ABSTRACTS
NVVC Najaarscongres
Donderdag 5 november
09.00 – 10.30 uur

SESSIE 3: Heart transplantation and mechanical circulatory support & AI

	Zaal: 6/7	Voorzitters: dr. Annelieke van Riel, cardioloog Martini Ziekenhuis dr. Julius Heemelaar, AIOS LUMC
1	09.00 - 09.10	**Validation of an Automated Decision Engine for Guideline-Directed Medical Therapy in Heart-Failure: A Post-Hoc Analysis of a real-world Heart-Failure Population** *De heer Hesam Amin, Medisch Spectrum Twente, Enschede*
2	09.11 - 09.21	**Pre-implant Inflammatory Profiles Are Associated with Right Heart Failure Post-left Ventricular Assist Device** *Mevrouw Marlie Kuenen, UMC Utrecht,Utrecht*
3	09.22 - 09.32	**Automated AI-Driven 3D Segmentation and Entry Tear Prediction: Towards Improved Preoperative Planning in Type A Aortic Dissection** *Mevrouw Laura Wienke, Isala, Zwolle*
4	09.33 - 09.43	**Prediction of Reentrant Circuit Location Using an Artificial Intelligence Arrhythmia Mapping System in Patients with Atrial Flutter** *Mevrouw Marisa van der Graaf, St. Antonius Ziekenhuis, Nieuwegein*
5	09.44 - 09.54	**Beyond ISHLT CAV Grading: CAD-RADS for Longitudinal CAV Surveillance after Heart Transplantation** *Mevrouw Britt van Dijk, Erasmus MC, Rotterdam*
6	09.55 - 10.05	**Surgical Exit-Site Relocation for Refractory Left Ventricular Assist Device Driveline Infection** *De heer Patrix Lanen, Catharina Ziekenhuis, Eindhoven*
7	10.06 - 10.16	**Left Ventricular Assist Device (LVAD) Infections: Through the Microbiology Looking-Glass** *De heer Kyo Renshof, Erasmus MC, Rotterdam*
8	10.17 - 10.27	**Clinical Significance of Liver Biomarkers Before and During Left Ventricular Assist Device Support** *De heer Parsa Jahangiri, Erasmus MC, Rotterdam*

Session 3: Heart transplantation and mechanical circulatory support & AI
Abstract 1

Validation of an Automated Decision Engine for Guideline-Directed Medical Therapy in Heart-Failure: A Post-Hoc Analysis of a real-world Heart-Failure Population

Presenting author: H. Amin
Department: Cardiologie

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** These authors contributed equally to this work*

Purpose:
Guideline-directed medical therapy (GDMT) significantly improves outcomes in heart failure with reduced ejection fraction (HFrEF), but implementation in daily practice remains challenging. We previously developed an automated based decision engine (DE) to provide specific, expert-driven recommendations for HFrEF therapy. This study aimed to validate the DE's accuracy and concordance with current European Society of Cardiology (ESC) heart failure guidelines in a real-world historical cohort.
Methods:
We used data from HFrEF patients (LVEF <50%) enrolled in TIME-CHF trial. This trial represents a real-world and clinically complex heart failure population. The DE processed clinical data (demographics, history, vitals, laboratory results, current medications) from 2,496 study visits (509 unique patients, median age 76 years) to generate prioritized GDMT recommendations. Two expert cardiologists evaluated all DE recommendations against the 2021 ESC HF guidelines. The primary outcome was the rate of guideline concordance.
Results:
Overall, 2,353 (94.3%) of the primary recommendations were concordant with the guidelines. The most frequent primary recommendations were initiating an SGLT2 inhibitor (35.3%), switching to or initiating an ARNI (26.8%), and initiating or increasing an MRA (22.4%), reflecting modern GDMT priorities applied retrospectively. The primary reason for non-concordance (5.7% of visits, n=143) was the recommendation to start an SGLT2 inhibitor despite a significant recent creatinine increase (>50%). However, there is no explicit guideline direction in all these 143 cases but the evaluators did not judge them as appropriate. Predictors for non-concordant recommendations included higher serum creatinine, higher potassium, lower systolic blood pressure, and presence of orthostasis at the visit. Safety checks, primarily due to parameter instability or contraindications, led to a

"seek specialist advice" output in 279 (11.2%) visits.

Conclusion:

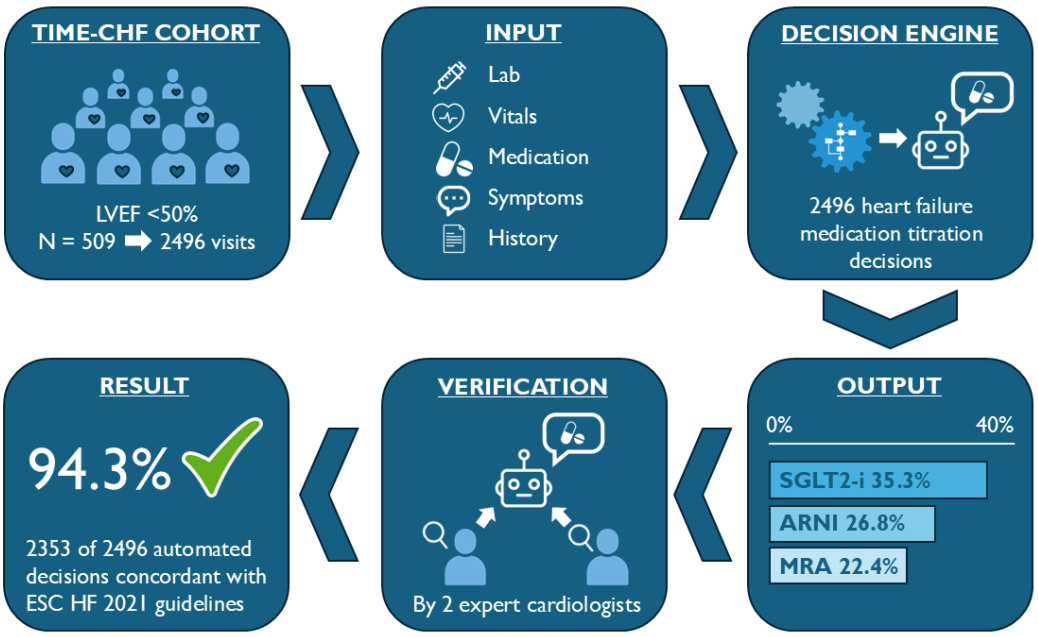
The automated decision engine demonstrated high concordance with current ESC HF guidelines when applied to a complex, elderly HFrEF cohort. While generally accurate, identified areas for refinement, particularly concerning dynamic changes in renal function and blood pressure thresholds, will further enhance its performance. The engine shows significant promise as a clinical decision support tool to aid GDMT optimization in HFrEF management, pending prospective validation.

Keywords:

Heart failure, Decision support systems, Guideline-Directed Medical Therapy

Figure:

Abbreviations: TIME-CHF = Trial of Intensified versus Standard Medical Therapy in Elderly Patients with Congestive Heart Failure; ESC = European Society of Cardiology; LVEF = left ventricular ejection fraction; HF = heart failure; SGLT2-i = sodium-glucose cotransporter-2 inhibitor; ARNI = angiotensin receptor–neprilysin inhibitor; MRA = mineralocorticoid receptor antagonist.



Session 3: Heart transplantation and mechanical circulatory support & AI
Abstract 2

Pre-implant Inflammatory Profiles Are Associated with Right Heart Failure Post-left Ventricular Assist Device

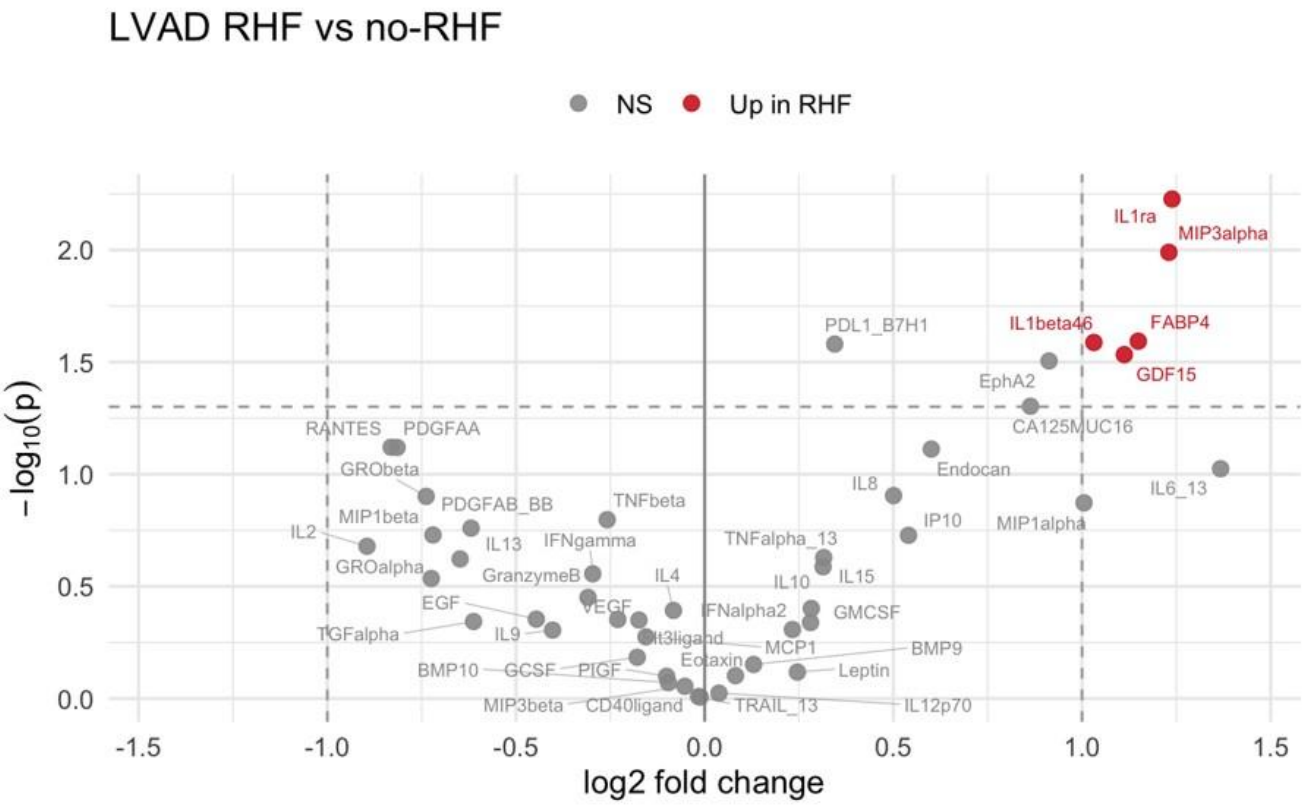
Presenting author: M.L.W. Kuenen
Department: Cardiology

M.L.W. Kuenen (UMC Utrecht, Utrecht); N. Treskes (UMC Utrecht, Utrecht), E.E.C. de Waal (UMC Utrecht, Utrecht), J.W. Duitman (Amsterdam UMC, Amsterdam), M. Guglielmo (UMC Utrecht, Utrecht), M.M. Mokhles (UMC Utrecht, Utrecht), L.W. van Laake (UMC Utrecht, Utrecht), M.G. van der Meer (UMC Utrecht, Utrecht), M.I.F. Oerlemans (UMC Utrecht, Utrecht), M.K. Szymanski (UMC Utrecht, Utrecht), F.S. de Man (Amsterdam UMC, Amsterdam), M.L. Handoko (UMC Utrecht, Utrecht), J. Elias (UMC Utrecht, Utrecht) , J. van Wezenbeek (Amsterdam UMC, Amsterdam & UMC Utrecht, Utrecht)

Purpose:
Right heart failure (RHF) remains a severe complication after left ventricular assist device (LVAD) implantation. While previous studies have examined inflammatory markers such as CRP in relation to RHF (PMID: 35388731), a comprehensive characterization of pre-implant inflammatory profiles and their association with RHF is lacking. This study aims to characterize pre-implant inflammatory profiles associated with RHF after LVAD implantation.
Methods:
We analysed LVAD patients from the University Medical Center Utrecht with available plasma samples and invasive hemodynamic data prior to LVAD implantation. We included N=13 healthy controls from Amsterdam UMC. Circulating cytokine levels were quantified using the Human XL Cytokine Luminex panel and a Custom Luminex Discovery panel cumulating in a total of 55 inflammatory mediators. We compared inflammatory markers between LVAD patients with and without RHF post-implantation and correlated those with hemodynamics.
Results:
Acute RHF (ISHLT definition) developed in 12/40 LVAD patients <30 days post-implantation. LVAD patients showed a broad upregulation of inflammatory proteins vs controls, including several pro-inflammatory mediators: vascular endothelial growth factor (VEGF), interleukin-1 beta (IL-1β) and several chemokines such as macrophage inflammatory protein-3 alpha (MIP-3α) and cancer antigen 125/mucin-16 (CA125/MUC16) and the anti-inflammatory cytokine interleukin-10 (IL-10). Among LVAD patients, those who developed RHF showed higher levels of several pro-inflammatory markers: IL-1β, MIP-3α, fatty acid binding protein-4 (FABP4), and growth differentiation factor 15 (GDF15), as well as the anti-inflammatory interleukin-1 receptor antagonist (IL-1ra) (Figure 1). Higher MIP-3α and GDF15 correlated with higher central venous pressure.
Conclusion:
Distinct inflammatory cytokine patterns are associated with RHF post-LVAD implantation. These findings suggest a dysregulated balance between pro- and anti-inflammatory mediators already present before LVAD implantation, which may contribute to RHF and can help identify patients at increased risk for RHF.

Keywords:
Inflammatory markers, Right heart failure, Left ventricular assist device

Figure:
Differential biomarker expression before LVAD implantation in patients with and without right heart failure after LVAD implantation



Session 3: Heart transplantation and mechanical circulatory support & AI
Abstract 3

Automated AI-Driven 3D Segmentation and Entry Tear Prediction: Towards Improved Preoperative Planning in Type A Aortic Dissection

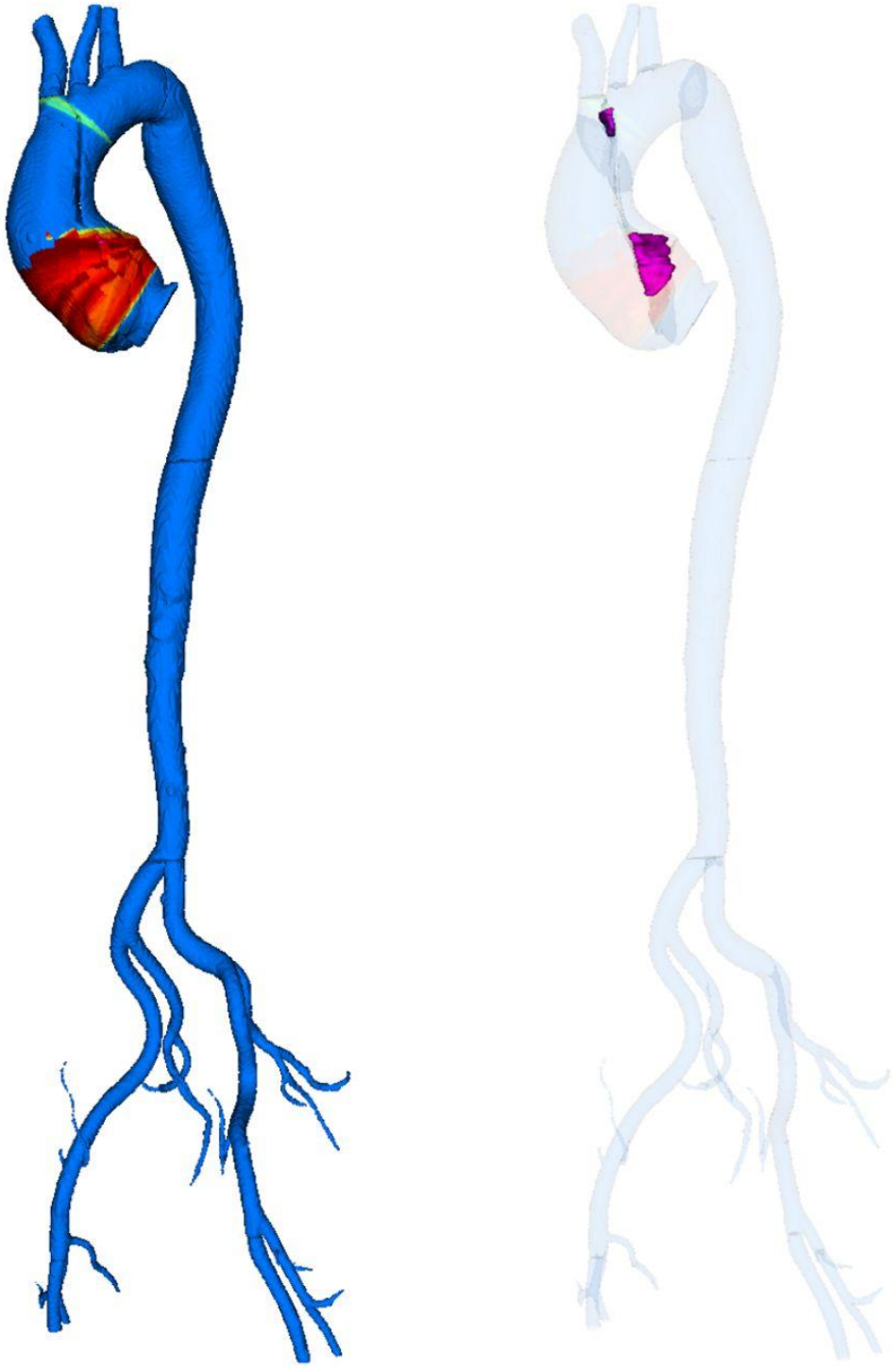
Presenting author: L. Wienke
Department: Cardiothoracic Surgery

L. Wienke; L. Wienke (Isala, Zwolle), D.J. Slotman (Isala, Zwolle), J.M. Wolterink (University of Twente, Enschede), I.M. Nijholt (Isala, Zwolle), M.F. Boomsma (Isala, Zwolle), M.A.H. van Leeuwen (Isala, Zwolle), J.R. Olsthoorn (Isala, Zwolle).

Purpose:
Acute type A aortic dissection (ATAAD) presents as a life-threatening emergency requiring urgent intervention and accurate classification to guide surgical decision-making. This study introduces an automated AI-based 3D method for aortic dissection segmentation and entry tear prediction to support preoperative planning.
Methods:
This retrospective cohort study included 120 patients with ATAAD. A segmentation model (SegTAAD) generated 3D reconstructions of the true and false lumen from computed tomography angiography (CTA) data and was validated on an independent test set from Isala. A slice-based classification model was trained to predict (re-)entry tear location and validated on a separate cohort, with predictions visualized on the 3D reconstruction. Segmentation performance was assessed using the Dice similarity coefficient (DSC) and 95th percentile Hausdorff distance (HD95), while entry tear prediction was evaluated using sensitivity and specificity.
Results:
The segmentation model achieved a high overall segmentation accuracy of 95% (DSC) and a boundary accuracy of 3.8 mm (HD95). Performance was consistent across the true lumen (90%, 4.9 mm) and false lumen (84%, 14 mm). Entry tear prediction demonstrated a high sensitivity of 89%, with a specificity of 76%, enabling visualization of the predicted (re-)entry tear location directly on the 3D reconstruction (see Figure).
Conclusion:
This AI-based 3D approach enables accurate segmentation and entry tear localization in ATAAD, providing surgeons with reliable preoperative information and 3D visualization to support timely, informed surgical decision-making. Future research should focus on external validation and clinical integration.

Keywords:
type A aortic dissection, deep learning, entry tear prediction

Figure:
Figure: 3D reconstruction of a type A aortic dissection. Left: predicted entry tear (red) and re-entry tear (green) visualized as a heatmap on the 3D model. Right: ground truth entry and re-entry tear segmentations (pink).



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Abstract 4

Prediction of Reentrant Circuit Location Using an Artificial Intelligence Arrhythmia Mapping System in Patients with Atrial Flutter

Presenting author: M. van der Graaf
Department: Cardiologie

M. van der Graaf (St. Antonius Ziekenhuis, Nieuwegein); J.C. Balt (St. Antonius Ziekenhuis, Nieuwegein); M.C.E.F. Wijffels (St. Antonius Ziekenhuis, Nieuwegein); J.S. Edens (St. Antonius Ziekenhuis, Nieuwegein); V.F. van Dijk (St. Antonius Ziekenhuis, Nieuwegein); M. Liebregts (St. Antonius Ziekenhuis, Nieuwegein); L.V.A. Boersma (St. Antonius Ziekenhuis, Nieuwegein)

Purpose:
Recognition of atrial flutter (AFL) and focal atrial tachycardia (AT) mechanisms on 12 lead ECGs remains challenging, particularly in patients with atypical arrhythmias after prior ablation. Non-invasive localization of these atrial arrhythmias and re-entry circuits may facilitate pre-procedural planning, reduce mapping time, and enable more targeted ablation strategies. The vMap ECG mapping system applies a forward solution approach to reconstruct atrial activation patterns from surface ECG recordings. In this study we evaluated the feasibility and diagnostic accuracy of the vMap system in identifying the involved atrium (right atrium (RA) vs. left atrium (LA)) and re-entry pathway localization of AFLs/ATs using 12 lead ECG data.
Methods:
We conducted an analysis of patients who underwent a catheter ablation for AFL/AT. Periprocedural ECG segments were analyzed using the vMap system, which compares this data with libraries containing model predicted ECGs. The vMap results were validated against periprocedural findings obtained with conventional 3D electroanatomical mapping systems. Endpoints included the accuracy of the vMap system in identifying the involved atrium and the characterization of re-entry pathways.
Results:
ECG segments of 60 arrhythmias were analyzed, including 35 RA and 25 LA arrhythmias. Distinct activation patterns were identified for typical CTI-dependent flutters and various LA re-entry circuits, which allowed for the development of a pragmatic interpretation workflow. Using this new workflow, the vMap-system correctly identified the arrhythmia localization of all 35 RA arrhythmias and in 24 of 25 (96%) of the LA arrhythmias, for an overall accuracy of 98.3%.
Conclusion:
Our study showed that ECG mapping with the vMap-system enables non-invasive localization of atrial arrhythmias and characterization of re-entry pathways. These findings highlight its potential value for pre-procedural planning and more efficient ablation procedures.

Keywords:
Artificial intelligence, non-invasive ECG mapping, atrial arrhythmias

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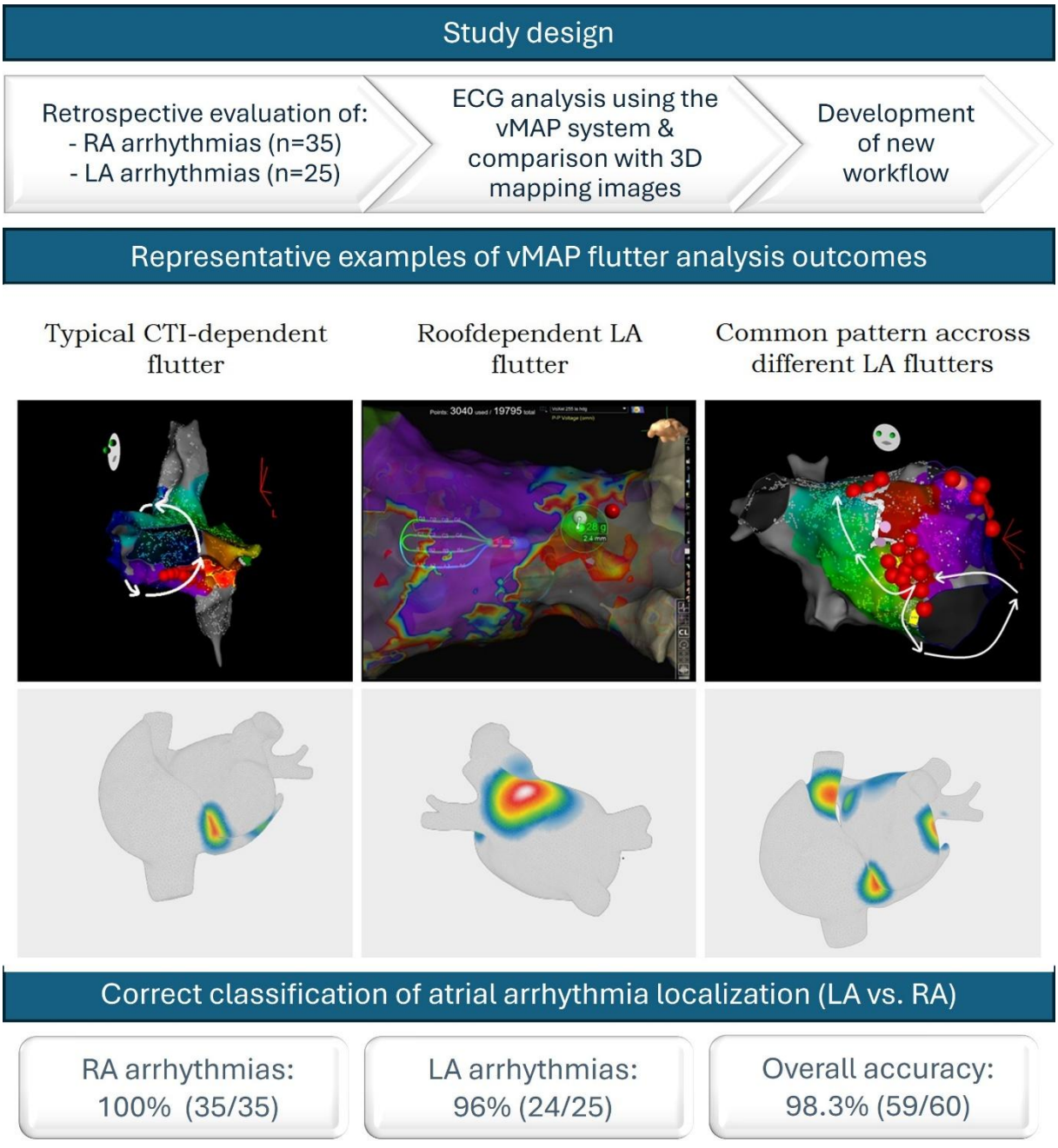
Figure:



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Abstract 5

Beyond ISHLT CAV Grading: CAD-RADS for Longitudinal CAV Surveillance after Heart Transplantation

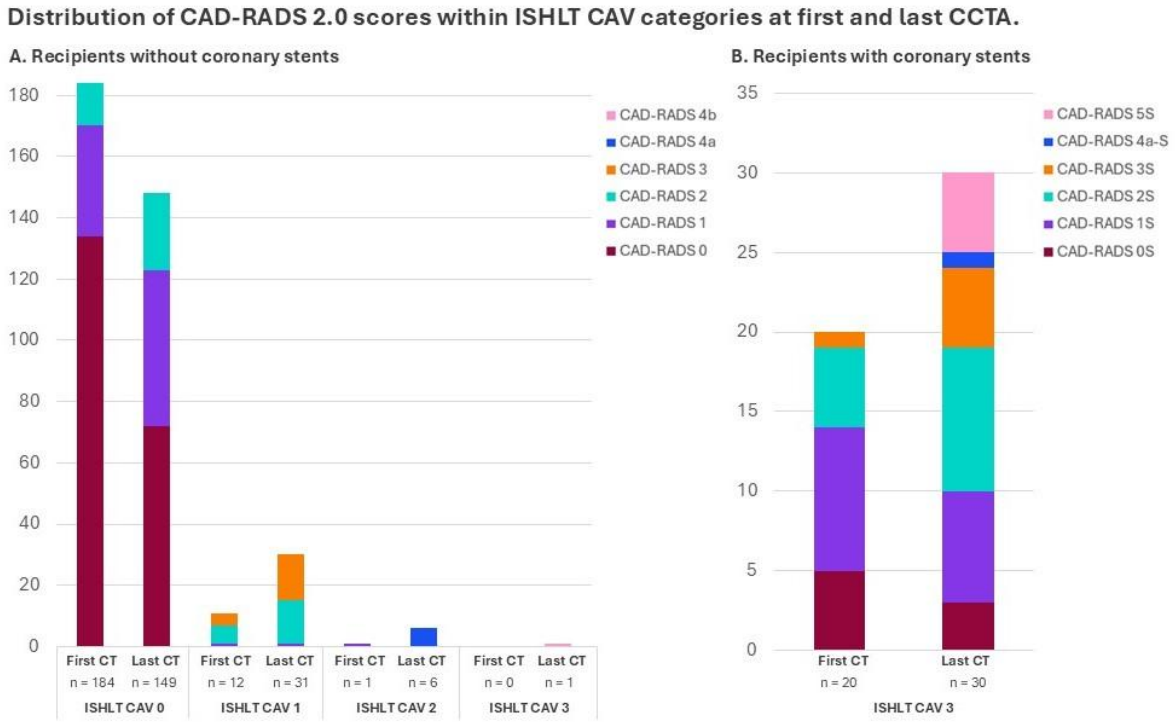
Presenting author: B.C.J. van Dijk
Department: Cardiology

B.C.J. van Dijk (Erasmus MC, Rotterdam); L.N.J. Elsman (Erasmus MC, Rotterdam), D. Bos (Erasmus MC, Rotterdam), W.C. Meijers (Erasmus MC, Rotterdam), R.A. de Boer (Erasmus MC, Rotterdam), Y.J.H.J. Taverne (Erasmus MC, Rotterdam), R.P.J. Budde (Erasmus MC, Rotterdam), O.C. Manintveld (Erasmus MC, Rotterdam)

Purpose:
Coronary allograft vasculopathy (CAV) remains a major limitation to long-term survival after heart transplantation (HT). The International Society for Heart and Lung Transplantation (ISHLT) grades CAV as 0,1,2 or 3 based on the number of coronary stenosis >70% which provides limited differentiation of early disease. We evaluated whether coronary computed tomography angiography (CCTA) evaluated with CAD-RADS provides more detailed CAV characterization than conventional ISHLT CAV grading.
Methods:
In this retrospective cohort study, HT recipients undergoing ≥2 CCTAs between 2018-2025 were included. Coronary stenosis was classified by ISHLT CAV grading and CAD-RADS at first and last CCTA. The highest CAD-RADS score represented overall stenosis burden. Recipients with and without coronary stents were evaluated separately.
Results:
A total of 218 HT recipients were included (age at HT: 45 [22-53] years, time since HT: 7 [6-12] years, 37% female). At first CCTA, 184/197(93%) recipients without coronary stents were classified as ISHLT CAV 0. However, 50/184(27%) had detectable stenosis (CAD-RADS 1-2).
At last CCTA, 149/188(79%) recipients remained CAV 0, of whom 76/149(51%) had detectable stenosis according to CAD-RADS (grade 1-2). In recipients with coronary stents, all examinations were classified as CAV 3, whereas CAD-RADS scores ranged from 0S-3S at first CT and 0S-5S at last CCTA, differentiating stenosis severity after stenting.
Conclusion:
CCTA combined with CAD-RADS 2.0 provides greater granularity than ISHLT CAV grading, particularly for early disease and after coronary stenting. More sensitive characterization of disease and longitudinal progression may enable earlier risk identification and targeted intervention, supporting personalized post-HT care.

Keywords:
Cardiac allograft vasculopathy, Coronary computed tomography angiography, Heart Transplantation

Figure:
Stacked bar charts show the distribution of CAD-RADS 2.0 scores at first and last CCTA, stratified by ISHLT CAV classification. CAD-RADS 2.0 scores range from 0-5 (without stents) and 0S-5S (with stents).
A. Recipients without coronary stents. B. Recipients with coronary stents.
ISHLT, International Society for Heart and Lung Transplantation; CAV, cardiac allograft vasculopathy; CAD-RADS 2.0, Coronary Artery Disease Reporting and Data System 2.0; CCTA, coronary computed tomography angiography.



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Abstract 6

Surgical Exit-Site Relocation for Refractory Left Ventricular Assist Device Driveline Infection

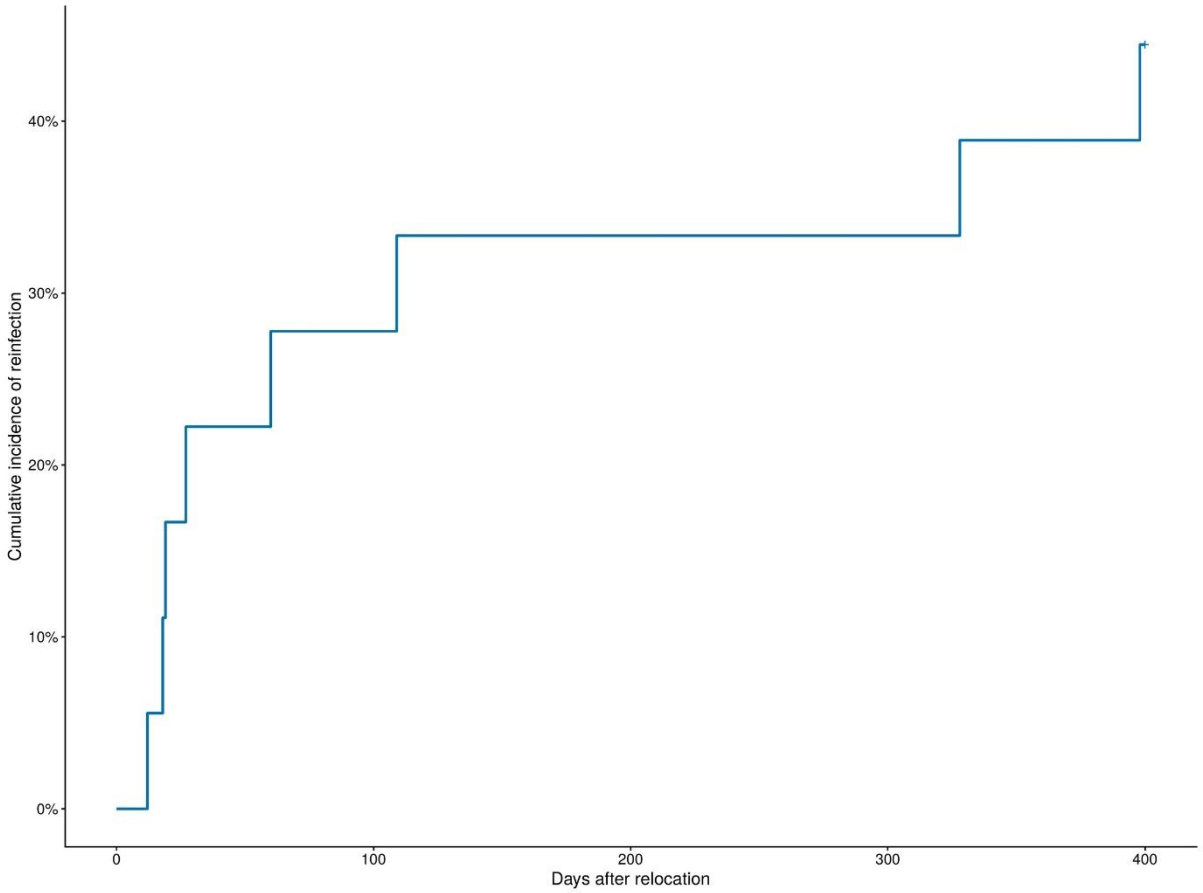
Presenting author: P.W.J. Lanen
Department: Cardiology

P.W.J. Lanen (Catharina Hospital, Eindhoven); P.W.J. Lanen (Catharina Hospital, Eindhoven); K.J.P.H. Renshof (Erasmus University Medical Center, Rotterdam); J. Sjatskig (Erasmus University Medical Center, Rotterdam); A.C. Constantinescu (Erasmus University Medical Center, Rotterdam); O.C. Manintveld (Erasmus University Medical Center, Rotterdam); F.R.N. van Schaagen (Erasmus University Medical Center, Rotterdam); V. Drost (Eindhoven University of Technology, Eindhoven); N.J. Verkaik (Erasmus University Medical Center, Rotterdam); S.H.B. van Dijk (Catharina Hospital, Eindhoven); L. Otterspoor (Catharina Hospital, Eindhoven); K. Caliskan (Erasmus University Medical Center, Rotterdam).

Purpose:
Driveline exit-site infection frequently complicates left ventricular assist device support. When infection persists despite antimicrobial therapy, exit-site relocation may preserve the device, but its durability is unclear.
Methods:
Single-centre retrospective cohort of consecutive HeartMate 3 (Abbott, Abbott Park, IL, USA) recipients underwent exit-site relocation for refractory driveline infection (2019–2026), defined as persistent or recurrent symptoms despite antimicrobials. Primary outcome: surgical success (absence of same-pathogen recurrence), tested against a pre-specified 80% threshold (one-sided exact binomial test); a secondary definition restricted recurrence to 90 days. Secondary outcomes: reinfection, complications, and correlation of reinfection timing with initial infection parameters (Spearman's ρ).
Results:
Eighteen relocations in 17 patients (median age 57 [53–63] years; 94% male). Primary pathogens at the last infection before relocation: Enterobacterales 6/18 (33%), Mycobacterium chelonae 4/18 (22%), Pseudomonas aeruginosa 4/18 (22%), culture-negative 2/18 (11%), Staphylococcus aureus and Corynebacterium amycolatum 1/18 each; six relocations had co-infection. Median follow-up 16 [8–33] months. Surgical success 16/18 (89%, 95% confidence interval (CI) 69–100), not above the 80% threshold (p=0.27); under the 90-day definition 18/18 (100%, 95% CI 85–100; p=0.02). Reinfection occurred in 44% (95% CI 22–67) after 44 [19–164] days (Figure). Perioperative complications 0/18; no pump exchange or infection-attributable death. Time to reinfection was unrelated to infection-to-relocation interval (ρ=−0.14, p=0.73) or antimicrobial duration (ρ=−0.58, p=0.13).
Conclusion:
Surgical success reached 89%, not above the pre-specified 80% threshold, although no same-pathogen recurrence occurred within 90 days. Reinfection with any pathogen affected 44% at a median of 44 days, without pump exchange. Prospective studies should define optimal timing and surveillance.

Keywords:
left ventricular assist device, driveline infection, surgical exit-site relocation

Figure:
Figure. Cumulative incidence of reinfection after exit-site relocation (Kaplan–Meier estimate; 18 relocations; follow-up truncated at 400 days). Reinfection was counted for any pathogen, not only the organism cultured before relocation. Each vertical step is one reinfection; tick marks denote censored observations, that is, follow-up ending without reinfection.



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Abstract 7

Left Ventricular Assist Device (LVAD) Infections: Through the Microbiology Looking-Glass

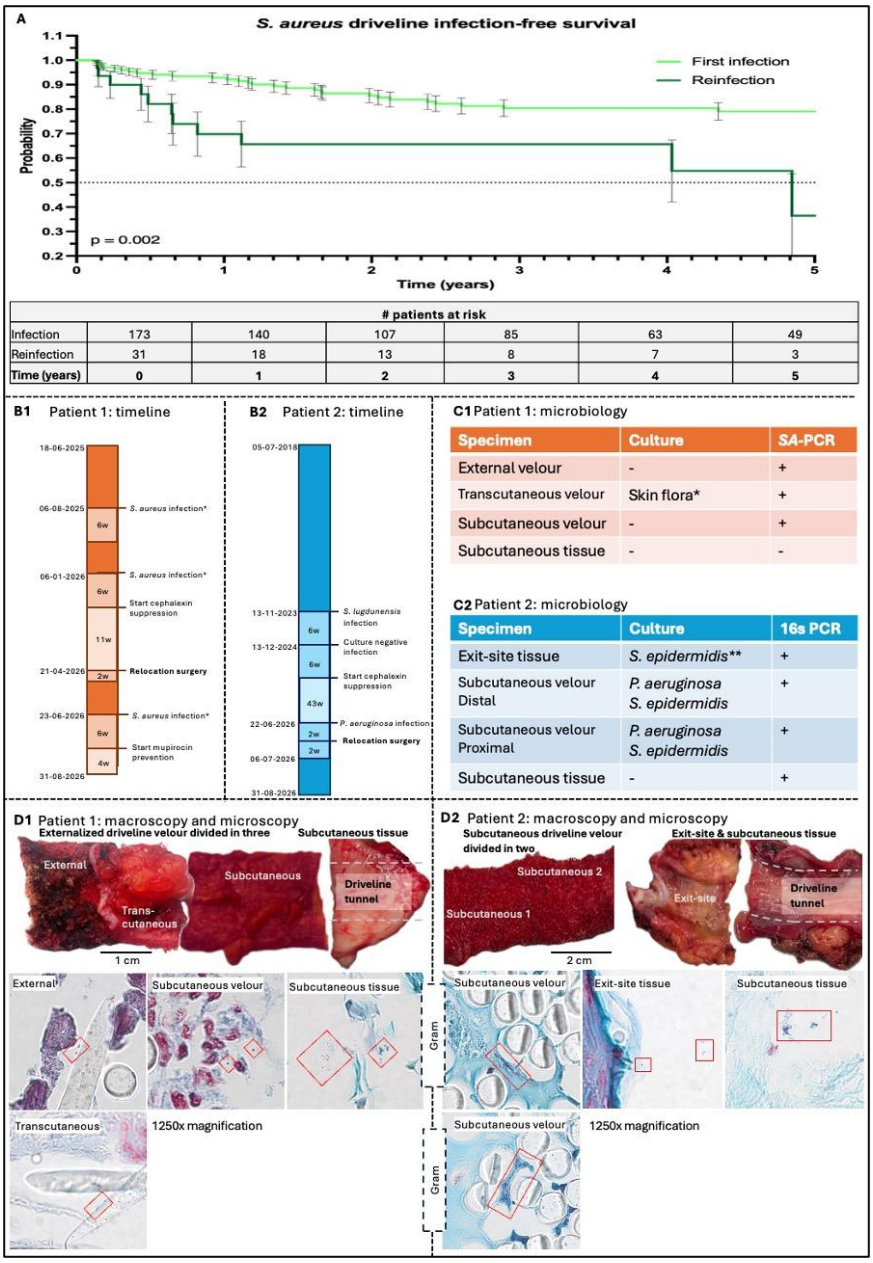
Presenting author: K. J. P. H. Renshof
Department: Medical Microbiology and Infectious Diseases

K. J. P. H. Renshof (Dept. Medical Microbiology and Infectious Diseases, Erasmus MC, Rotterdam); P. Lanen (Dept. Cardiology, Catharina Hospital, Eindhoven), C. P. Haanappel (Dept. Medical Microbiology and Infectious Diseases, Erasmus MC, Rotterdam), J. Sjatskig (Dept. Cardiothoracic Surgery, Erasmus MC, Rotterdam), A. C. Constantinescu (Dept. Cardiology, Erasmus MC, Rotterdam), K. Caliskan (Dept. Cardiology, Erasmus MC, Rotterdam), N. J. Verkaik (Dept. Medical Microbiology and Infectious Diseases, Erasmus MC, Rotterdam), K. R. Lattwein (Dept. Medical Microbiology and Infectious Diseases, Erasmus MC, Rotterdam)

Purpose:
Left ventricular assist device (LVAD) infections cause substantial morbidity and mortality, yet prevention and treatment guidance remains limited. Staphylococcus aureus (SA) and Pseudomonas aeruginosa (PA) commonly infect LVADs, leading to recurrent infection despite antibiotics. We investigated LVAD (re)infection incidence and outcomes, and driveline velour as a potential microbial reservoir.
Methods:
We performed a retrospective cohort study (2019-2026) including LVAD patients at Erasmus MC. Resected LVAD-driveline velour and surrounding tissues (n=2) underwent microbiological and histopathological analyses to identify persistent bacteria.
Results:
Among 173 patients, 17.9% (n= 31) experienced ≥1 SA and 5.2% (n= 9) ≥1 PA infection. At 1 and 5 years, SA infection-free survival was 92.1% (SE2.1) and 79.1% (SE3.6), respectively, while reinfection-free survival was 69.8% (SE9.0) and 36.5% (SE17.1). Reinfection risk was 2.84 times higher than the risk of first infection (95%CI 1.08-7.42). Driveline relocation was required in 12.9% (n=4) SA and 66.7% (n=6) PA infections. Among infections managed without relocation, 33.3% (n = 9) SA and 100% PA cases required long-term suppressive antibiotics. Despite relocation, 75% (n=3) SA cases relapsed after 244 days (median; range 63-341), compared with 0% PA cases. In one patient with relapsing SA infection, SA-PCR was positive in all velour samples, whereas SA cultures were negative, and histology was suggestive of bacteria. In another patient, PA was cultured from resected velour despite antibiotic therapy.
Conclusion:
SA LVAD infections frequently recur despite treatment, while no PA recurrences were observed following driveline relocation. Driveline velour is a potential microbial reservoir. These findings have informed institutional prevention and treatment guidelines.

Keywords:
Left Ventricular Assist Device, Infection, Staphylococcus aureus

Figure:
Figure 1. LVAD driveline infection dynamics and microbial persistence. (A) Kaplan-Meier curves of Staphylococcus aureus driveline infection-free survival (bright green) and reinfection-free survival (dark green) over 5-years; error bars indicate SE. Numbers at risk shown below the graph. (B) Timelines of infections and antibiotic treatment in patients with recurrent infection. (C) Culture and PCR results from resected velour samples (n = 2). SA-PCR = Staphylococcus aureus polymerase chain reaction; 16S PCR = bacterial 16S ribosomal RNA gene PCR. (D) Macroscopic and microscopic tissue samples. Red boxes indicate bacteria identified by Gram staining at 1250× magnification.



Session 3: Heart transplantation and mechanical circulatory support & AI
Abstract 8

Clinical Significance of Liver Biomarkers Before and During Left Ventricular Assist Device Support

Presenting author: P. Jahangiri (Erasmus University Medical Centre, Rotterdam)
Department: Cardiologie

P. Jahangiri (Erasmus University Medical Centre, Rotterdam); P. Jahangiri (Erasmus University Medical Centre, Rotterdam); Y. Luo (Erasmus University Medical Centre, Rotterdam); M. Brankovic (University of Minnesota Medical School, Minneapolis); G. Guven (Hacettepe University, Ankara); M.J. Sonneveld (Erasmus University Medical Centre, Rotterdam); K. Veen (Erasmus University Rotterdam, Rotterdam); A. Constantinescu (Erasmus University Medical Centre, Rotterdam); R.M.A. van der Boon (Erasmus University Medical Centre, Rotterdam); J. Sjatskig (Erasmus University Rotterdam, Rotterdam); J. Brugts (Erasmus University Medical Centre, Rotterdam); O. Manintveld (Erasmus University Medical Centre, Rotterdam); J. Kluin (Erasmus University Rotterdam, Rotterdam); R.A. de Boer (Erasmus University Medical Centre, Rotterdam); K. Caliskan (Erasmus University Medical Centre, Rotterdam)

Purpose:
The clinical significance of liver biomarkers in left ventricular assist device (LVAD) recipients remains poorly characterized. We therefore investigated their relationship with pre-implant hemodynamics, their trajectories during LVAD support, and their associations with clinical outcomes.
Methods:
This retrospective cohort included HeartMate 3 recipients implanted from 2016–2025. Pre-implant hemodynamic–liver biomarker associations were assessed using multivariable regression, post-implant trajectories using mixed-effects models, early outcomes using logistic regression, and longitudinal biomarker–outcome associations using joint longitudinal-survival models.
Results:
191 recipients were included. Seven of 72 pre-implant hemodynamic–liver biomarker associations were significant: bilirubin with right atrial pressure (RAP) and RAP/pulmonary capillary wedge pressure (PCWP); gamma-glutamyl transferase (GGT) with RAP and RAP/PCWP; and aspartate aminotransferase (AST) with RAP, PCWP, and cardiac power output. Strongest was bilirubin–RAP ($\beta=0.54$;$p<0.001$). Liver biomarkers showed nonlinear recovery post-LVAD, with rapid bilirubin improvement, initial albumin decline followed by recovery, and delayed cholestatic peaks followed by gradual declines (Figure 1A-F). Pre-implant RAP≥12 mmHg was associated with less favorable recovery patterns. Pre-implant bilirubin (OR 1.92), alkaline phosphatase (OR 1.99), and GGT (OR 1.50) were associated with early right heart failure. During LVAD support, higher current AST (HR 3.72), bilirubin (HR 2.48), alanine aminotransferase (HR 1.71), and GGT (HR 1.41), and lower albumin (HR 2.06), were associated with 1-year mortality.
Conclusion:
Liver biomarkers were closely associated with pre-implant right-heart hemodynamics, particularly RAP, and showed dynamic recovery after LVAD implantation. Higher pre-implant RAP was associated with less favorable liver biomarker recovery. Pre-implant biomarkers were associated with early postoperative complications, while longitudinal levels during

LVAD support were associated with 1-year mortality.

Keywords:
Ventricular Assist Devices, Liver Function Tests, Treatment Outcome

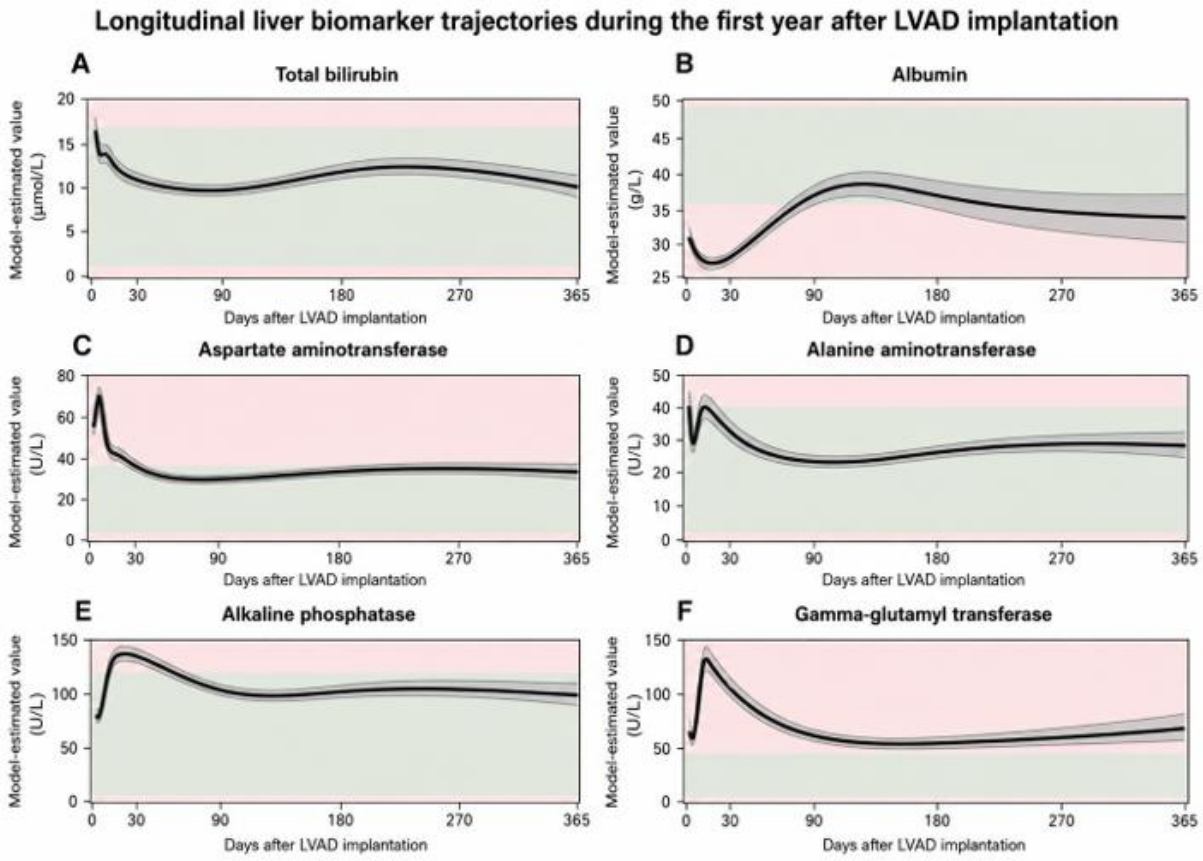



Figure:
Figure 1. Longitudinal trajectories of liver biomarkers during the first year after LVAD implantation. Panels show A) total bilirubin, B) albumin, C) aspartate aminotransferase, D) alanine aminotransferase, E) alkaline phosphatase, and F) gamma-glutamyl transferase. Black lines show model-estimated trajectories and grey shaded areas 95% confidence intervals. Day 0 represents the last value before LVAD implantation. Green areas indicate approximate adult reference ranges and red areas values outside these ranges. Sex-specific upper reference limits for aspartate aminotransferase, alanine aminotransferase, and gamma-glutamyl transferase were averaged for visual presentation only.