PET/CT in infective endocarditis

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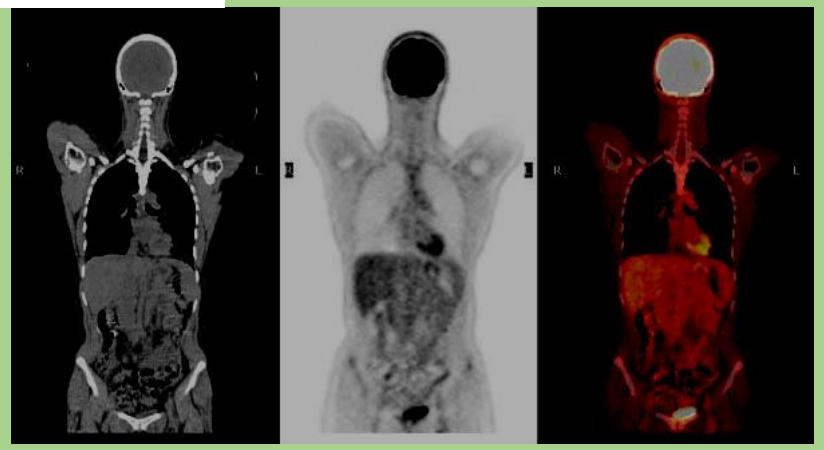
Hybrid imaging

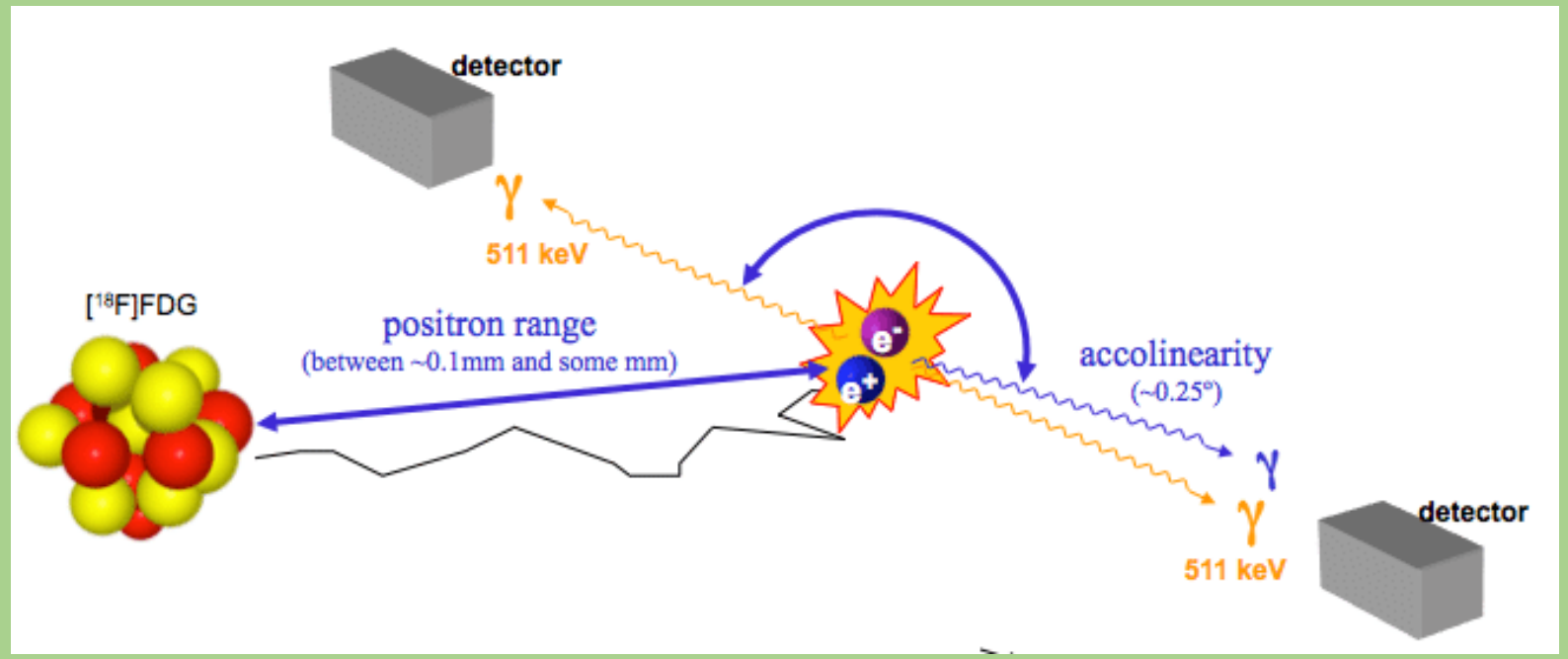
PET

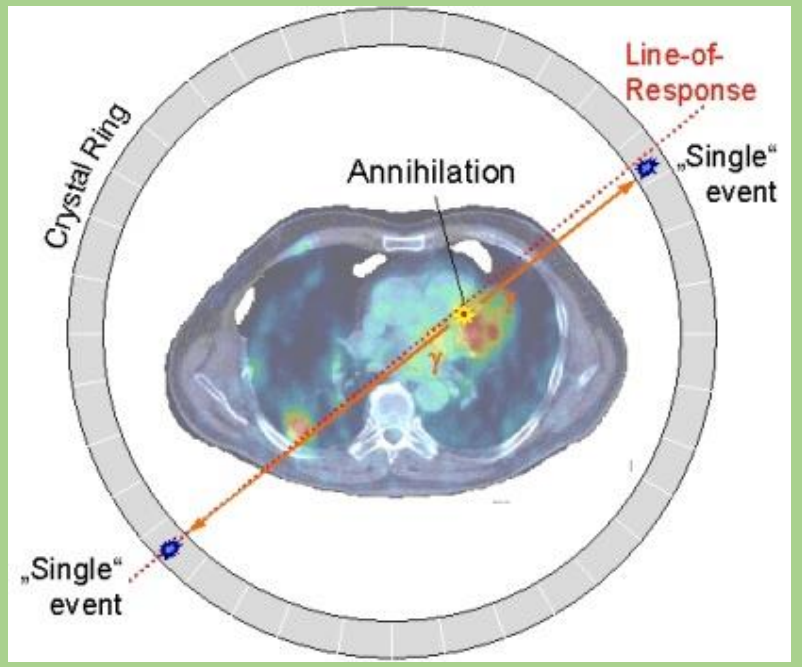
CT

PET-CT



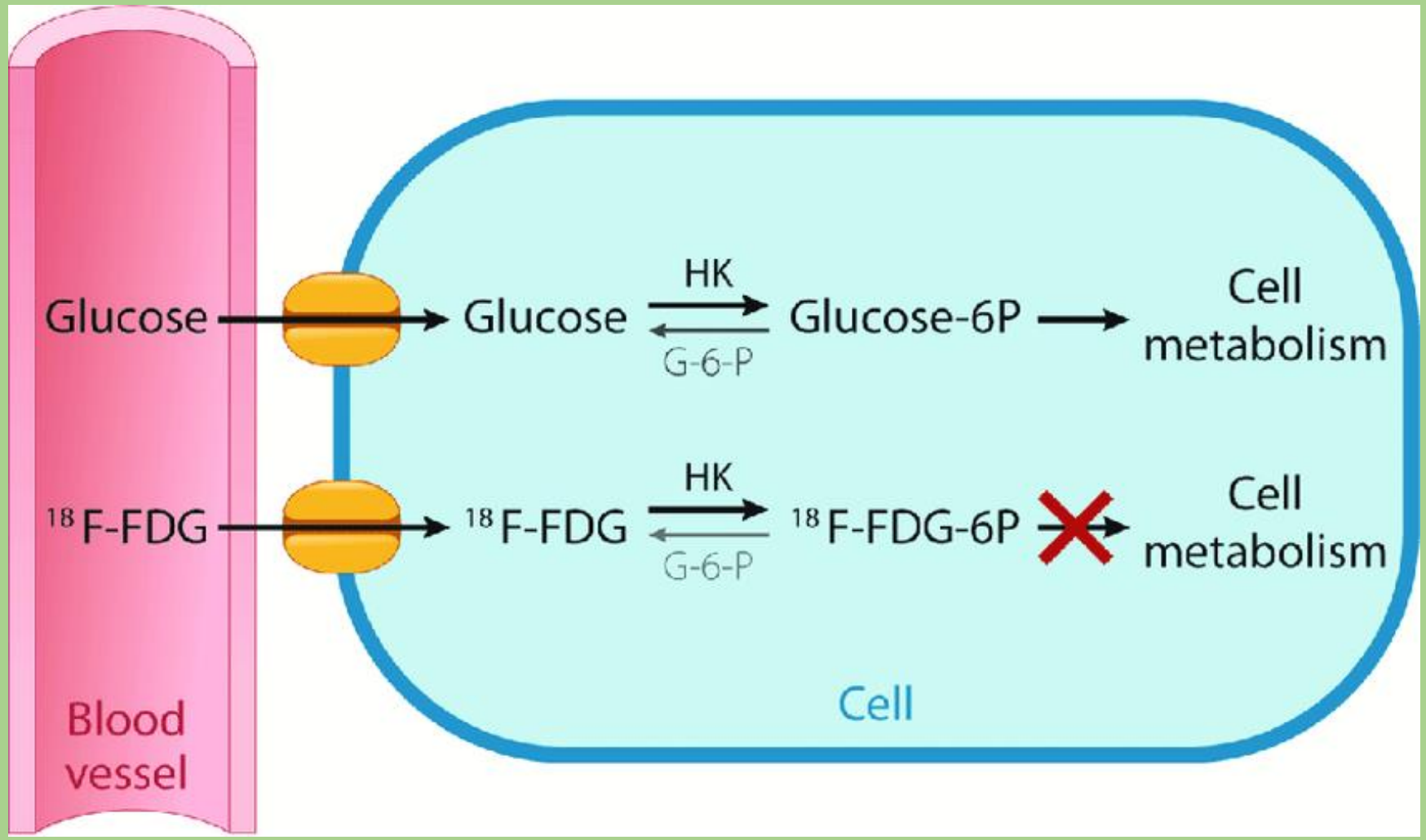
PET: Positron Emission Tomography





Isotope	Half-live	β^+ Decay Fraction	Mean β^+Energy	Mean β^+Range	Production
Carbon-11	20.385 min	99%	386 keV	1.266 mm	cyclotron
Nitrogen-13	9.965 min	100%	488 keV	1.730 mm	cyclotron
Oxygen-15	122.24 sec	100%	735 keV	2.965 mm	cyclotron
Fluorine-18	109.77 min	97%	252 keV	0.660 mm	cyclotron
Copper-62	9.67 min	93%	1.314 MeV	6.077 mm	generator
Copper-64	12.70 hr	17%	278 keV	0.688 mm	reactor or cyclotron
Gallium-68	68.06 min	88%	844 keV	3.559 mm	generator
Rubidium-82	1.273 min	96%	1.551 MeV	7.491 mm	generator
Iodine-124	4.18 days	23%	819 keV	~ 1.7 mm	cyclotron

FDG: Fluorodeoxyglucose



CARDIAC PET/CT

- Myocardial viability
- Myocardial perfusion
- Infection
  - Prosthetic and native valve endocarditis
  - cardiac implantable electronic devices IE
  - Vascular graft infection
- Cardiac sarcoidosis
- Cardiac masses

The 2023 Duke-International Society for cardiovascular Infectious Disease Criteria for Infective Endocarditis: Updating the Modified Duke Criteria

Clinical Infectious Diseases, Volume 77, Issue 4, 15 August 2023

B. Imaging Major Criteria

(1) Echocardiography and **cardiac computed tomography (CT)** imaging
i. Echocardiography and/or **cardiac CT** showing vegetation,[e] valvular/leaflet perforation,[f] valvular/leaflet aneurysm,[g] abscess,[h] pseudoaneurys
intracardiac fistula[j]

or

ii. Significant new valvular regurgitation on echocardiography as compared with previous imaging. Worsening or changing of preexisting regurgitation is not sufficient.

or

iii. New partial dehiscence of prosthetic valve as compared with previous imaging [52]

(2) Positron emission computed tomography with 18F-fluorodeoxyglucose ([18F]FDG PET/CT imaging)

Abnormal metabolic activity[k] involving a native or prosthetic valve, ascending aortic graft (with concomitant evidence of valve involvement), intracardiac device leads or other prosthetic material[l,m]

Values of FDG PET/CT in suspected IE

- Establish the diagnosis of IE
- Detection of portal of entry (cutaneous, dental, GIT).
- Evaluation of disseminated disease
- Identification of other foci of infection should IE be ruled out
- Prognosis

- FDG- PET/CT is mainly applied when the diagnosis remains uncertain after other diagnostic tests are performed

Indications of FDG PET/CT in suspected IE

Native value endocarditis	Prosthetic valve endocarditis	Cardiac device related endocarditis	
		Pocket infection	Lead infection
Detect disseminated disease	.Detect intracardiac lesions .Detect disseminated disease	.Detect pocket lesion .Detect disseminated dissase	.Detect intracardiac lesions .Detect disseminated disease
Intracardiac lesion detection Sensitivity: 36% Specificity: 98%	Intracardiac lesion detection Sensitivity: 86% Specificity: 84%	Pocket lesion detection Sensitivity: 93% Specificity: 98%	Intracardiac lesion detection Sensitivity: 65% Specificity: 88%

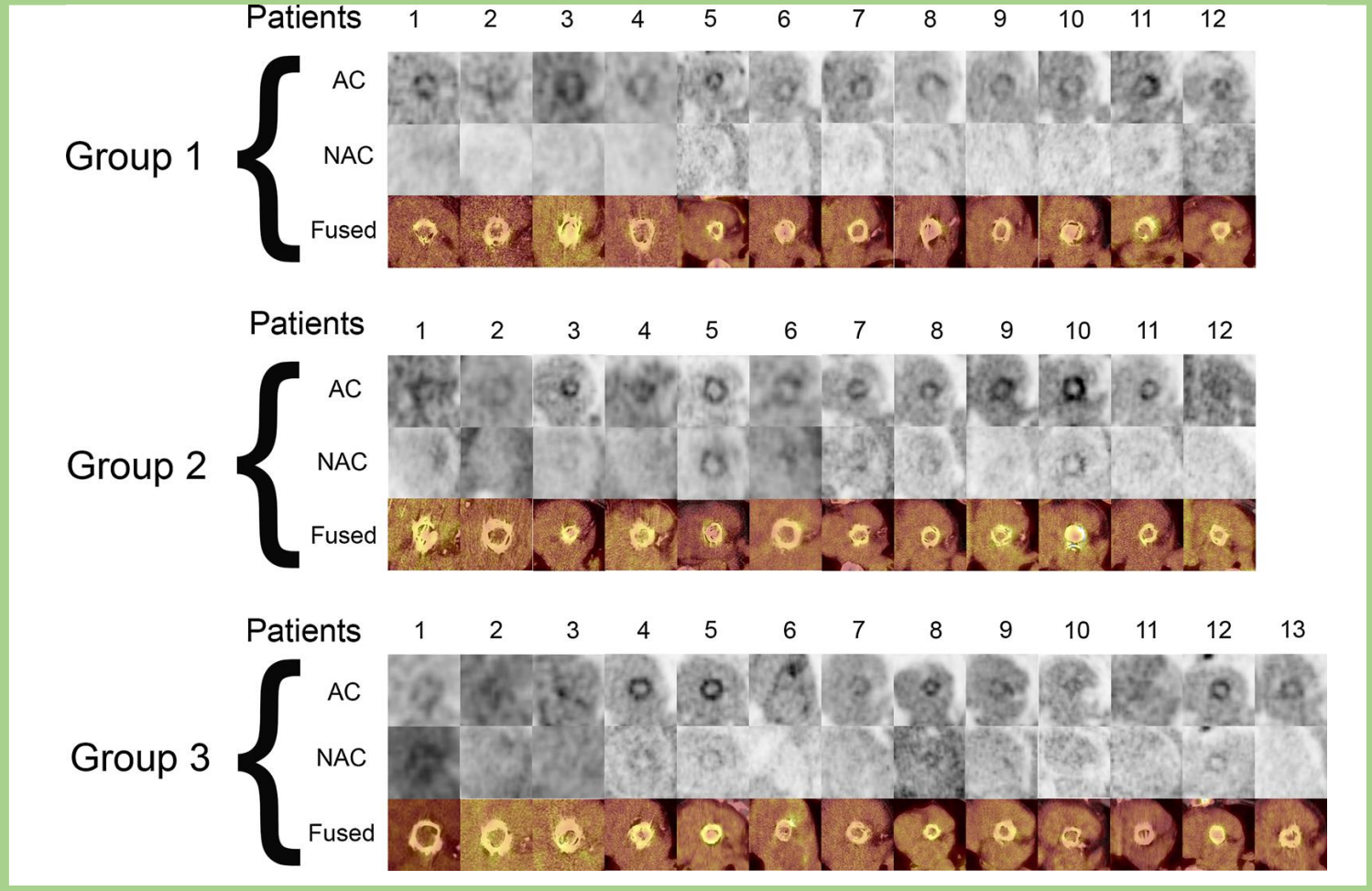
18F-FDG PET/CT in Infective Endocarditis: Indications and Approaches for Standardization. Ten Hove et al., Current Cardiology Reports (2021) 23: 130

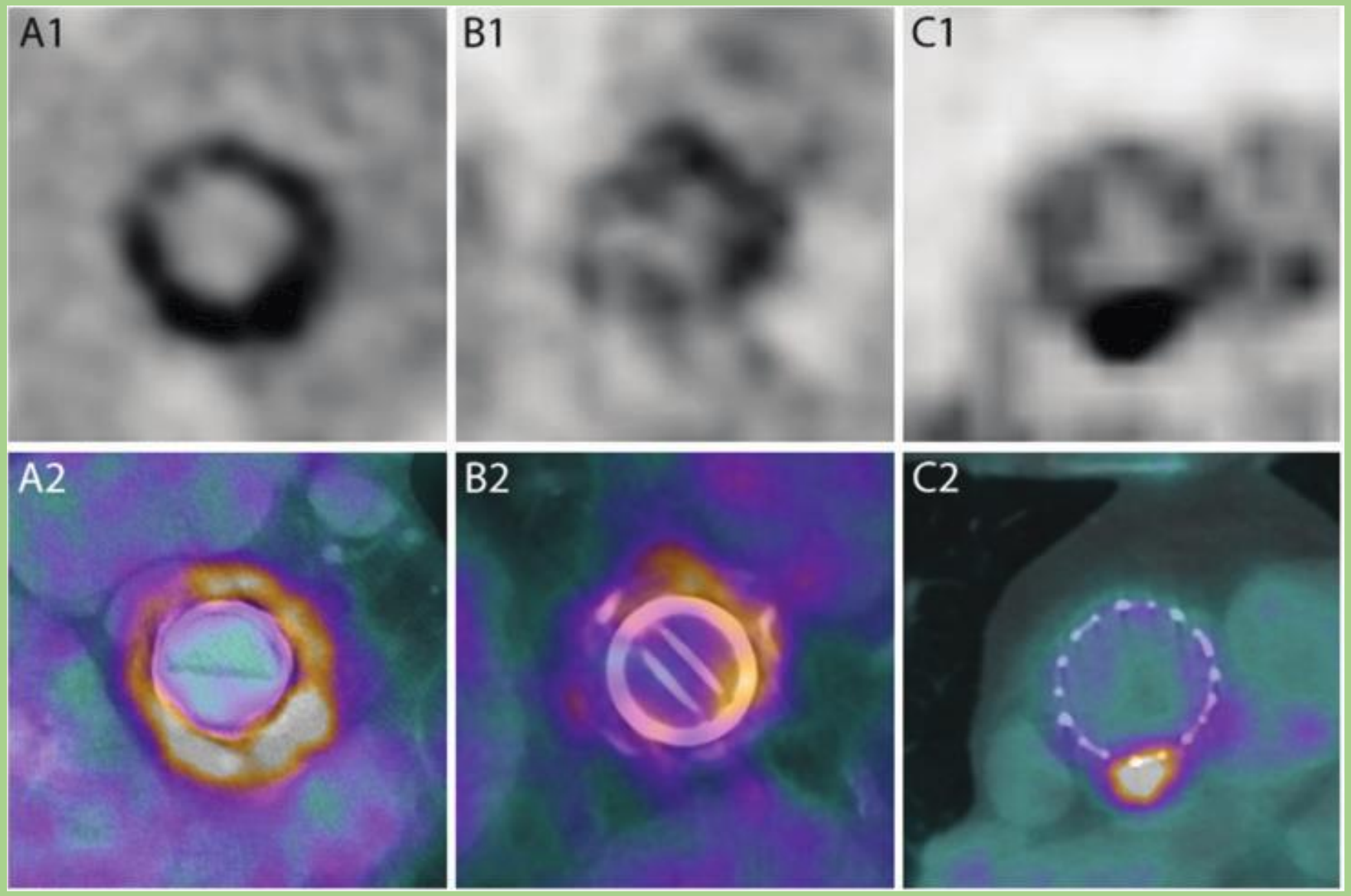
Timing of FDG PET/CT

- After surgery
  - 1-3 months delay is recommended to decreased false positive results.
  - Negative study early post operatively excluds IE.
  - False positive with the use of
    - Surgical adhisive (BioGlue)
    - Specific bioprosthetic mitral valve type (medtronic Mosaic)
- Antibiotics: appropriate antiboiotics decrease inflammation leading to flase negative results (C reactive protein less than 40 mg/L is associated with false negative results).

Normal imaging findings after aortic valve implantation on 18F-Fluorodeoxyglucose positron emission tomography with computed tomography

J Nucl Cardiol 2021;28:2258–68





IE

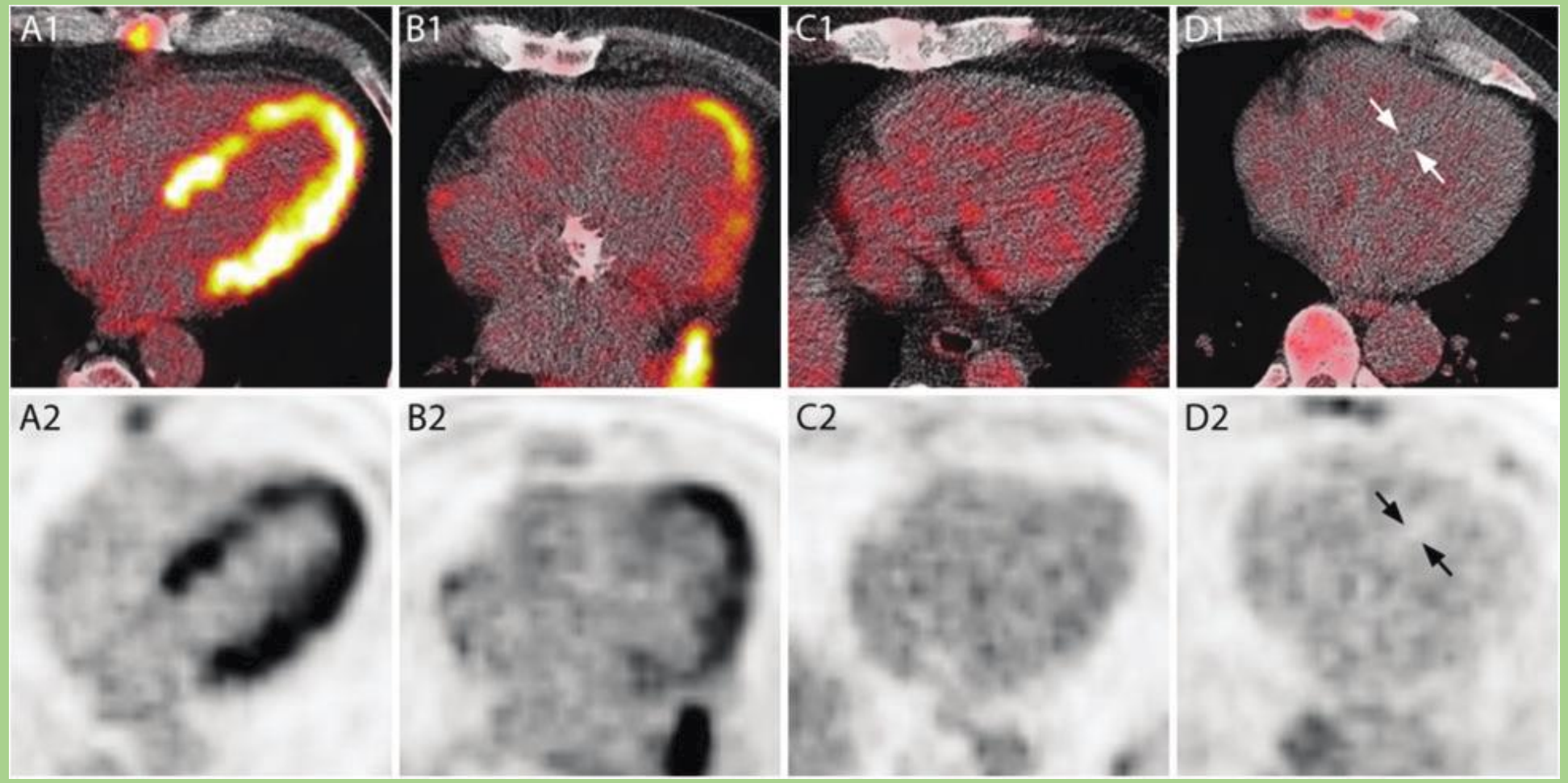
IE after 14 days of antibiotics

IE

European Heart Journal (2018) 39, 3739–3749

Patient reparation

- The aim is to decrease physiologic cardiac FDG uptake
  - Fasting 12-18 hours
  - Low carbohydrate high fat diet for 24 hours before the study
  - Heparin IV 15-30 min before FDG injection (controvertial)



6 hours fasting

6 hours fasting + 24 hours low carb diet

12 hours fasting + 24 hours low carb diet

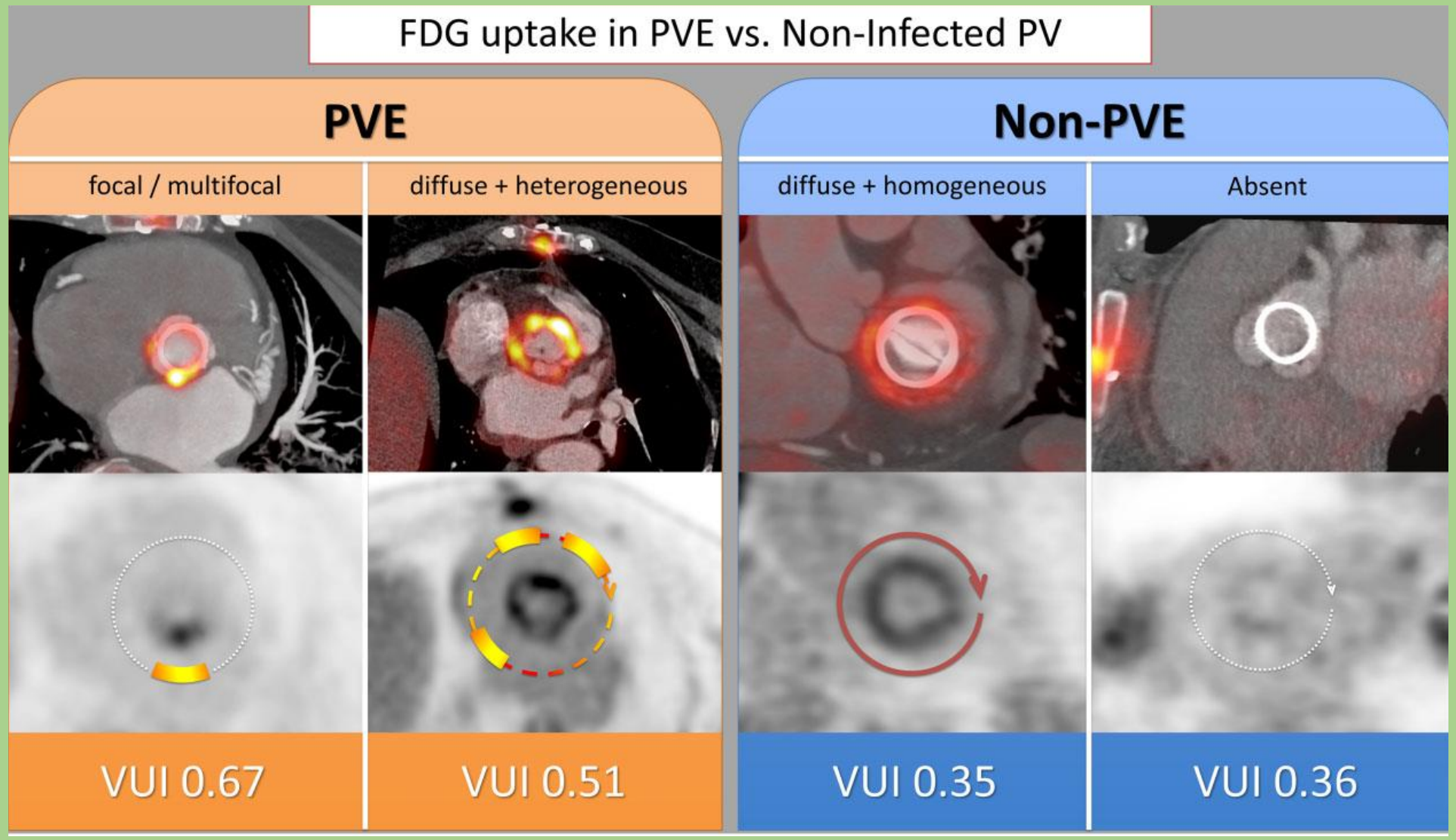
6 hours fasting + 24 hours low carb diet + 50IU IV heparin 15 min before FDG injection

European Heart Journal (2018) 39, 3739–3749

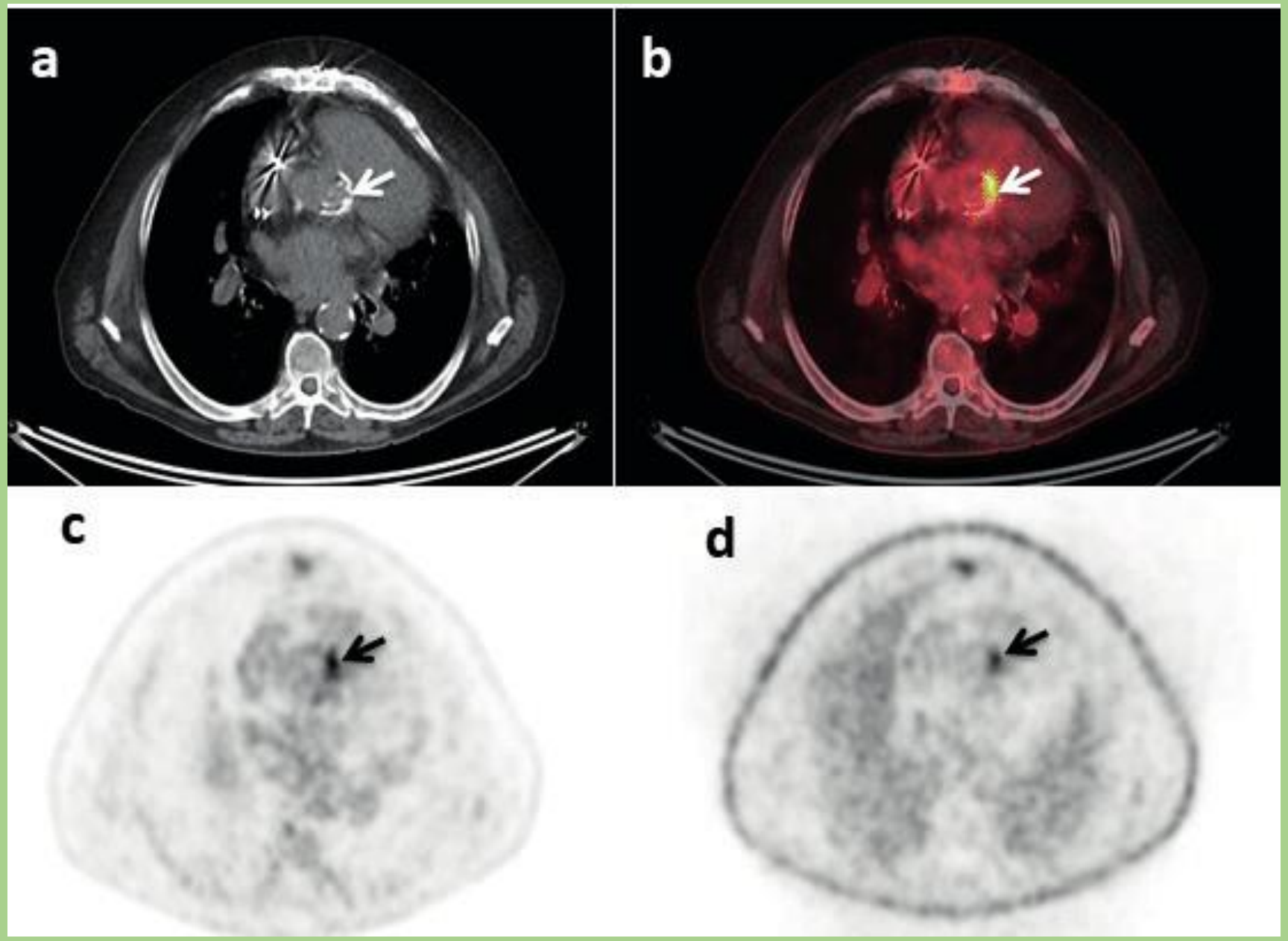
Image interpretation

	Negative for IE	Positive for IE
Qualitative	Mild/no uptake Diffuse uptake Homogenous uptake	Intense uptake Focal uptake Heterogenous uptake
Quantitative	SUVratio < 2 Valve uptake index < 0.45	SUVratio > 2 Valve uptake index > 0.45

Visual assessment must be performed on both attenuation corrected and non-attenuation corrected images

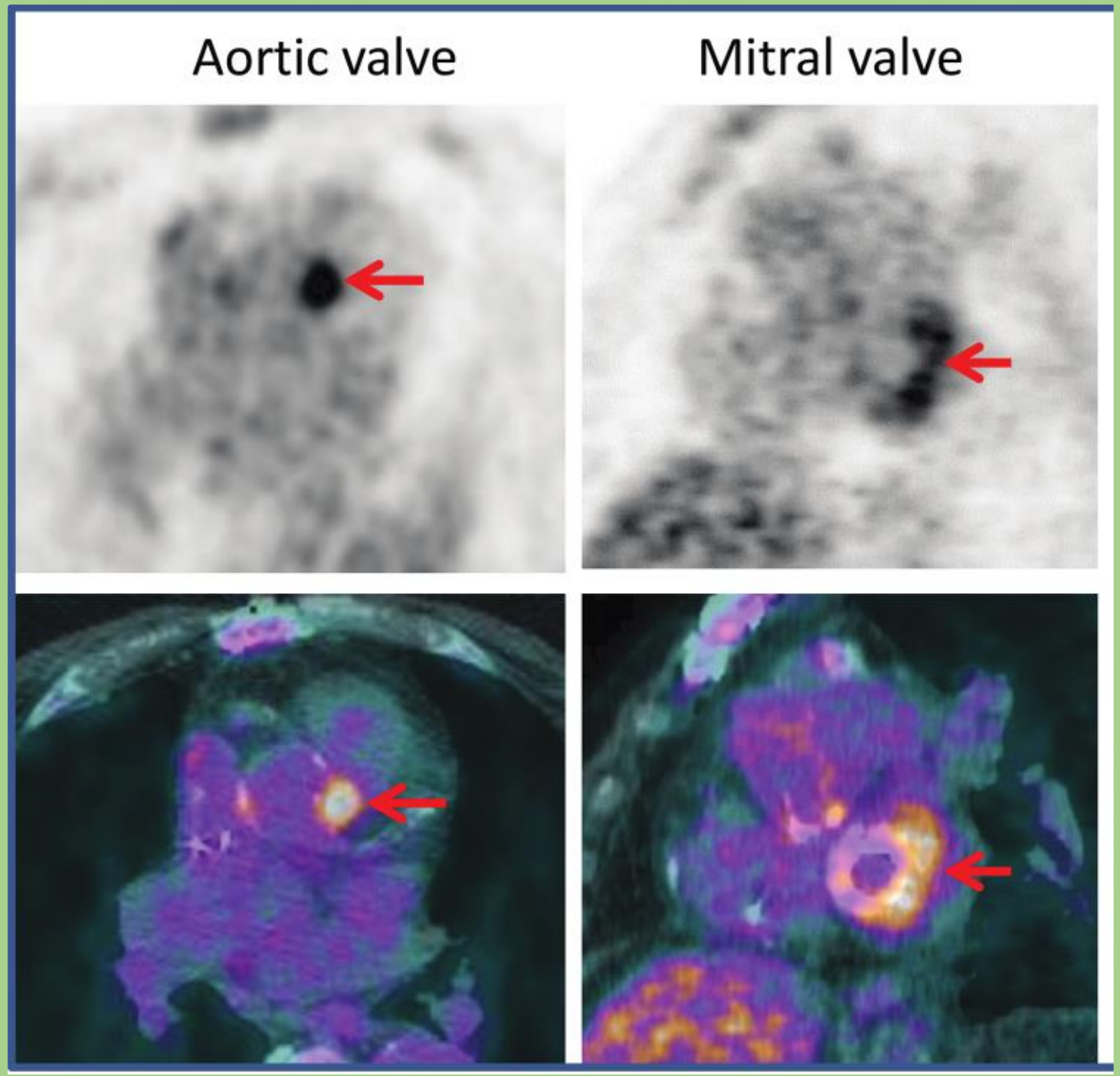


European Heart Journal - Cardiovascular Imaging (2022) 23, 1260–1271



AC

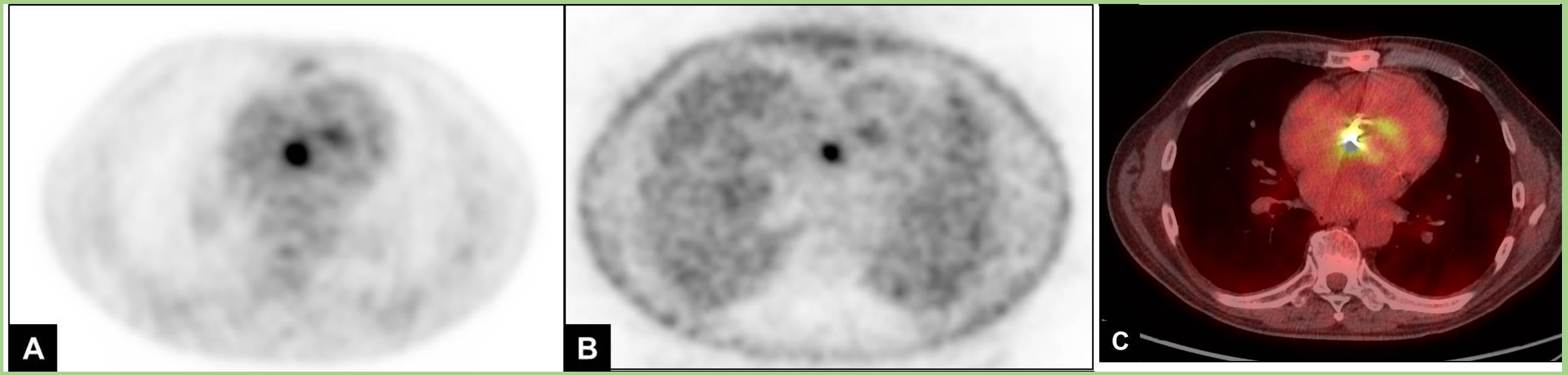
NAC


Aortic valve
Mitral valve

AC

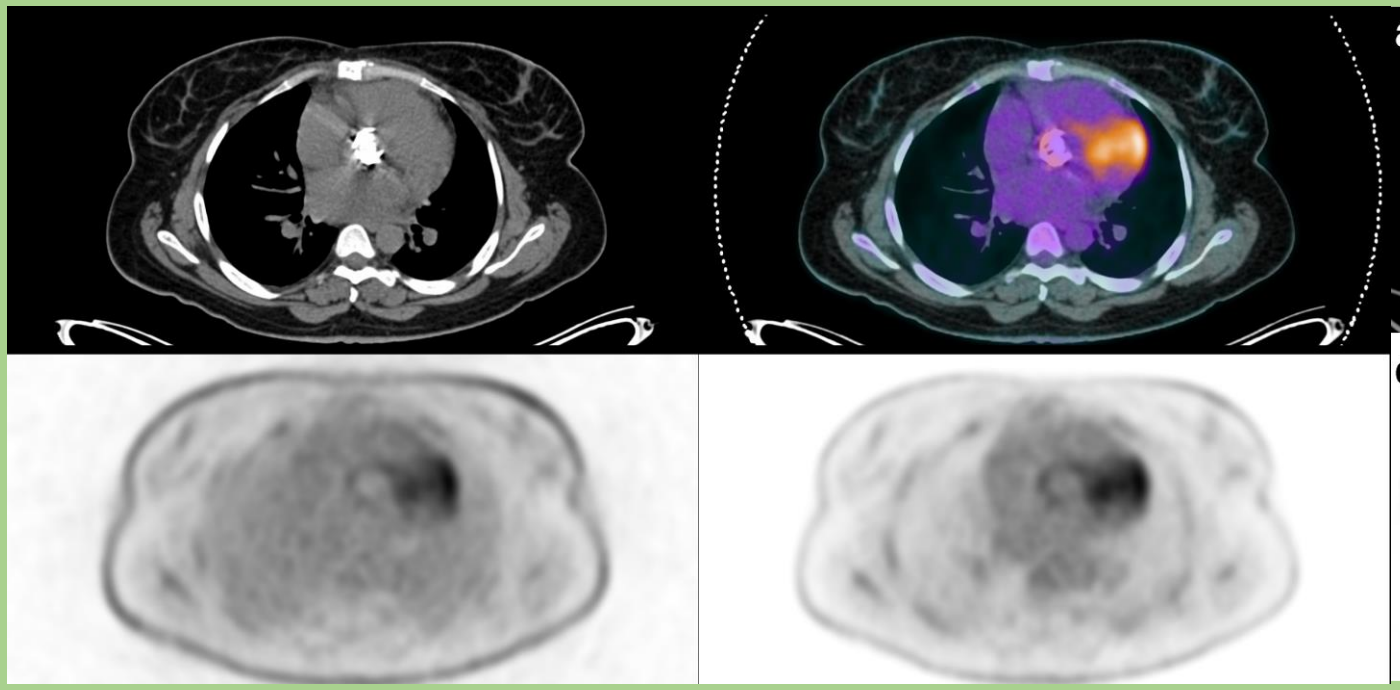
NAC

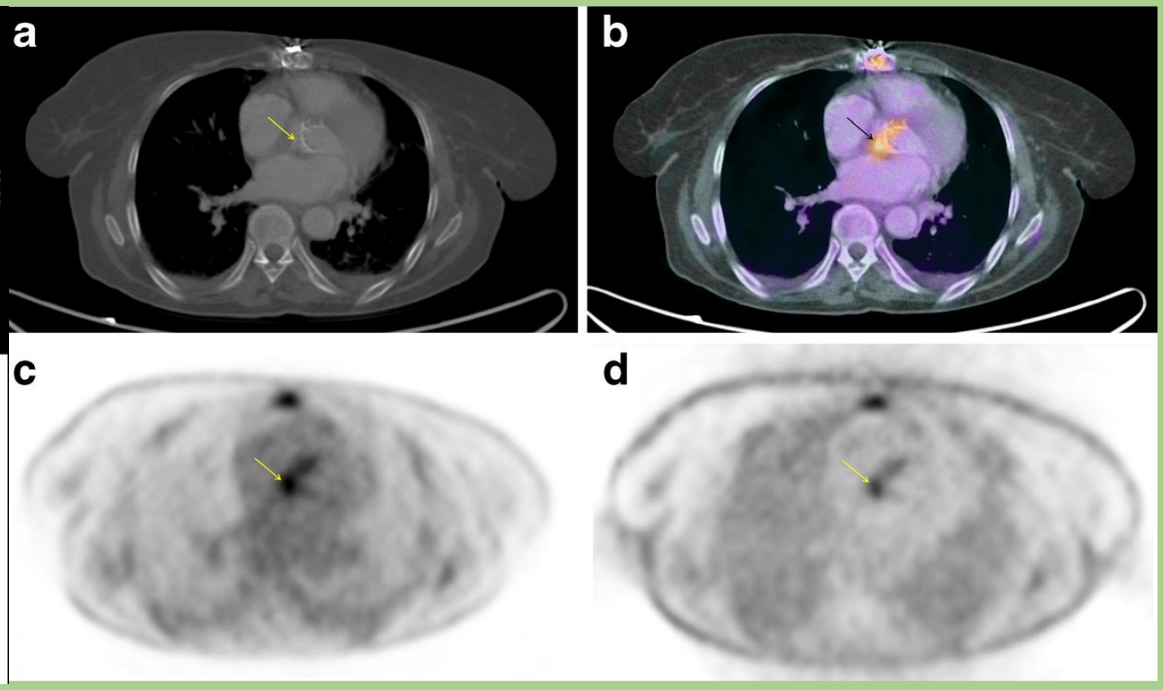
fused



Negative for IE

Positive for IE





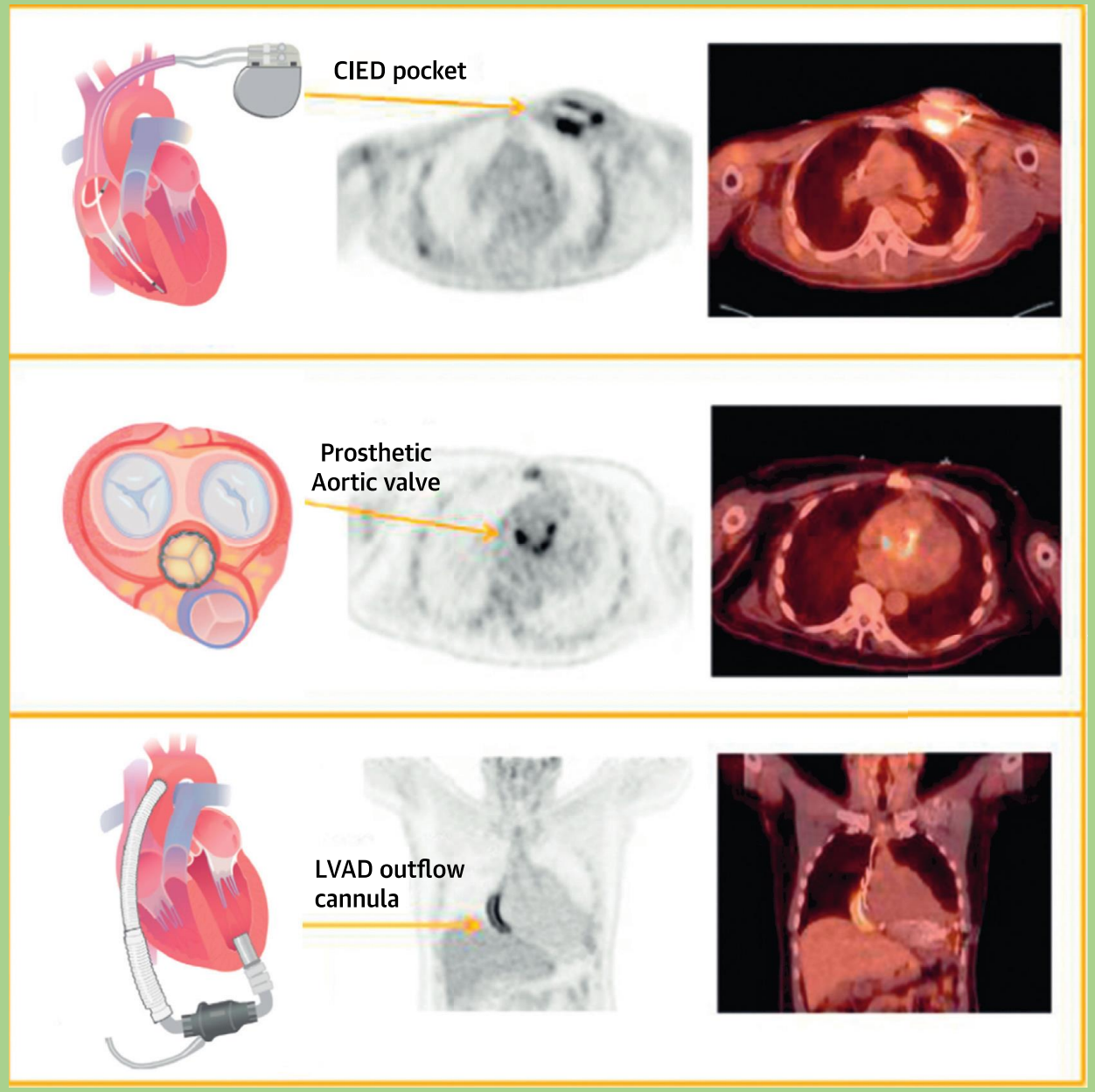
NAC

AC

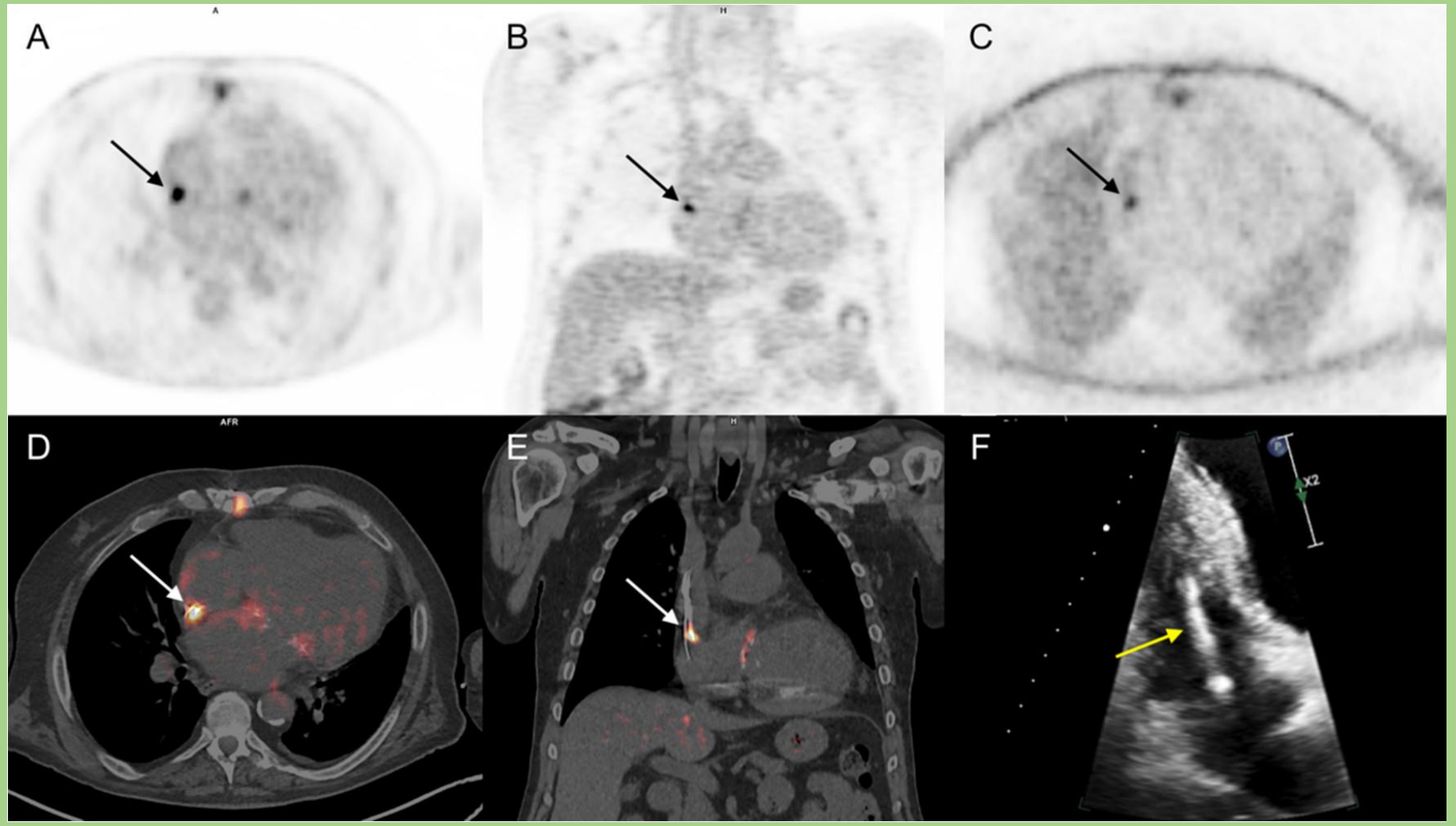
AC

NAC

cardiac implantable electronic devices IE

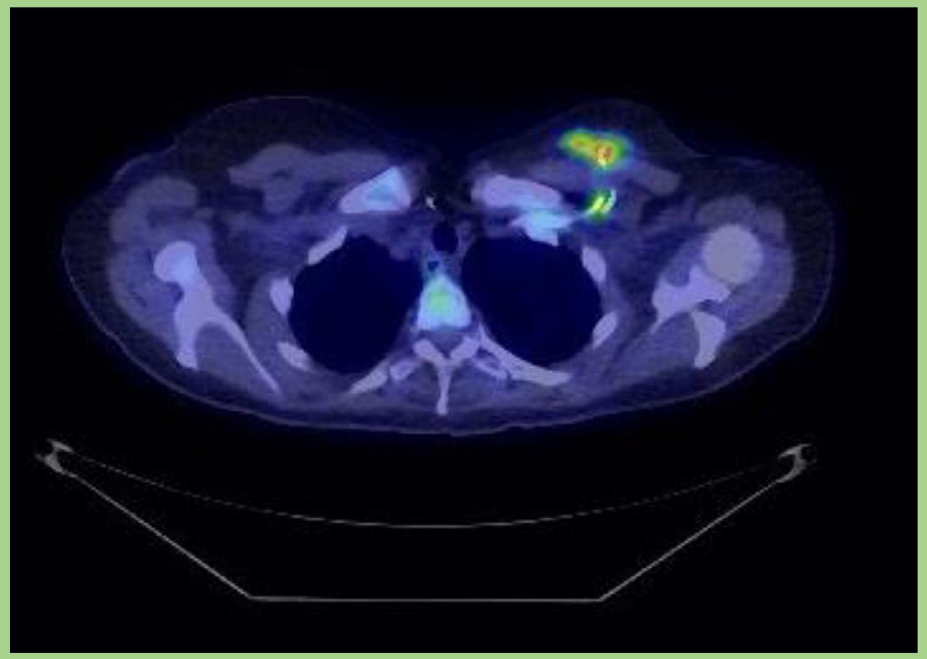


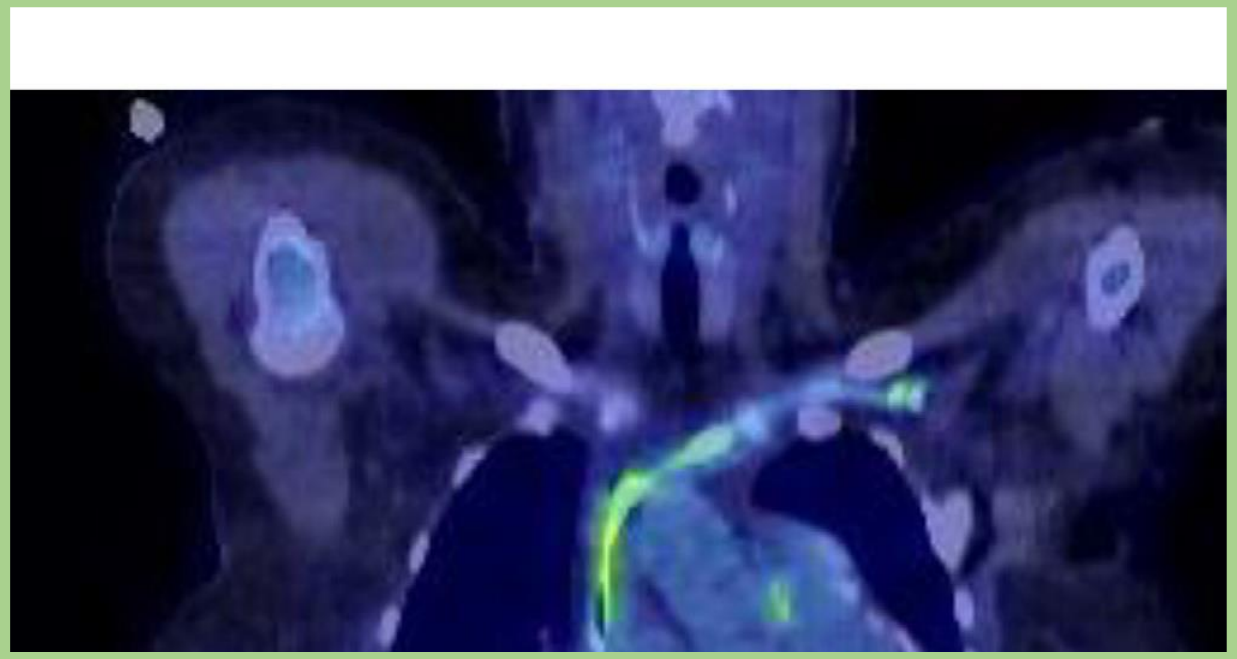
Chen, W. et al. J Am Coll Cardiol Img. 2018;11(11):1679–91.

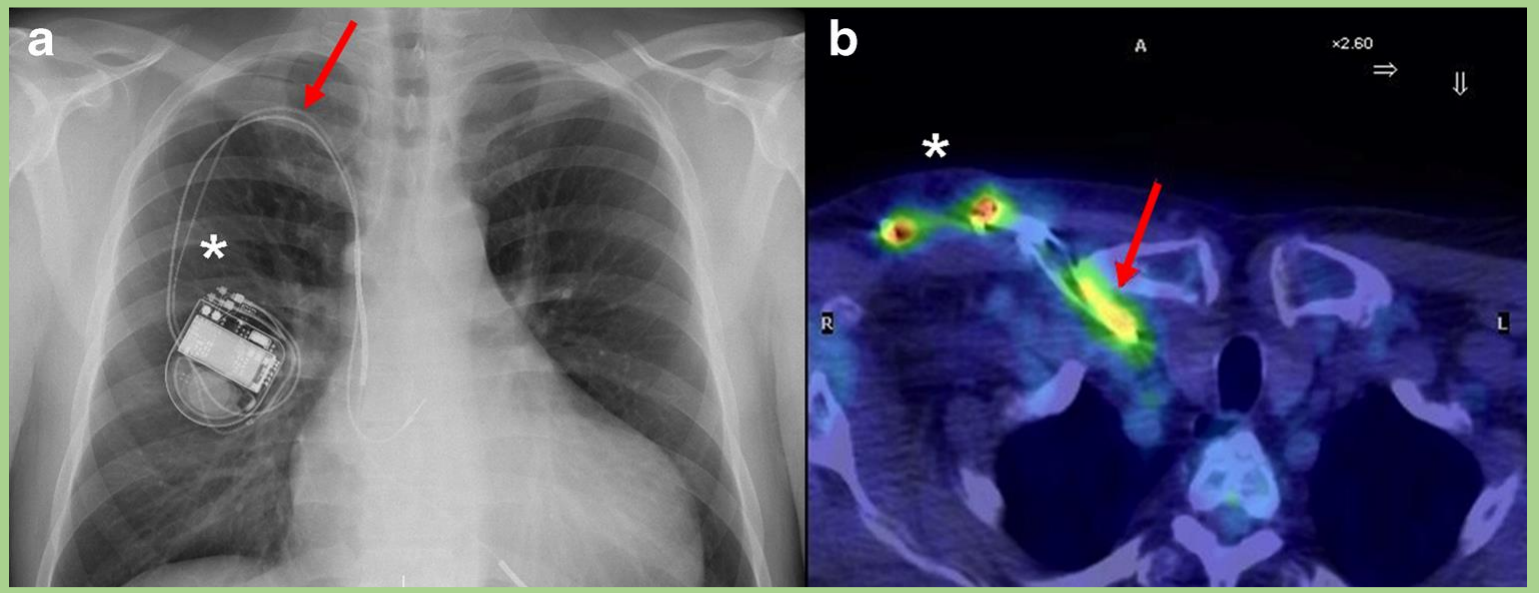


implantable cardiac defibrillator lead IE
Pretet et al., Diagnostics 2021, 11, 720

Mahmood and Abu Saleh, Seminars in Nuclear medicine, 2020





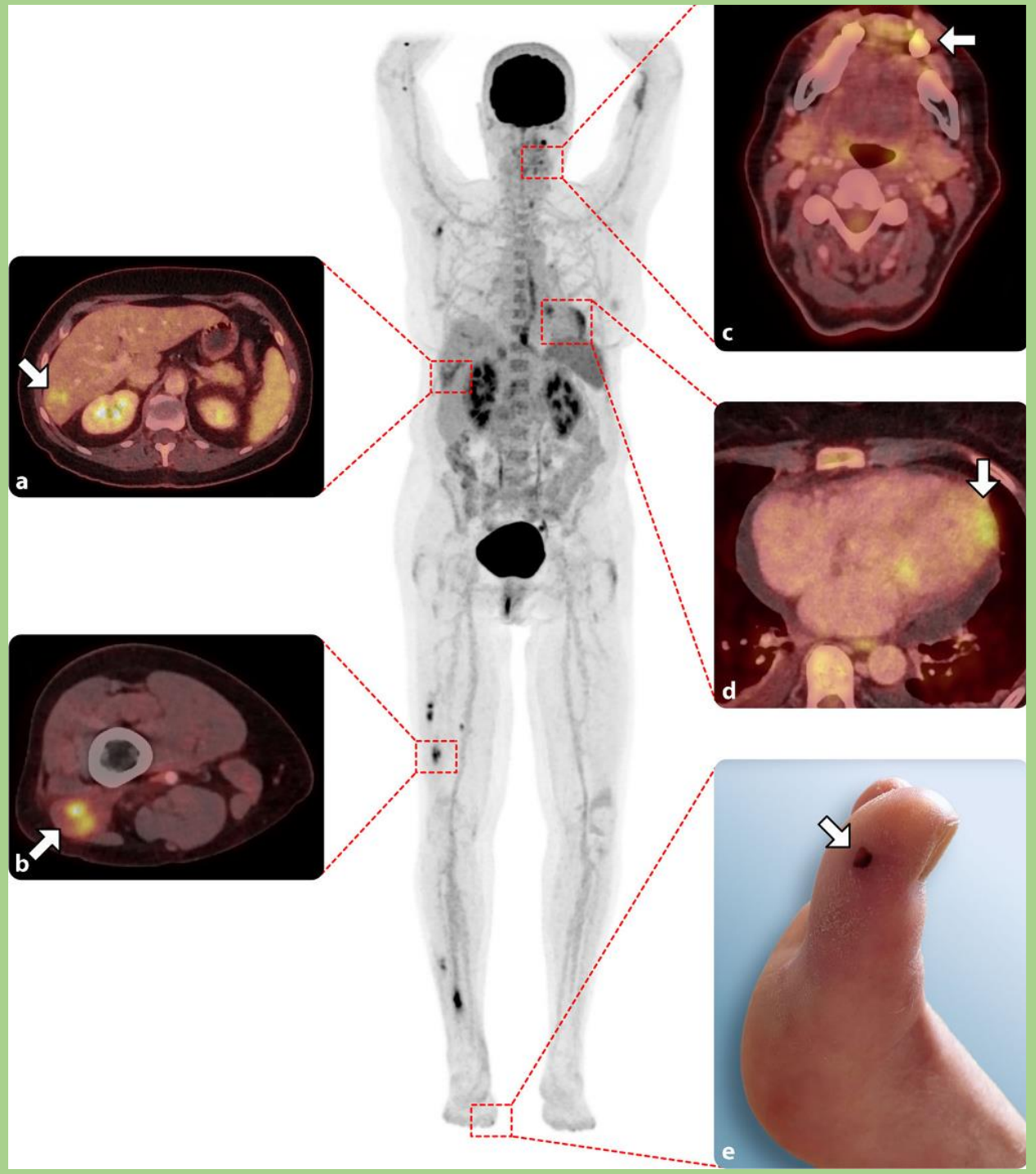


Distant embolisation in infective endocarditis: characteristics and outcomes

Mariëlle G. J. Duffels · Tjeerd Germans · Annet Bos-Schaap · Olivier Drexhage · Jiri F. P. Wagenaar · Friso M. van der Zant · Martine Hoogewerf · Remco J. J. Knol · Victor A. W. M. Umans

Neth Heart J (2023) 31:390–398

- 157 patients
- Incedence of distant embolization 24%
- Cerebral and coronary embolization provoked symptoms, while visceral emboli remained silent.


a
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Clinical Infectious Diseases

MAJOR ARTICLE

Impact of Systematic Whole-body ^{18}F-Fluorodeoxyglucose PET/CT on the Management of Patients Suspected of Infective Endocarditis: The Prospective Multicenter TEPvENDO Study

Xavier Duval,[1,2,3,4] Vincent Le Moing,[5] Sarah Tubiana,[1,2,3] Marina Esposito-Farèse,[1,2,6] Emila Ilic-Habensus,[1,2] Florence Leclercq,[7] Aurélie Bourdon,[8] François Goehringer,[9] Christine Selton-Suty,[10] Elodie Chevalier,[11] David Boutoille,[12] Nicolas Piriou,[13,14] Thierry Le Tourneau,[13] Catherine Chirouze,[15] Marie-France Seronde,[16] Olivier Morel,[17] Lionel Piroth,[18] Jean-Christophe Eicher,[19] Olivier Humbert,[20] Matthieu Revest,[21,22] Elise Thébault,[22] Anne Devillers,[23] François Delahaye,[24] André Boibieux,[25] Bastien Grégoire,[26] Bruno Hoen,[9] Cédric Laouenan,[1,2,3,4,6,a] Bernard Iung,[1,2,3,4,a] and François Rouzet[1,2,3,4,27,a]; for the AEPEI-TEPvENDO study group

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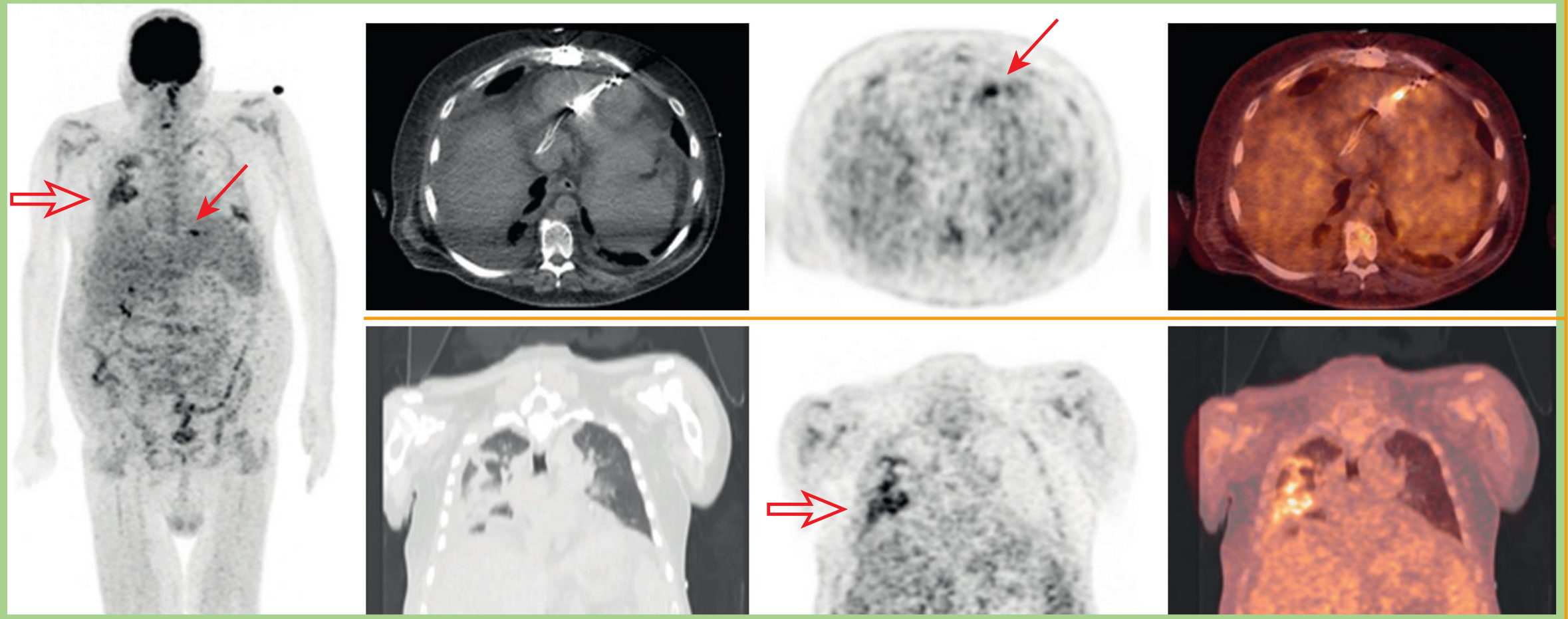
Duval et al., **Clinical infectious diseases 2021:73**

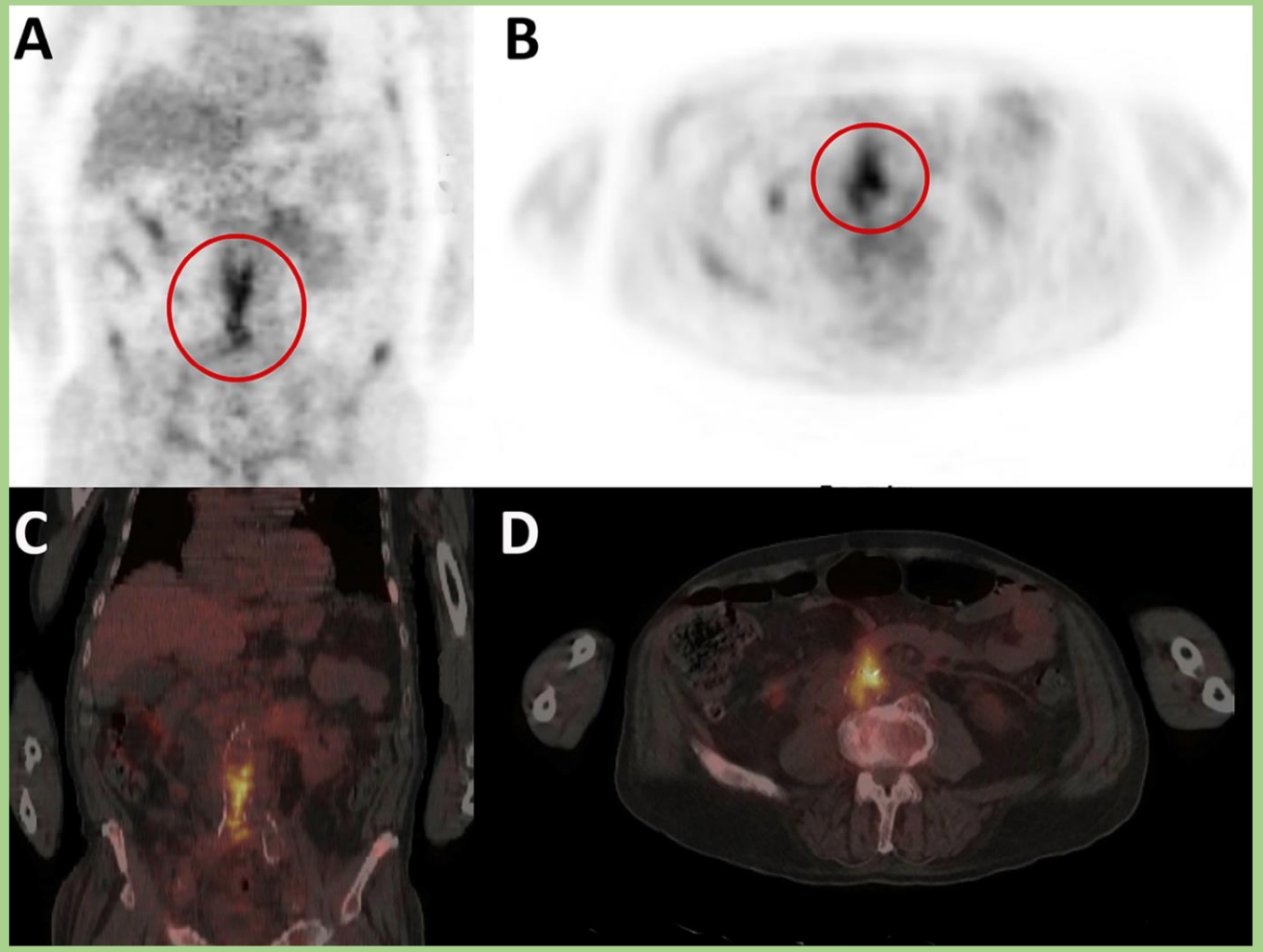
- 140 patients
- Emboli/infection was found in 69 patients (49.3%)
- Portal of entry was detected in 33 patients (23.6%)
- Management modification in 37 patients (24.6%)
  - antibiotic therapy (modification of duration and/or of type) in 22 patients
  - Surgical management (surgery postponed, advanced, indicated, or canceled) in 7 patients)
  - Both in 5 patients
  - Other aspects in 3 patients


A
B
C

Defibrillator Lead Infection With Lung Septic Emboli



Detection of other cause for fever



Prognostic significant of FDG PET/CT in patients with IE

- 18F-FDG PET/CT is predictive of major cardiac events in prosthetic valve endocarditis and new embolic events within the first year following IE. (J Am Coll Cardiol 2019;74:1031–40).
- Moderate to intense valvular FDG uptake was assocaited with worse outcome.

Future prostectives

- FDG PET/MRI for native valve
- Dynamic FDG PET/CT (infection or inflammation)
- AI (infection or inflammation)
- FDG PET/CT guided therapy
  - Monitoring effect of treatment
  - Guiding therapeutic decision making:
    - changing antibiotic dose.
    - switching to a different therapeutic strategy.
    - deciding when treatment can safely be stopped.