BREAKOUT SESSION 6
Diagnostic Challenges and Technological Opportunities in Valvular and Vascular Toxicities
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- Identify **current limitations in the diagnostic pathways for early detection of valvular and vascular toxicities**, focusing on the interpretation of ECG, biomarkers, echocardiography and CMR.

- Highlight technological and AI-driven **opportunities that can enhance diagnostic precision, enable earlier recognition** of damage and **support more consistent decision-making in cardio-oncology.**

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- Identify **current limitations in the diagnostic pathways for early detection of valvular and vascular toxicities**, focusing on the interpretation of ECG, biomarkers, echocardiography and CMR.

System recognized for using in clinical trials- systems qualified for classiifying histology samples with metabolic properties

Need validated and simple technologies

Patient perspective- diagnostic tools not convenient for patietns in many cases
Issues around accuracy and borderline assessments. Rapid implementation is needed for patients.

Need to follow protocols in homogenous way. Lack of material and technical resources can be a barrier. Needs a reproducible model for implementation.

Current limitations in diagnostic pathways for early detection of valvular and vascular toxicities

Observer dependence and variability

- Interpretation of ECG, echocardiography and CMR is highly observer-dependent, leading to inconsistent results across clinicians, centres and countries.
- Even standard tests (e.g. ECGs, GLS on echo, CMR mapping) can yield different conclusions depending on reader expertise.
- This variability limits reliability for longitudinal follow-up and use as trial endpoints.

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Lack of standardised, widely implemented pathways

- There is no uniformly adopted, standardised cardio-oncology diagnostic pathway across Europe.
- Protocols are inconsistently applied due to shortages of trained staff, limited equipment, and local practice differences.
- Diagnostic approaches often depend on individual clinicians rather than reproducible, guideline-driven models.

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Biomarker interpretation challenges

- Biomarkers (troponin, NT-proBNP, lipids, glucose) are inconsistently measured and often poorly understood outside cardiology.
- Reference ranges are derived from healthy populations and may not be valid in cancer patients with inflammation, renal dysfunction or multimorbidity.
- Misinterpretation can lead to false reassurance or unnecessary alarm.

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Imaging access and patient burden

- Advanced imaging (CMR, PET-CT) is not widely available and often restricted to specialised centres.
- Scan duration, claustrophobia and physical stress limit patient acceptability.
- Image quality issues and artefacts further complicate interpretation, particularly in early disease.

Underuse of existing data

- Valuable cardiovascular information embedded in routine oncology CT scans (e.g. coronary or valvular calcification) is frequently ignored.
- Opportunities for opportunistic screening and earlier referral are therefore missed.

Limited predictive capability

- Current pathways are largely reactive and diagnostic rather than predictive.
- Existing risk scores are mostly expert-opinion–based and perform poorly in predicting who will develop valvular or vascular toxicity and when.

2. Technological and AI-driven opportunities to enhance diagnostic precision and decision-making

Reducing variability and improving consistency

- AI-assisted interpretation of ECGs, echocardiography and CMR can reduce inter-observer variability and standardise measurements.
- Automated quantification (e.g. EF, strain, valve assessment, tissue mapping) supports more reproducible follow-up and trial readiness.

Earlier detection of subclinical disease

- AI tools can identify early signatures of disease (e.g. severe aortic stenosis from ECG or limited echo views).
- Advanced CMR mapping, molecular imaging and strain analysis enable detection of early fibrosis, inflammation and mitochondrial dysfunction before overt dysfunction develops.

Faster, more patient-friendly diagnostics

- AI-accelerated imaging acquisition and reconstruction can significantly shorten scan times, improving patient experience and throughput.
- This helps address capacity constraints in cardiology services.

Risk stratification and triage

- AI can act as a first-line screening filter: identifying “normal” patients versus those with red flags who require specialist cardiology input.
- This tiered approach supports efficient use of specialist resources while maintaining safety.

Integration of multimodal data

- Combining ECG waveforms, imaging data, biomarkers, wearables and clinical history enables more holistic risk assessment.

Multimodal AI models can outperform siloed interpretation and support longitudinal monitoring

Use of existing data and opportunistic screening

- AI can extract cardiovascular risk information from routine oncology CT scans, enabling early identification of atherosclerosis or valvular calcification without additional tests.

Digital twins and population-specific reference values

- Digital twin models and large datasets can help define **cancer-specific and comorbidity-specific reference ranges** for biomarkers and imaging parameters.
- This addresses a major gap in current interpretation frameworks.

Decision support, not replacement of clinicians

- AI is viewed as a decision-support tool that empowers oncologists and cardiologists rather than replacing specialist judgement.
- Clinician oversight remains essential, particularly for complex interpretation, therapy decisions and patient communication.

Enabling networks and standardised care

- AI tools, combined with ESC-endorsed guidelines and structured care pathways, can support networks of cardio-oncology centres.
- Shared platforms, checklists and guideline-linked tools can improve education, awareness and consistency across healthcare systems.

Overall message:
The main barriers are not a lack of diagnostic tools, but variability, limited access, poor integration and absence of standardised pathways. AI and digital technologies offer major opportunities to improve consistency, enable earlier detection, support prediction rather than reaction, and deliver scalable, patient-centred cardio-oncology care—provided they are rigorously validated, regulated and embedded within clear clinical governance frameworks.