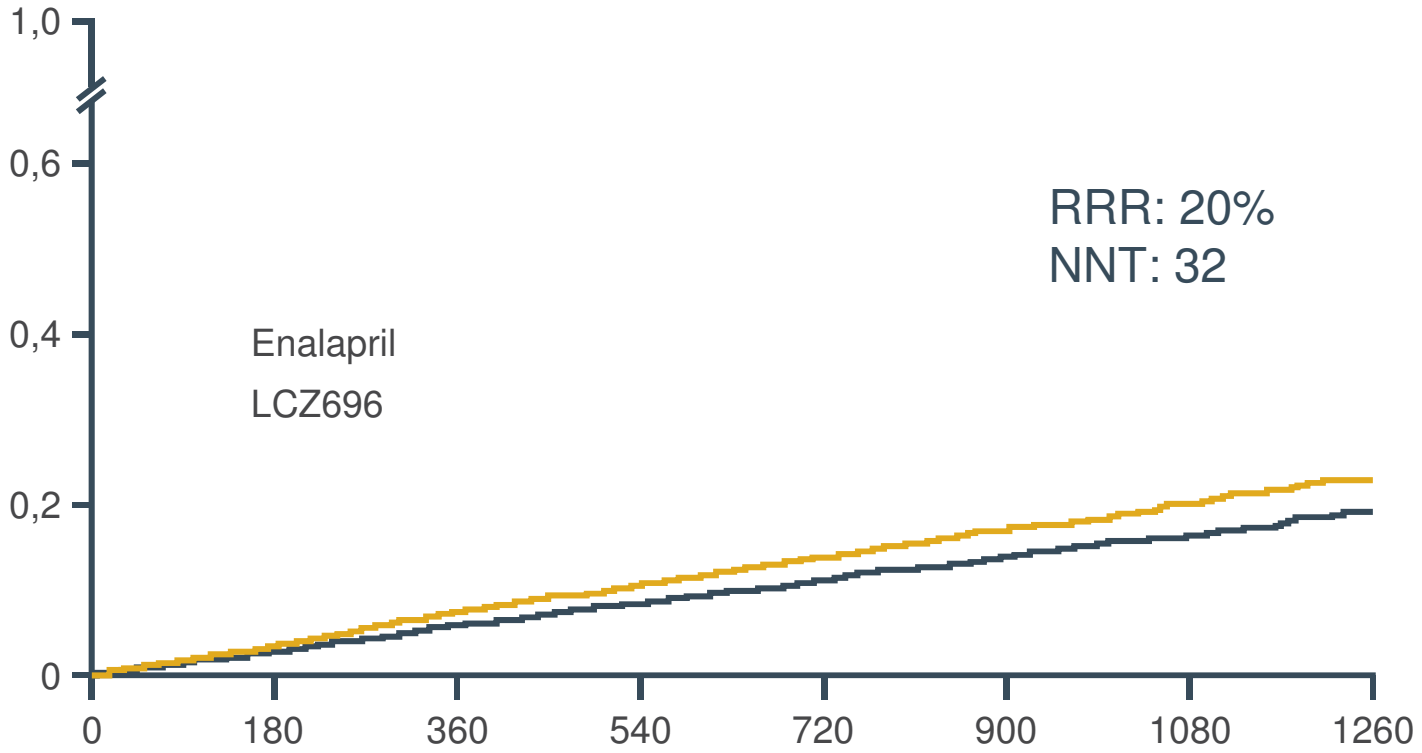
- 20%

- HbA1c,HDL-Chol

Primärer Endpunkt: CV-bedingter Tod oder erste stationäre Aufnahme aufgrund von Herzinsuffizienz



Komponenten des primären Endpunkts: CV-bedingter Tod



Kontraindikationen

- Gleichzeitige ACE-Hemmer Gabe (36h Washout)
- Anamnestisch bekanntes Angioödem im Zusammenhang mit früherer ACE-Hemmer oder ATII-Blocker Therapie
- Hereditäres oder idiopathisches Angioödem
- Schwere Leberinsuffizienz, biliäre Zirrhose oder Cholestase
- Gleichzeitige Anwendung mit aliskirenhaltigen Arzneimitteln bei Patienten mit Diabetes Mellitus oder eGFR < 60 ml/min/1,73 m^2
- 2. und 3. Schwangerschafts-Trimester
- Überempfindlichkeit gegen die Wirkstoffe Sacubitril und Valsartan oder einen der sonstigen Bestandteile

Vorsichtsmaßnahmen bei Hypotonie

- Vorsicht bei SBP < 100 mmHg
- Symptomatische Hypotonie :
  - Dosisanpassung von Diuretika, weiteren antihypertensiven Medikamenten
  - Therapie anderer Ursachen (z.B. Hypovolämie)
  - Dosisreduktion von Sacubitril/Valsartan

- Dosisreduktion, wenn Patient eine Verschlechterung der Nierenfunktion entwickelt
- Vorsicht bei Patienten mit eGFR < 30 ml/min

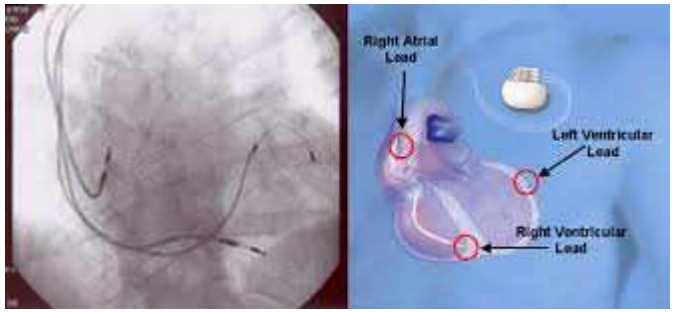
- Hyperkaliämie
  - Anpassung der Begleitarzneimittel oder vorübergehende Dosisreduktion
  - Nicht beginnen bzw. absetzen empfohlen, wenn Kaliumspiegel > 5,4 mmol/l

- Leberfunktionsstörung
  - Vorsicht bei Patienten mit mittelschwerer Leberfunktionsstörung (Child-Pugh B) oder mit AST/ALT Werten > 2x Obergrenze des Normalwertes

Ivabradin

- If-Kanalblocker
- Herzfrequenzsenkung bei SR
- HF> 75/min
- trotz optimaler Therapie symptomatisch
- EF< 35%
- Betablocker(NW,KI)
- Herzinsuff-Hospital. In letzt.12 Monaten

CRT



- QRS > 150 ms u. LSB ja!
- QRS < 130-149 ms u. LSB ja!
- QRS < 130 ms nein!
- QRS > 130 ms und nicht LSB ?
- Vorhofflimmern ???

- HFrEF und PM-Indikation Ja!

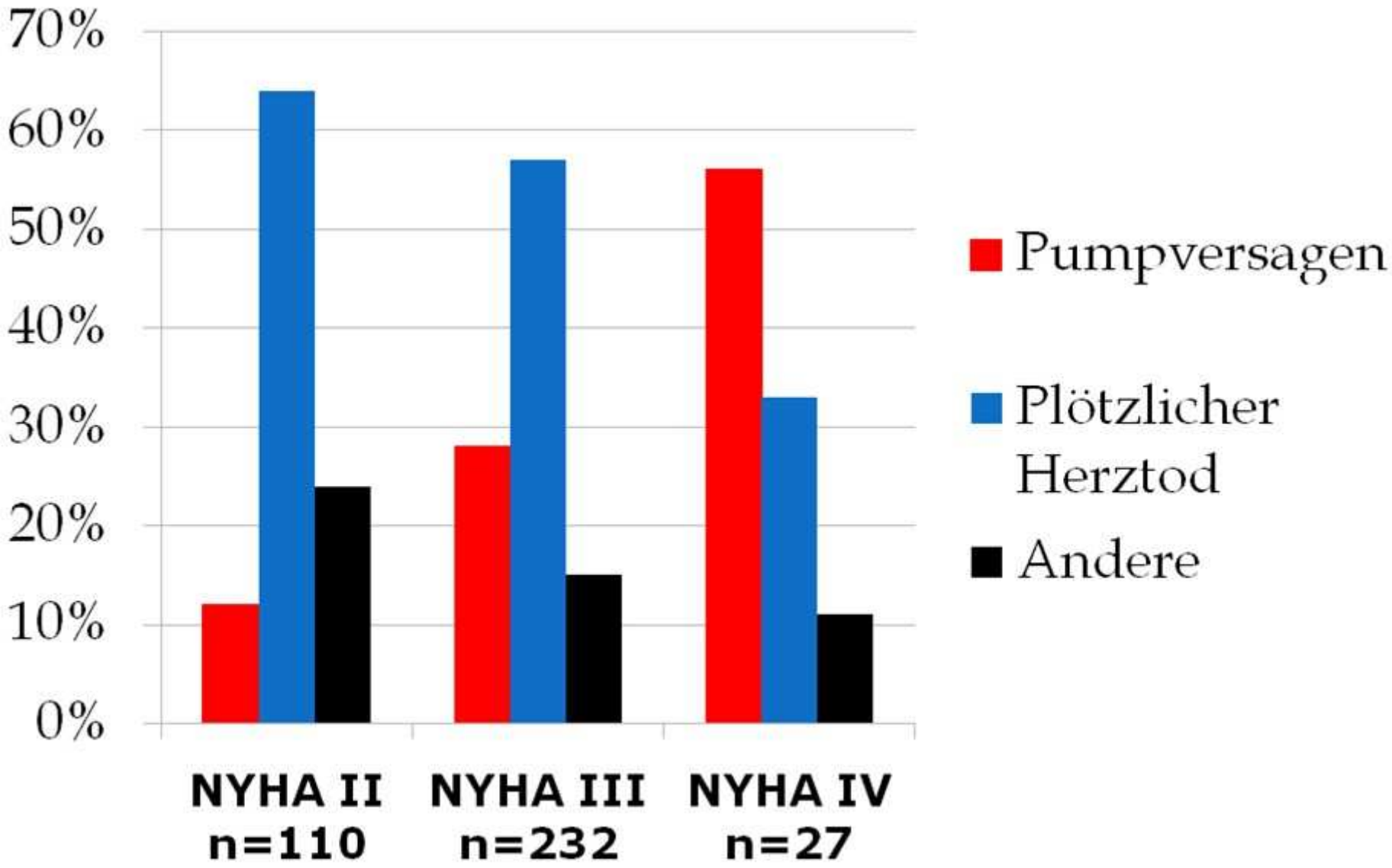
Recommendations	Class[a]	Level[b]	Ref[c]
CRT is recommended for symptomatic patients with HF in sinus rhythm with a QRS duration ≥150 msec and LBBB QRS morphology and with LVEF ≤35% despite OMT in order to improve symptoms and reduce morbidity and mortality.	I	A	261–272
CRT should be considered for symptomatic patients with HF in sinus rhythm with a QRS duration ≥150 msec and non-LBBB QRS morphology and with LVEF ≤35% despite OMT in order to improve symptoms and reduce morbidity and mortality.	IIa	B	261–272
CRT is recommended for symptomatic patients with HF in sinus rhythm with a QRS duration of 130–149 msec and LBBB QRS morphology and with LVEF ≤35% despite OMT in order to improve symptoms and reduce morbidity and mortality.	I	B	266, 273
CRT may be considered for symptomatic patients with HF in sinus rhythm with a QRS duration of 130–149 msec and non-LBBB QRS morphology and with LVEF ≤35% despite OMT in order to improve symptoms and reduce morbidity and mortality.	IIb	B	266, 273
CRT rather than RV pacing is recommended for patients with HFrEF regardless of NYHA class who have an indication for ventricular pacing and high degree AV block in order to reduce morbidity. This includes patients with AF (see Section 10.1).	I	A	274–277
CRT should be considered for patients with LVEF ≤35% in NYHA Class III–IV[n] despite OMT in order to improve symptoms and reduce morbidity and mortality, if they are in AF and have a QRS duration ≥130 msec provided a strategy to ensure bi-ventricular capture is in place or the patient is expected to return to sinus rhythm.	IIa	B	275, 278–281
Patients with HFrEF who have received a conventional pacemaker or an ICD and subsequently develop worsening HF despite OMT and who have a high proportion of RV pacing may be considered for upgrade to CRT. This does not apply to patients with stable HF.	IIb	B	282
CRT is contra-indicated in patients with a QRS duration < 130 msec.	III	A	266, 283–285

Weitere Therapieformen

- Digitalis ??
- Nitrate ??
- Diuretika zur Besserung der Symptome
- Barorezeptorstimulation
- ICD
- HTX
- Disease-Management-Programme

Recommendations	Class[a]	Level[b]	Ref[c]
Diuretics			
Diuretics are recommended in order to improve symptoms and exercise capacity in patients with signs and/or symptoms of congestion.	I	B	178, 179
Diuretics should be considered to reduce the risk of HF hospitalization in patients with signs and/or symptoms of congestion.	IIa	B	178, 179
Angiotensin receptor neprilysin inhibitor			
Sacubitril/valsartan is recommended as a replacement for an ACE-I to further reduce the risk of HF hospitalization and death in ambulatory patients with HFrEF who remain symptomatic despite optimal treatment with an ACE-I, a beta-blocker and an MRA[f]	I	B	162
If-channel inhibitor			
Ivabradine should be considered to reduce the risk of HF hospitalization or cardiovascular death in symptomatic patients with LVEF ≤35%, in sinus rhythm and a resting heart rate ≥70 bpm despite treatment with an evidence-based dose of beta-blocker (or maximum tolerated dose below that), ACE-I (or ARB), and an MRA (or ARB).	IIa	B	180
Ivabradine should be considered to reduce the risk of HF hospitalization and cardiovascular death in symptomatic patients with LVEF ≤35%, in sinus rhythm and a resting heart rate ≥70 bpm who are unable to tolerate or have contra-indications for a beta-blocker. Patients should also receive an ACE-I (or ARB) and an MRA (or ARB).	IIa	C	181
ARB			
An ARB is recommended to reduce the risk of HF hospitalization and cardiovascular death in symptomatic patients unable to tolerate an ACE-I (patients should also receive a beta-blocker and an MRA).	I	B	182
An ARB may be considered to reduce the risk of HF hospitalization and death in patients who are symptomatic despite treatment with a beta-blocker who are unable to tolerate an MRA.	IIb	C	-
Hydralazine and isosorbide dinitrate			
Hydralazine and isosorbide dinitrate should be considered in self-identified black patients with LVEF ≤35% or with an LVEF <45% combined with a dilated LV in NYHA Class III–IV despite treatment with an ACE-I a beta-blocker and an MRA to reduce the risk of HF hospitalization and death.	IIa	B	183
Hydralazine and isosorbide dinitrate may be considered in symptomatic patients with HFrEF who can tolerate neither an ACE-I nor an ARB (or they are contra-indicated) to reduce the risk of death.	IIb	B	184
Other treatments with less-certain benefits			
Digoxin			
Digoxin may be considered in symptomatic patients in sinus rhythm despite treatment with an ACE-I (or ARB), a beta-blocker and an MRA, to reduce the risk of hospitalization (both all-cause and HF-hospitalizations).	IIb	B	185
N-3 PUFA			
An n-3 PUFA[e] preparation may be considered in symptomatic HF patients to reduce the risk of cardiovascular hospitalization and cardiovascular death.	IIb	B	186

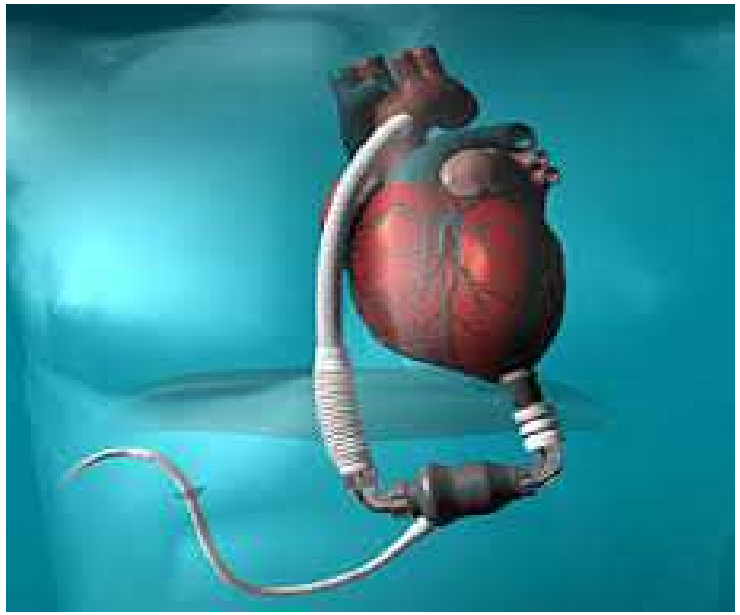
Not-recommended treatments of co-morbidities in patients with heart failure	Class [a]	Level [b]
Adaptive servo-ventilation is not recommended in patients with HFrEF and a predominant central sleep apnoea because of an increased all-cause and cardiovascular mortality.	III	B
Thiazolidinediones (glitazones) are not recommended in patients with HF, as they increase the risk of HF worsening and HF hospitalization.	III	A
NSAIDs or COX-2 inhibitors are not recommended in patients with HF, as they increase the risk of HF worsening and HF hospitalization.	III	B
Recommendations regarding diagnostic measurements in patients with suspected acute heart failure	**Class [a]**	**Level [b]**
Upon presentation a measurement of plasma natriuretic peptide level (BNP, NT-proBNP or MR-proANP) is recommended in all patients with acute dyspnoea and suspected AHF to help in the differentiation of AHF from non-cardiac causes of acute dyspnoea.	I	A
Recommendations for the management of patients with acute heart failure – pharmacotherapy	**Class [a]**	**Level [b]**
Intravenous loop diuretics are recommended for all patients with AHF admitted with signs/symptoms of fluid overload to improve symptoms. It is recommended to regularly monitor symptoms, urine output, renal function and electrolytes during use of i.v. diuretics.	I	C
In patients with new-onset AHF or those with chronic, decompensated HF not receiving oral diuretics the initial recommended dose should be 20–40 mg i.v. furosemide (or equivalent); for those on chronic diuretic therapy, initial i.v. dose should be at least equivalent to oral dose.	I	B
It is recommended to give diuretics either as intermittent boluses or a continuous infusion, and the dose and duration should be adjusted according to the patients' symptoms and clinical status.	I	B
Inotropic agents are not recommended unless the patient is symptomatically hypotensive or hypoperfused because of safety concern.	III	A
Recommendations regarding management of patients with cardiogenic shock	**Class [a]**	**Level [b]**
In all patients with suspected cardiogenic shock, immediate ECG and echocardiography are recommended.	I	C
All patients with cardiogenic shock should be rapidly transferred to a tertiary care centre which has a 24/7 service of cardiac catheterization, and a dedicated ICU/CCU with availability of short-term mechanical circulatory support.	I	C
Recommendations regarding oral evidence-based disease-modifying therapies in patients with acute heart failure	**Class [a]**	**Level [b]**
In case of worsening of chronic HFrEF, every attempt should be made to continue evidence-based, disease-modifying therapies, in the absence of haemodynamic instability or contra-indications.	I	C
Recommendations for exercise, multidisciplinary management, and monitoring of patients with heart failure	**Class [a]**	**Level [b]**
It is recommended that regular aerobic exercise is encouraged in patients with HF to improve functional capacity and symptoms.	I	A
It is recommended that regular aerobic exercise is encouraged in stable patients with HFrEF to reduce the risk of HF hospitalization.	I	A
It is recommended that patients with HF are enrolled in a multidisciplinary care management programme to reduce the risk of HF hospitalization and mortality.	I	A


70%
60%
50%
40%
30%
20%
10%
0%
NYHA II
n=110
NYHA III
n=232
NYHA IV
n=27
Pumpversagen
Plötzlicher Herztod
Andere

Recommendations	Class[a]	Level[b]	Ref[c]
Secondary prevention An ICD is recommended to reduce the risk of sudden death and all-cause mortality in patients who have recovered from a ventricular arrhythmia causing haemodynamic instability, and who are expected to survive for >1 year with good functional status.	I	A	223–226
Primary prevention An ICD is recommended to reduce the risk of sudden death and all-cause mortality in patients with symptomatic HF (NYHA Class II–III), and an LVEF ≤35% despite ≥3 months of OMT, provided they are expected to survive substantially longer than one year with good functional status, and they have:			
• IHD (unless they have had an MI in the prior 40 days – see below).	I	A	149, 156, 227
• DCM.	I	B	156, 157, 227
ICD implantation is not recommended within 40 days of an MI as implantation at this time does not improve prognosis.	III	A	158, 228
ICD therapy is not recommended in patients in NYHA Class IV with severe symptoms refractory to pharmacological therapy unless they are candidates for CRT, a ventricular assist device, or cardiac transplantation.	III	C	229–233
Patients should be carefully evaluated by an experienced cardiologist before generator replacement, because management goals and the patient's needs and clinical status may have changed.	IIa	B	234–238
A wearable ICD may be considered for patients with HF who are at risk of sudden cardiac death for a limited period or as a bridge to an implanted device.	IIb	C	239–241

Komorbiditäten

- **Schlafapnoe**: keine ASV bei zentraler
- **Eisenmangel**: bei Ferritin < 100 yg/l
  o. TFS < 20%
- **Anämie**: Epo nein
- **DM**: Metformin, SGLT2-Hemmer ja
  Glitazone nein, DPP4Hemmer ?
- **COPD**: kardioselektive B-Blocker ja

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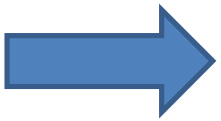


Recommendations	Class [a]	Level [b]	Ref [c]
Potential aggravating/precipitating factors (e.g. low serum potassium/ magnesium, ongoing ischaemia) should be sought and corrected in patients with ventricular arrhythmias.	IIa	C	
Treatment with beta-blocker, MRA and sacubitril/valsartan reduces the risk of sudden death and is recommended for patients with HFrEF and ventricular arrhythmias (as for other patients)(see Section 7).	I	A	162, 170–175
Implantation of an ICD or CRT-D device is recommended for selected patients with HFrEF (see Section 8).	I	A	223–226, 388
Several strategies should be considered to reduce recurrent symptomatic arrhythmias in patients with an ICD (or in those who are not eligible for ICD), including attention to risk factors and optimal pharmacological treatment of HF, amiodarone, catheter ablation and CRT.	IIa	C	
Routine use of antiarrhythmic agents is not recommended in patients with HF and asymptomatic ventricular arrhythmias because of safety concerns (worsening HF, proarrhythmia, and death).	III	A	247, 248, 364, 365

Was nicht?

Recommendations	Class [a]	Level [b]	Ref [c]
Thiazolidinediones (glitazones) are not recommended in patients with HF, as they increase the risk of HF worsening and HF hospitalization.	III	A	209, 210
NSAIDs or COX-2 inhibitors are not recommended in patients with HF, as they increase the risk of HF worsening and HF hospitalization.	III	B	211–213
Diltiazem or verapamil are not recommended in patients with HFrEF, as they increase the risk of HF worsening and HF hospitalization.	III	C	214
The addition of an ARB (or renin inhibitor) to the combination of an ACE-I and an MRA is not recommended in patients with HF, because of the increased risk of renal dysfunction and hyperkalaemia.	III	C	

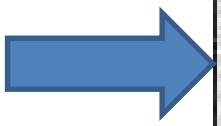
Was nicht ?

Recommendations	Class[a]	Level[b]	Ref[c]
Step 1			
ACE-I (or ARB), a beta-blocker or an MRA (or a combination) is recommended to reduce blood pressure as first-, second- and third-line therapy, respectively, because of their associated benefits in HFrEF (reducing the risk of death and HF hospitalization). They are also safe in HFpEF.	I	A	2, 164, 165, 167, 168, 171–174, 182, 461–463
Step 2			
A thiazide diuretic (or if the patient is being treated with a thiazide diuretic, switching to a loop diuretic) is recommended to reduce blood pressure when hypertension persists despite treatment with a combination of an ACE-I (or alternatively ARB but NOT together withan ACE-I), a beta-blocker and an MRA.	I	C	
Step 3			
Amlodipine or hydralazine is recommended to reduce blood pressure when hypertension persists despite treatment with a combination of an ACE-I (or alternatively ARB but NOT together withan ACE-I), a beta-blocker, an MRA and a diuretic.	I	A	183, 184, 215, 409
Felodipine should be considered to reduce blood pressure when hypertension persists despite treatment with a combination of an ACE-I (or alternatively ARB but NOT together withan ACE-I), a beta-blocker, an MRA and a diuretic.	IIa	B	216
Moxonidine is not recommended to reduce blood pressure because of safety concerns in HFrEF patients (increased mortality).	III	B	460
Alpha-adrenoceptor antagonists are not recommended to reduce blood pressure because of safety concerns in HFrEF patients (neurohormonal activation, fluid retention, worsening HF).	III	A	458, 464, 465
Diltiazem and verapamil are not recommended to reduce blood pressure in patients with HFrEF because of their negative inotropic action and risk of worsening HF.	III	C	214

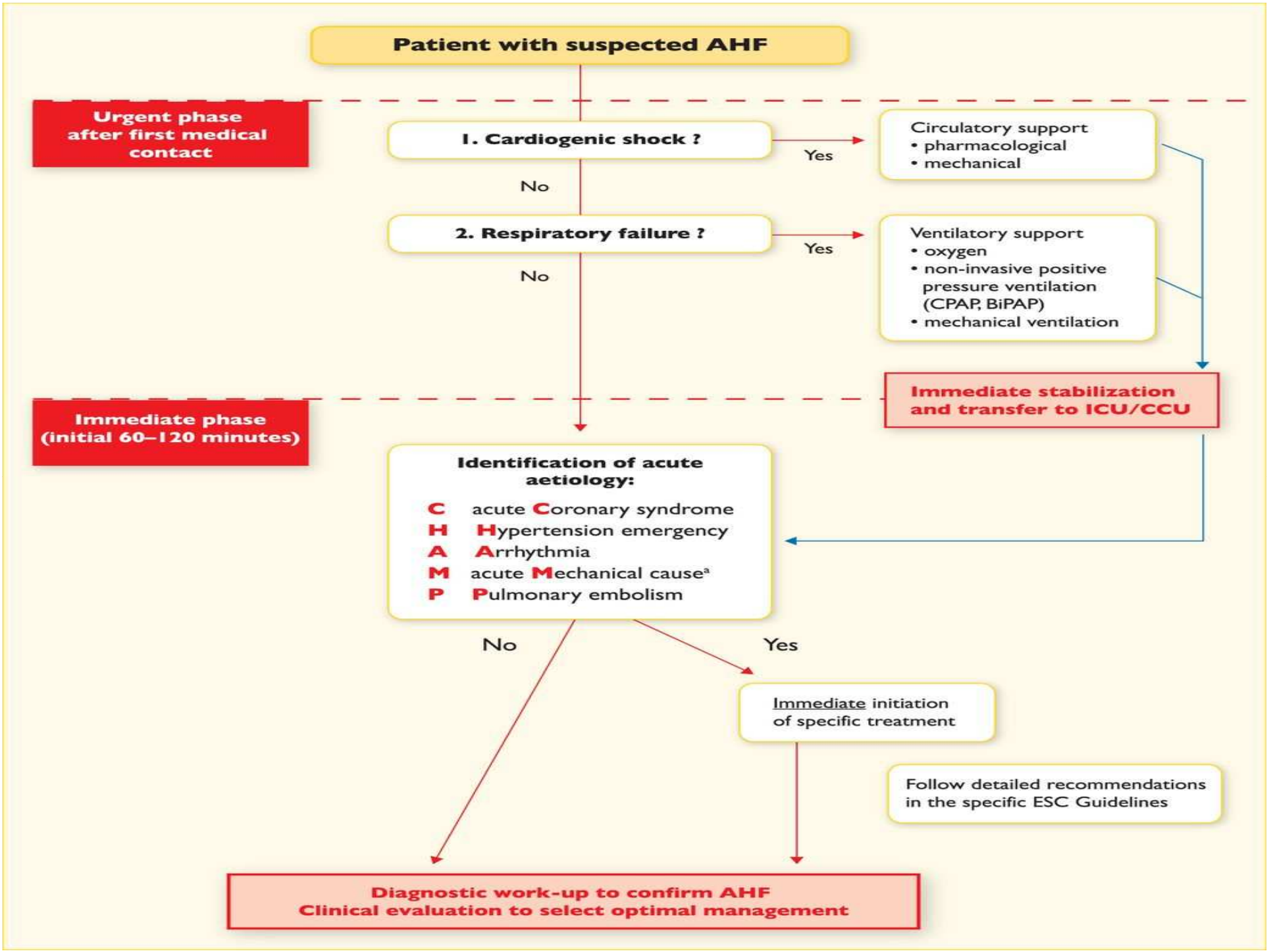

MEIN RECHTES HERZ IST ERWEITERT
SIE HABEN ZWEI?


Vielen Dank!

Recommendations	Class [a]	Level [b]	Ref [c]
it is recommended to screen patients with HFpEF or HFmrEF for both cardiovascular and non-cardiovascular comorbidities, which, if present, should be treated provided safe and effective interventions exist to improve symptoms, well-being and/or prognosis.	I	C	
Diuretics are recommended in congested patients with HFpEF or HFmrEF in order to alleviate symptoms and signs.	I	B	178, 179



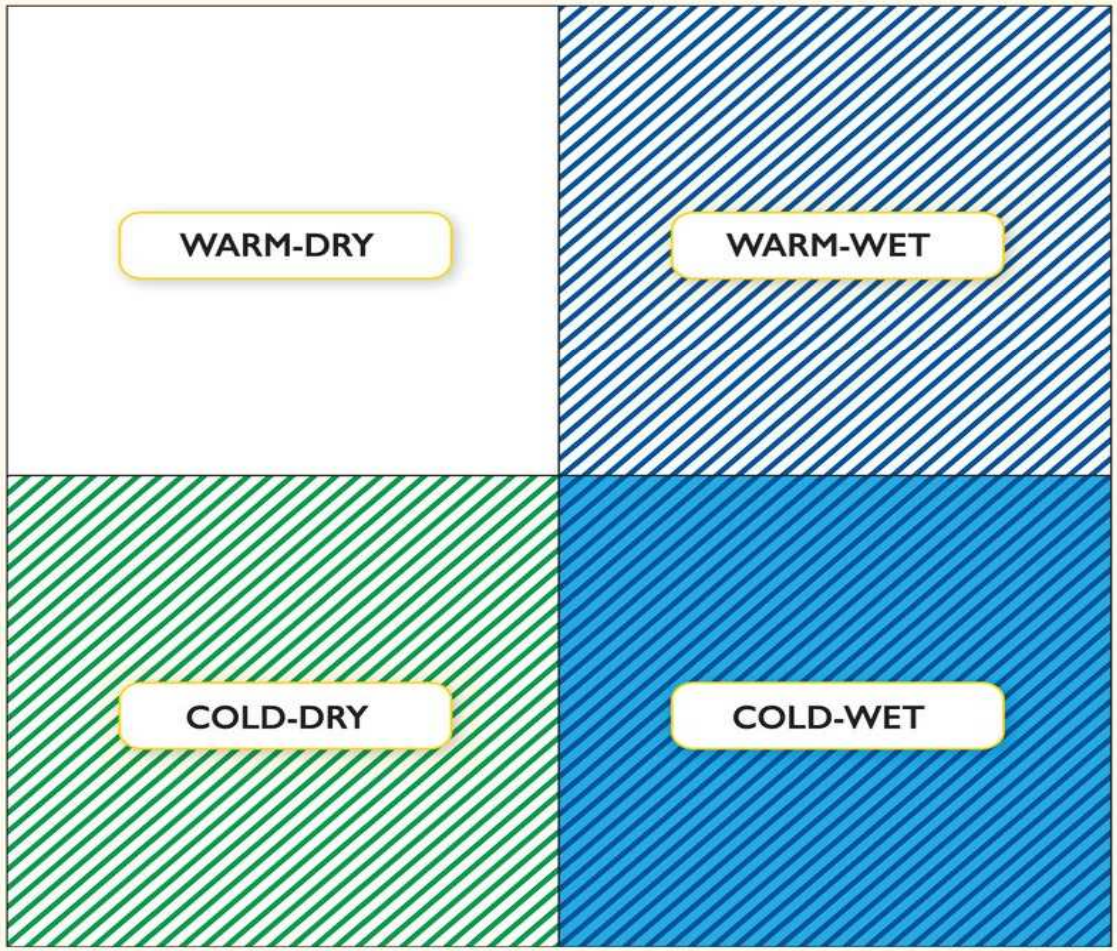
Recommendations	Class [a]	Level [b]	Ref [c]
When pauses >3 seconds are identified on the ECG, or if the bradycardia is symptomatic and the resting ventricular rate is <50 bpm in sinus rhythm or <60 bpm in AF, it should be considered whether there is need for any rate limiting medications prescribed; for patients in sinus rhythm beta-blockers should be reduced in dose or withdrawn only as a last resort.	IIa	C	
For patients with symptomatic, prolonged or frequent pauses despite adjustment of rate limiting medication, either beta-blocker withdrawal or pacing may be considered as the next step.	IIb	C	
Pacing solely to permit initiation or titration of beta-blocker therapy in the absence of a conventional pacing indication is not recommended.	III	C	
In patients with HFrEF who require pacing and who have high degree AV block, CRT rather than RV pacing is recommended.	I	A	274, 275, 290
In patients with HFrEF who require pacing who do not have high degree AV block, pacing modes that avoid inducing or exacerbating ventricular dyssynchrony should be considered.	IIa	C	


Patient with suspected AHF
Urgent phase after first medical contact
1. Cardiogenic shock ?
Yes
Circulatory support
• pharmacological
• mechanical
No
2. Respiratory failure ?
Yes
Ventilatory support
• oxygen
• non-invasive positive pressure ventilation (CPAP, BiPAP)
• mechanical ventilation
No
Immediate stabilization and transfer to ICU/CCU
Immediate phase (initial 60–120 minutes)
Identification of acute aetiology:
C acute Coronary syndrome
H Hypertension emergency
A Arrhythmia
M acute Mechanical cause[a]
P Pulmonary embolism
No
Yes
Immediate initiation of specific treatment
Follow detailed recommendations in the specific ESC Guidelines
Diagnostic work-up to confirm AHF
Clinical evaluation to select optimal management

CONGESTION (-)

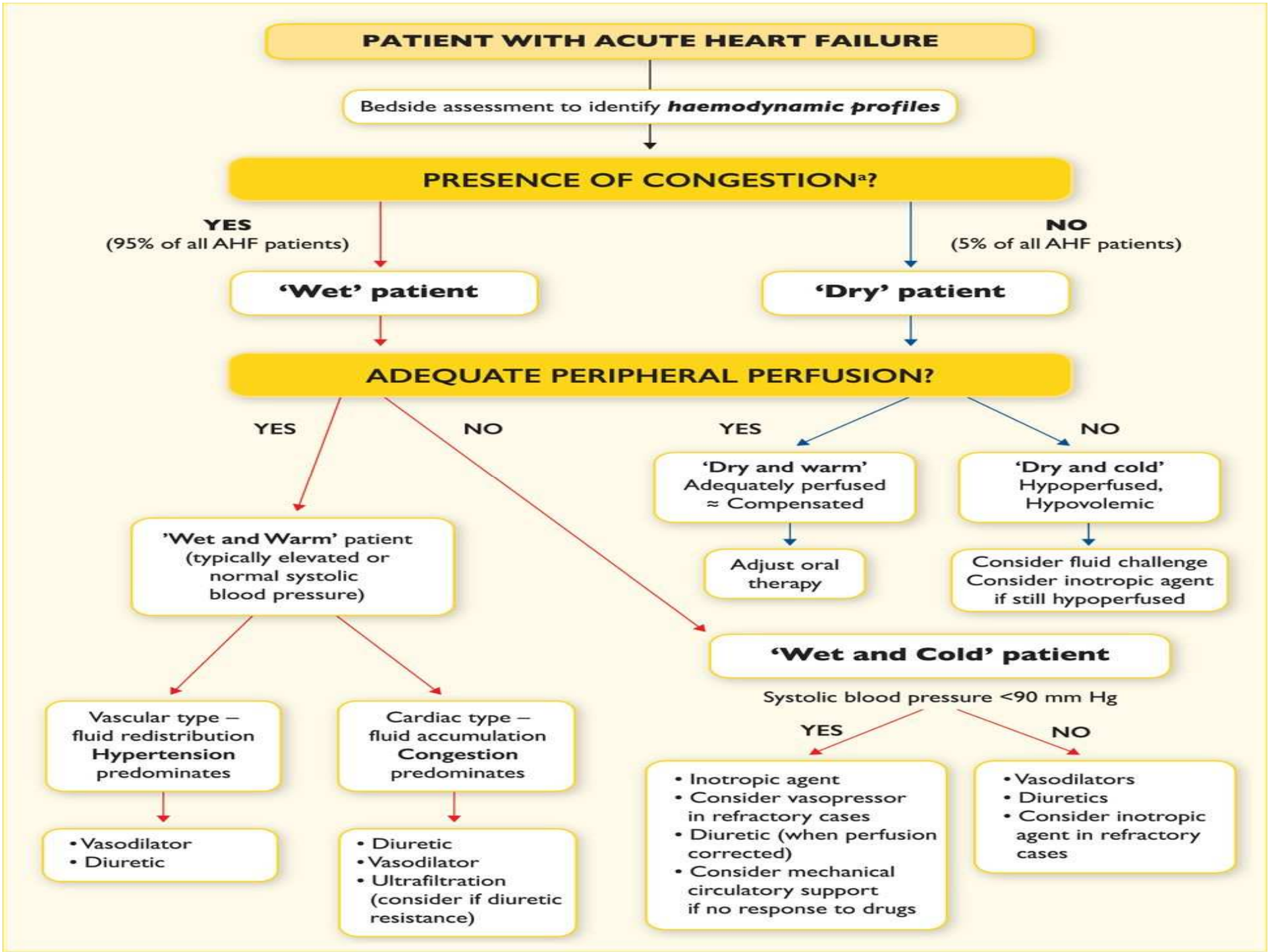
CONGESTION (+)
Pulmonary congestion
Orthopnoea/paroxysmal nocturnal dyspnoea
Peripheral (bilateral) oedema
Jugular venous dilatation
Congested hepatomegaly
Gut congestion, ascites
Hepatojugular reflux

HYPOPERFUSION (-)



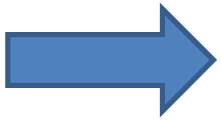
HYPOPERFUSION (+)
Cold sweated extremities
Oliguria
Mental confusion
Dizziness
Narrow pulse pressure

Hypoperfusion is not synonymous with hypotension, but often hypoperfusion is accompanied by hypotension.


PATIENT WITH ACUTE HEART FAILURE
Bedside assessment to identify haemodynamic profiles
PRESENCE OF CONGESTION[a]?
YES
(95% of all AHF patients)
NO
(5% of all AHF patients)
'Wet' patient
'Dry' patient
ADEQUATE PERIPHERAL PERFUSION?
YES
NO
YES
NO
'Dry and warm'
Adequately perfused
≈ Compensated
'Dry and cold'
Hypoperfused,
Hypovolemic
Adjust oral therapy
Consider fluid challenge
Consider inotropic agent
if still hypoperfused
'Wet and Warm' patient
(typically elevated or normal systolic blood pressure)
'Wet and Cold' patient
Systolic blood pressure <90 mm Hg
YES
NO
Vascular type – fluid redistribution
Hypertension predominates
Cardiac type – fluid accumulation
Congestion predominates
• Vasodilator
• Diuretic
• Diuretic
• Vasodilator
• Ultrafiltration (consider if diuretic resistance)
• Inotropic agent
• Consider vasopressor in refractory cases
• Diuretic (when perfusion corrected)
• Consider mechanical circulatory support if no response to drugs
• Vasodilators
• Diuretics
• Consider inotropic agent in refractory cases

Cardiac	Heart failure Acute coronary syndromes Pulmonary embolism Myocarditis Left ventricular hypertrophy Hypertrophic or restrictive cardiomyopathy Valvular heart disease Congenital heart disease Atrial and ventricular tachyarrhythmias Heart contusion Cardioversion, ICD shock Surgical procedures involving the heart Pulmonary hypertension
Non-cardiac	Advanced age Ischaemic stroke Subarachnoid haemorrhage Renal dysfunction Liver dysfunction (mainly liver cirrhosis with ascites) Paraneoplastic syndrome Chronic obstructive pulmonary disease Severe infections (including pneumonia and sepsis) Severe burns Anaemia Severe metabolic and hormone abnormalities (e.g. thyrotoxicosis, diabetic ketosis)

Recommendations	Class[a]	Level[b]	Ref[c]
Monitoring of transcutaneous arterial oxygen saturation (SpO_2) is recommended.	I	C	
Measurement of blood pH and carbon dioxide tension (possibly including lactate) should be considered, especially in patients with acute pulmonary oedema or previous history of COPD using venous blood. In patients with cardiogenic shock arterial blood is preferable.	IIa	C	
Oxygen therapy is recommended in patients with AHF and SpO_2 <90% or PaO_2 <60 mmHg (8.0 kPa) to correct hypoxaemia.	I	C	
Non-invasive positive pressure ventilation (CPAP, BiPAP) should be considered in patients with respiratory distress (respiratory rate >25 breaths/min, SpO_2 <90%) and started as soon as possible in order to decrease respiratory distress and reduce the rate of mechanical endotracheal intubation. Non-invasive positive pressure ventilation can reduce blood pressure and should be used with caution in hypotensive patients. Blood pressure should be monitored regularly when this treatment is used.	IIa	B	541–545
Intubation is recommended, if respiratory failure, leading to hypoxaemia (PaO_2 <60 mmHg (8.0 kPa)), hypercapnia ($PaCO_2$ >50 mmHg (6.65 kPa)) and acidosis (pH <7.35), cannot be managed non-invasively.	I	C	



Recommendations	Class [a]	Level [b]	Ref [c]
Sleep apnoea			
Adaptive servo-ventilation is not recommended in patients with HFrEF and a predominant central sleep apnoea because of an increased all-cause and cardiovascular mortality.	III	B	473
Diabetes			
Thiazolidinediones (glitazones) are not recommended in patients with HF, as they increase the risk of HF worsening and HF hospitalization.	III	A	209, 210
Arthritis			
NSAIDs or COX-2 inhibitors are not recommended in patients with HF, as they increase the risk of HF worsening and HF hospitalization.	III	B	211–213

Recommendations	Class[a]	Level[b]	Ref[c]
Diuretics			
Intravenous loop diuretics are recommended for all patients with AHF admitted with signs/symptoms of fluid overload to improve symptoms. It is recommended to regularly monitor symptoms, urine output, renal function and electrolytes during use of i.v. diuretics.	I	C	
In patients with new-onset AHF or those with chronic, decompensated HF not receiving oral diuretics the initial recommended dose should be 20–40 mg i.v. furosemide (or equivalent); for those on chronic diuretic therapy, initial i.v. dose should be at least equivalent to oral dose.	I	B	540, 548
It is recommended to give diuretics either as intermittent boluses or as a continuous infusion, and the dose and duration should be adjusted according to patients' symptoms and clinical status.	I	B	548
Combination of loop diuretic with either thiazide-type diuretic or spironolactone may be considered in patients with resistant oedema or insufficient symptomatic response.	IIb	C	549
Vasodilators			
i.v. vasodilators should be considered for symptomatic relief in AHF with SBP >90 mmHg (and without symptomatic hypotension). Symptoms and blood pressure should be monitored frequently during administration of i.v. vasodilators.	IIa	B	537, 550–555
In patients with hypertensive AHF, i.v. vasodilators should be considered as initial therapy to improve symptoms and reduce congestion.	IIa	B	537, 551–554
Inotropic agents – dobutamine, dopamine, levosimendan, phosphodiesterase III (PDE III) inhibitors			
Short-term, i.v. infusion of inotropic agents may be considered in patients with hypotension (SBP <90 mmHg) and/or signs/symptoms of hypoperfusion despite adequate filling status, to increase cardiac output, increase blood pressure, improve peripheral perfusion and maintain end-organ function.	IIb	C	
An intravenous infusion of levosimendan or a PDE III inhibitor may be considered to reverse the effect of beta-blockade if beta-blockade is thought to be contributing to hypotension with subsequent hypoperfusion.	IIb	C	
Inotropic agents are not recommended unless the patient is symptomatically hypotensive or hypoperfused because of safety concern.	III	A	556, 557
Vasopressors			
A vasopressor (norepinephrine preferably) may be considered in patients who have cardiogenic shock, despite treatment with another inotrope, to increase blood pressure and vital organ perfusion.	IIb	B	558
It is recommended to monitor ECG and blood pressure when using inotropic agents and vasopressors, as they can cause arrhythmia, myocardial ischaemia, and in the case of levosimendan and PDE III inhibitors also hypotension. In such cases intra-arterial blood pressure measurement may be considered.	I IIb	C C	540, 559–563
Thrombo-embolism prophylaxis			
Thrombo-embolism prophylaxis (e.g. with LMWH) is recommended in patients not already anticoagulated and with no contra-indication to anticoagulation, to reduce the risk of deep venous thrombosis and pulmonary embolism.	I	B	564
Other drugs			
For acute control of the ventricular rate in patients with atrial fibrillation: a. digoxin and/or beta-blockers should be considered as the first-line therapy.[d] b. amiodarone may be considered.	IIa IIb	C B	565–567
Opiates may be considered for cautious use to relieve dyspnoea and anxiety in patients with severe dyspnoea but nausea and hypopnea may occur.	IIb	B	568, 569

Vasodilator	Dosing	Main side effects	Other
Nitroglycerine	Start with10–20 µg/min, increase up to 200 µg/min	Hypotension, headache	Tolerance on continuous use
Isosorbide dinitrate	Start with 1 mg/h, increase up to 10 mg/h	Hypotension, headache	Tolerance on continuous use
Nitroprusside	Start with 0.3 µg/kg/min and increase up to 5 µg/kg/min	Hypotension, isocyanate toxicity	Light sensitive
Nesiritide[a]	Bolus 2 µg/kg + infusion 0.01 µg/kg/min	Hypotension	

Recommendations	Class [a]	Level [b]	Ref [c]
Urgent electrical cardioversion is recommended if AF is thought to be contributing to the patient's haemodynamic compromise in order to improve the patient clinical condition.	I	C	
For patients in NYHA Class IV, in addition to treatment for AHF, an intravenous bolus of amiodarone or, in digoxin-naïve patients, an intravenous bolus of digoxin should be considered to reduce the ventricular rate.	IIa	B	348, 349
For patients in NYHA Class I–III, a beta-blocker, usually given orally, is safe and therefore is recommended as first-line treatment to control ventricular rate, provided the patient is euvolaemic.	I	A	177
For patients in NYHA Class I–III, digoxin, should be considered when ventricular rate remains high[d] despite beta-blockers or when beta-blockers are not tolerated or contra-indicated.	IIa	B	197
AV node catheter ablation may be considered to control heart rate and relieve symptoms in patients unresponsive or intolerant to intensive pharmacological rate and rhythm control therapy, accepting that these patients will become pacemaker dependent.	IIb	B	290
Treatment with dronedarone to improve ventricular rate control is not recommended due to safety concerns.	III	A	347

Vasodilator	Bolus	Infusion rate
Dobutamine[a]	No	2–20 µg/kg/min (beta+)
Dopamine	No	3–5 µg/kg/min; inotropic (beta+)
		>5 µg/kg/min: (beta+), vasopressor (alpha+)
Milrinone[a,b]	25–75 µg/kg over 10–20 min	0.375–0.75 µg/kg/min
Enoximone[a]	0.5–1.0 mg/kg over 5–10 min	5–20 µg/kg/min
Levosimendan[a]	12 µg/kg over 10 min (optional) [c]	0.1 µg/kg/min, which can be decreased to 0.05 or increased to 0.2 µg/kg/min
Norepinephrine	No	0.2–1.0 µg/kg/min
Epinephrine	Bolus: 1 mg can be given i.v. during resuscitation, repeated every 3–5 min	0.05–0.5 µg/kg/min

Recommendations	Class [a]	Level [b]	Ref [c]
In all patients with suspected cardiogenic shock, immediate ECG and echocardiography are recommended.	I	C	
All patients with cardiogenic shock should be rapidly transferred to a tertiary care center which has a 24/7 service of cardiac catheterization, and a dedicated ICU/CCU with availability of short-term mechanical circulatory support.	I	C	
In patients with cardiogenic shock complicating ACS an immediate coronary angiography is recommended (within 2 hours from hospital admission) with an intent to perform coronary revascularization.	I	C	
Continous ECG and blood pressure monitoring are recommended.	I	C	
Invasive monitoring with an arterial line is recommended.	I	C	
Fluid challenge (saline or Ringer's lactate, >200 ml/15–30 min) is recommended as the first-line treatment if there is no sign of overt fluid overload.	I	C	
Intravenous inotropic agents (dobutamine) may be considered to increase cardiac output.	IIb	C	
Vasopressors (norepinephrine preferable over dopamine) may be considered if there is a need to maintain SBP in the presence of persistent hypoperfusion.	IIb	B	558
IABP is not routinely recommended in cardiogenic shock.	III	B	585, 586
Short-term mechanical circulatory support may be considered in refractory cardiogenic shock depending on patient age, comorbidities and neurological function.	IIb	C	

INTERMACS level	NYHA Class	Description	Device	1y survival with LVAD therapy
1. Cardiogenic shock "Crash and burn"	IV	Haemodynamic instability in spite of increasing doses of catecholamines and/or mechanical circulatory support with critical hypoperfusion of target organs (severe cardiogenic shock).	ECLS, ECMO, percutaneous support devices	52.6±5.6%
2. Progressive decline despite inotropic support "Sliding on inotropes"	IV	Intravenous inotropic support with acceptable blood pressure but rapid deterioration of renal function, nutritional state, or signs of congestion.	ECLS, ECMO, LVAD	63.1±3.1%
3. Stable but inotrope dependent "Dependent stability"	IV	Haemodynamic stability with low or intermediate doses of inotropics, but necessary due to hypotension, worsening of symptoms, or progressive renal failure.	LVAD	78.4±2.5%
4. Resting symptoms "Frequent flyer"	IV ambulatory	Temporary cessation of inotropic treatment is possible, but patient presents with frequent symptom recurrences and typically with fluid overload.	LVAD	78.7±3.0%
5. Exertion intolerant "Housebound"	IV ambulatory	Complete cessation of physical activity, stable at rest, but frequently with moderate fluid retention and some level of renal dysfunction.	LVAD	93.0±3.9%[2]
6. Exertion limited "Walking wounded"	III	Minor limitation on physical activity and absence of congestion while at rest. Easily fatigued by light activity.	LVAD / Discuss LVAD as option	-
7. "Placeholder"	III	Patient in NYHA Class III with no current or recent unstable fluid balance.	Discuss LVAD as option	-

Recommendations	Class [a]	Level [b]	Ref [c]
An LVAD should be considered in patients who have end- stage HFrEF despite optimal medical and device therapy and who are eligible for heart transplantation in order to improve symptoms, reduce the risk of HF hospitalization and the risk of premature death (Bridge to transplant indication).	IIa	C	
An LVAD should be considered in patients who have end-stage HFrEF despite optimal medical and device therapy and who are not eligible for heart transplantation to, reduce the risk of premature death.	IIa	B	605, 612, 613

Recommendations	Class [a]	Level [b]	Ref [c]
In symptomatic patients with reduced LVEF and 'low-flow, low-gradient' aortic stenosis (valve area <1 cm^2, LVEF <40%, mean pressure gradient <40 mmHg), low-dose dobutamine stress echocardiography should be considered to identify those with severe aortic stenosis suitable for valve replacement.	IIa	C	
TAVI is recommended in patients with severe aortic stenosis who are not suitable for surgery as assessed by a 'heart team' and have predicted post-TAVI survival >1 year.	I	B	495, 496, 509
TAVI should be considered in high-risk patients with severe aortic stenosis who may still be suitable for surgery, but in whom TAVI is favoured by a 'heart team' based on the individual risk profile and anatomic suitability.	IIa	A	497, 498
In patients with severe aortic regurgitation, aortic valve repair or replacement is recommended in all symptomatic patients and in asymptomatic patients with resting LVEF ≤50%, who are otherwise fit for surgery.	I	C	317
Evidence-based medical therapy in patients with HFrEF is recommended in order to reduce functional mitral regurgitation.	I	C	
Combined surgery of secondary mitral regurgitation and coronary artery bypass grafting should be considered in symptomatic patients with LV systolic dysfunction (LVEF <30%), requiring coronary revascularization for angina recalcitrant to medical therapy.	IIa	C	
Isolated surgery of non-ischaemic regurgitant mitral valve in patients with severe functional mitral regurgitation and severe LV systolic dysfunction (LVEF <30%) may be considered in selected patients in order to avoid or postpone transplantation.	IIb	C	

Recommendations	Class [a]	Level [b]	Ref [c]
It is recommended that regular aerobic exercise is encouraged in patients with HF to improve functional capacity and symptoms.	I	A	321, 618–621
It is recommended that regular aerobic exercise is encouraged in stable patients with HFrEF to reduce the risk of HF hospitalization.	I	A	618, 619
It is recommended that patients with HF are enrolled in a multidisciplinary care management programme to reduce the risk of HF hospitalization and mortality.	I	A	622–625
Referral to primary care for long-term follow-up may be considered for stable HF patients who are on optimal therapy to monitor for effectiveness of treatment, disease progression and patient adherence.	IIb	B	626, 627
Monitoring of pulmonary artery pressures using a wireless implantable haemodynamic monitoring system (CardioMems) may be considered in symptomatic patients with HF with previous HF hospitalization in order to reduce the risk of recurrent HF hospitalization.	IIb	B	628, 629
Multiparameter monitoring based on ICD (IN-TIME approach) may be considered in symptomatic patients with HFrEF (LVEF ≤35%) in order to improve clinical outcomes.	IIb	B	630

Recommendations for cardiac imaging in patients with suspected or established heart failure	Class [a]	Level [b]
TTE is recommended for the assessment of myocardial structure and function in subjects with suspected HF in order to establish a diagnosis of either HFrEF, HFmrEF or HFpEF.	I	C
TTE is recommended for the assessment of LVEF in order to identify patients with HF who would be suitable for evidence-based pharmacological and device (ICD, CRT) treatment recommended for HFrEF.	I	C
Recommendations aiming to prevent or delay the development of overt heart failure or prevent death before the onset of symptoms	**Class [a]**	**Level [b]**
Treatment of hypertension is recommended to prevent or delay the onset of HF and prolong life.	I	A
ACE-I is recommended in patients with asymptomatic LV systolic dysfunction and a history of myocardial infarction in order to prevent or delay the onset of HF and prolong life.	I	A
Beta-blocker is recommended in patients with asymptomatic LV systolic dysfunction and a history of myocardial infarction, in order to prevent or delay the onset of HF and prolong life.	I	B
Pharmacological treatments indicated in patients with symptomatic heart failure with reduced ejection fraction	**Class [a]**	**Level [b]**
An ACE-I[c] is recommended, in addition to a beta-blocker, for symptomatic patients with HFrEF to reduce the risk of HF hospitalization and death.	I	A
A beta-blocker is recommended, in addition to an ACE-I[c], for patients with stable, symptomatic HFrEF to reduce the risk of HF hospitalization and death.	I	A
An MRA is recommended for patients with HFrEF, who remain symptomatic despite treatment with an ACE-I[c] and a beta-blocker, to reduce the risk of HF hospitalization and death.	I	A
Other pharmacological treatments recommended in selected patients with symptomatic heart failure with reduced ejection fraction	**Class [a]**	**Level [b]**
Diuretics are recommended in order to improve symptoms and exercise capacity in patients with signs and/or symptoms of congestion.	I	B
Sacubitril/valsartan is recommended as a replacement for an ACE-I to further reduce the risk of HF hospitalization and death in ambulatory patients with HFrEF who remain symptomatic despite optimal treatment with an ACE-I, a beta-blocker and an MRA.	I	B
Treatments (or combinations of treatments) that may cause harm in patients with symptomatic (New York Heart Association Class II–IV) heart failure with reduced ejection fraction	**Class [a]**	**Level [b]**
Diltiazem or verapamil are not recommended in patients with HFrEF, as they increase the risk of HF worsening and HF hospitalization.	III	C
The addition of an ARB (or a renin inhibitor) to the combination of an ACE-I and an MRA is not recommended in patients with HF, because of the increased risk of renal dysfunction and hyperkalaemia.	III	C
Recommendations for implantable cardioverter-defibrillator in patients with heart failure	**Class [a]**	**Level [b]**
Secondary prevention An ICD is recommended to reduce the risk of sudden death and all-cause mortality in patients who have recovered from a ventricular arrhythmia causing haemodynamic instability, and who are expected to survive for >1 year with good functional status.	I	A
Primary prevention An ICD is recommended to reduce the risk of sudden death and all-cause mortality in patients with symptomatic HF (NYHA Class II–III), and an LVEF ≤35% despite ≥3 months of OMT, provided they are expected to survive substantially longer than 1 year with good functional status, and they have: • IHD (unless they have had an MI in the prior 40 days) • DCM	 I I	 A B
ICD implantation is not recommended within 40 days of an MI as implantation at this time does not improve prognosis.	III	A
Recommendations for cardiac resynchronization therapy implantation in patients with heart failure	**Class [a]**	**Level [b]**
CRT is recommended for symptomatic patients with HF in sinus rhythm with a QRS duration ≥150 msec and LBBB QRS morphology and with LVEF ≤35% despite OMT in order to improve symptoms and reduce morbidity and mortality.	I	A
CRT is recommended for symptomatic patients with HF in sinus rhythm with a QRS duration of 130–149 msec and LBBB QRS morphology and with LVEF ≤35% despite OMT in order to improve symptoms and reduce morbidity and mortality.	I	B
CRT rather than RV pacing is recommended for patients with HFrEF regardless of NYHA Class who have an indication for ventricular pacing and high degree AV block in order to reduce morbidity. This includes patients with atrial fibrillation (see Section 10.1).	I	A
CRT is contra-indicated in patients with a QRS duration <130 msec	III	A

Stabile AP

Recommendations	Class[a]	Level[b]	Ref[c]
Step 1			
A beta-blocker (in an evidence-based dose or maximum tolerated) is recommended as the preferred first-line treatment to relieve angina because of the associated benefits of this treatment (reducing the risk of HF hospitalization and the risk of premature death).	I	A	167–173
Step 2: on top of beta-blocker or if a beta-blocker is not tolerated			
Ivabradine should be considered as an anti-anginal drug in suitable HFrEF patients (sinus rhythm and HR ≥70 bpm) as per recommended HFrEF management.	IIa	B	180, 410, 411
Step 3: For additional angina symptom relief – except from any combination not recommended			
A short-acting oral or transcutaneous nitrate should be considered (effective anti-anginal treatment, safe in HF).	IIa	A	183, 184, 409
A long acting oral or transcutaneous nitrate should be considered (effective anti-anginal treatment, not extensively studied in HF).	IIa	B	183, 184
Trimetazidine may be considered when angina persists despite treatment with a beta-blocker (or alternative) to relieve angina (effective anti-anginal treatment, safe in HF).	IIb	A	400–403
Amlodipine may be considered in patients unable to tolerate a beta-blocker to relieve angina (effective anti-anginal treatment, safe in HF).	IIb	B	215, 407
Nicorandil may be considered in patients unable to tolerate a beta-blocker to relieve angina (effective anti-anginal treatment, but safety in HF uncertain).	IIb	C	
Ranolazine may be considered in patients unable to tolerate a beta-blocker to relieve angina (effective anti-anginal treatment, but safety in HF uncertain).	IIb	C	
Step 4: Myocardial revascularization			
Myocardial revascularization is recommended when angina persists despite treatment with anti-angina drugs.	I	A	385, 412, 413
Alternatives to myocardial revascularization: combination of ≥3 antianginal drugs (from those listed above) may be considered when angina persists despite treatment with beta-blocker, ivabradine and an extra anti-angina drug (excluding the combinations not recommended below).	IIb	C	
The following are NOT recommended:			
(1) Combination of any of ivabradine, ranolazine, and nicorandil because of unknown safety.	III	C	
(2) Combination of nicorandil and a nitrate (because of lack of additional efficacy).	III	C	
Diltiazem and verapamil are not recommended because of their negative inotropic action and risk of worsening HF.	III	C	214

Tabelle 2

Wichtige Einflussgrößen von BNP und NT-proBNP

	Einflussgröße	Effekt
Kardial	Auswurffraktion ↓	Marker ↑
	Linksventrikuläre Masse ↑	Marker ↑
	Vorhofgröße ↑	Marker ↑
Extrakardial	Alter ↑	Marker ↑
	weibliches Geschlecht	Marker ↑
	Glomeruläre Filtration ↓	Marker ↑
	ACE-I/AT-RB*	Marker ↓
	Diuretika	Marker ↓

* Therapie mit ACE-Inhibitor oder Angiotensin-Rezeptorblocker; ACE, angiotensin converting enzyme

Normwerte

Parameter	Frauen	Männer
BNP	•< 150 pg/ml	•< 100 pg/ml
	ESC-Leitlienien: < 100 pg/ml	
NT-proBNP*	•< 155 pg/ml** (< 50 Jahre)	•< 84 pg/ml** (< 50 Jahre)
	•< 222 pg/ml** (50-65 Jahre)	•< 194 pg/ml** (50-65 Jahre)
	ESC-Leitlinien: < 300 pg/ml	