

CADTH RAPID RESPONSE REPORT: SUMMARY OF ABSTRACTS

Positron Emission Tomography–Computed Tomography for Cardiovascular Indications: Diagnostic Accuracy, Clinical Utility, Cost-Effectiveness, and Guidelines

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About CADTH: CADTH is an independent, not-for-profit organization responsible for providing Canada's health care decision-makers with objective evidence to help make informed decisions about the optimal use of drugs, medical devices, diagnostics, and procedures in our health care system.

Research Questions

1. What is the diagnostic test accuracy of positron emission tomography–computed tomography (PET-CT) in patients with cardiac sarcoidosis, prosthetic vascular graft infection, or infective endocarditis?
2. What is the clinical utility of PET-CT in patients with cardiac sarcoidosis, prosthetic vascular graft infection, or infective endocarditis?
3. What is the cost-effectiveness of PET-CT in patients with cardiac sarcoidosis, prosthetic vascular graft infection, or infective endocarditis?
4. What are the evidence-based guidelines regarding the use of PET-CT in patients with cardiac sarcoidosis, prosthetic vascular graft infection, or infective endocarditis?

Key Findings

Three systematic reviews (two with meta-analysis), one meta-analysis, and seven non-randomized studies were identified regarding positron emission tomography–computed tomography in patients with cardiac sarcoidosis, prosthetic vascular graft infection, or infective endocarditis. No relevant evidence-based guidelines were identified.

Methods

A limited literature search was conducted on key resources including PubMed, the Cochrane Library, University of York Centre for Reviews and Dissemination (CRD) databases, Canadian and major international health technology agencies, as well as a focused Internet search. No filters were applied to limit the retrieval by study type. Where possible, retrieval was limited to the human population. The search was also limited to English language documents published between January 1, 2013 and July 27, 2018. Internet links were provided, where available.

Selection Criteria

One reviewer screened citations and selected studies based on the inclusion criteria presented in Table 1.

Table 1: Selection Criteria

Population	Patients with cardiac sarcoidosis, prosthetic vascular graft infection, or infective endocarditis
Intervention	Fluorodeoxyglucose Positron Emission Tomography–Computed Tomography (FDG PET-CT)
Comparators	Q1-3: Alternative diagnostic modalities (e.g., single-photon emission computed tomography [SPECT], electrocardiogram [EKG], magnetic resonance imaging [MRI], myocardial perfusion scan); Biopsy Q4: No comparator
Outcomes	Q1: Diagnostic accuracy Q2: Clinical utility Q3: Cost-effectiveness Q4: Evidence-based guidelines
Study Designs	Health technology assessments, systematic reviews, meta-analyses, randomized controlled trials, non-randomized studies, economic evaluations, evidence-based guidelines

Results

Rapid Response reports are organized so that the higher quality evidence is presented first. Therefore, health technology assessment reports, systematic reviews, and meta-analyses are presented first. These are followed by randomized controlled trials, non-randomized studies, economic evaluations, and evidence-based guidelines.

Three systematic reviews (two with meta-analysis), one meta-analysis, and seven non-randomized studies were identified regarding PET-CT in patients with cardiac sarcoidosis, prosthetic vascular graft infection, or infective endocarditis. No relevant health technology assessments, randomized controlled trials, economic evaluations, or evidence-based guidelines were identified.

Additional references of potential interest are provided in the appendix.

Overall Summary of Findings

Three systematic reviews (SRs)^{1-2,4} (two with meta-analysis^{1,3}), one meta-analysis (MA),³ and seven non-randomized studies⁵⁻¹¹ were identified regarding positron emission tomography–computed tomography (PET-CT) in patients with cardiac sarcoidosis, prosthetic vascular graft infection, or infective endocarditis.

Conflicting evidence was identified in the SRs and MAs, with one SR stating that (18)F-fluorodeoxyglucose (FDG) PET-CT had good accuracy, sensitivity, and specificity in the diagnosis of infective endocarditis (IE)¹ while another SR noted that its sensitivity was low in patients with IE.⁴ The authors of two other SRs noted that (18)F-FDG PET-CT should be considered as an adjunctive imaging technique in challenging³ cases of IE,^{2,3} particularly in cases of prosthetic valve endocarditis.³

Of the identified non-randomized studies, it was observed that (18)F-FDG PET-CT may be useful in the diagnosis of cardiac sarcoidosis in patients with new onset atrioventricular block,⁶ IE⁹ (including transcatheter aortic valve replacement IE⁸), and prosthetic valve endocarditis.¹¹ (18)F-FDG PET-CT was also observed to identify metabolically active disease in patients presenting with persistent cardiac inflammatory symptoms.¹⁰ In addition,

the uptake of (18)F-FDG was observed to be greater in cardiac lesions when compared to (18)F-3'-deoxy-3'-(18)F-fluorothymidine (FLT).⁵

Detailed trial characteristics and conclusions are presented in Table 2.

Table 2: Detailed Study Characteristics of Included Studies

First Author, Year	Study and Population Characteristics	Intervention	Comparator(s)	Outcome(s)	Conclusions
Systematic Reviews and Meta-Analyses					
Juneau, 2018 ¹	<ul style="list-style-type: none"> 14 studies included Patients with IE MA performed 	(18)F-FDG PET-CT	<ul style="list-style-type: none"> (67)Ga citrate^a Radiolabeled WBC scintigraphy 	Utility (sensitivity, specificity, accuracy)	<ul style="list-style-type: none"> (18)F-FDG PET-CT and WBC have good accuracy, sensitivity, and specificity for the diagnosis of IE Both (18)F-FDG PET-CT and WBC can be considered when there is an uncertain diagnosis
Gomes, 2017 ²	<ul style="list-style-type: none"> 31 studies included Patients with NVA, intracardiac prosthetic material-related infection, or extracardiac foci 	(18)F-FDG PET-CT	<ul style="list-style-type: none"> MDCTA ECG-gated MRI Leucocyte scintigraphy 	Diagnostic performance	<ul style="list-style-type: none"> Positive but weak evidence for the diagnostic benefit of (18)F-FDG PET-CT and MDCTA They should be considered as additional imaging techniques when IE is suspected
Mahmood, 2017 ³	<ul style="list-style-type: none"> 13 studies included (N=537) Patients with IE, NVA, PVE MA performed 	(18)F-FDG PET-CT	NA	Accuracy	<ul style="list-style-type: none"> (18)F-FDG PET-CT is a useful evaluative adjunctive diagnostic tool in diagnostically challenging cases of IE (particularly PVE)
Yan, 2016 ⁴	<ul style="list-style-type: none"> 6 studies included (N=246) Patients with IE MA performed 	(18)F-FDG PET-CT	NA	Evidence of sensitivity, specificity	<ul style="list-style-type: none"> (18)F-FDG PET-CT has low sensitivity; hence is not sufficient for the diagnosis of IE
Non-Randomized Studies					
Norikane, 2017 ⁵	<ul style="list-style-type: none"> Retrospective study 20 patients with newly diagnosed sarcoidosis 	(18)F-FDG PET-CT	(18)F-FLT PET-CT	<ul style="list-style-type: none"> Uptake of radiotracers Diagnosis of lesions 	<ul style="list-style-type: none"> Both (18)F-FDG and (18)F-FLT can detect cardiac and extra-cardiac thoracic involvement in patients newly diagnosed with sarcoidosis Uptake in lesions was significantly higher using (18)F-FDG compared with (18)F-FLT

First Author, Year	Study and Population Characteristics	Intervention	Comparator(s)	Outcome(s)	Conclusions
Ohira, 2016 ⁶	<ul style="list-style-type: none"> Prospective study involving 30 steroid-naïve patients with newly diagnosed CSD due to CS Patients classified as: <ul style="list-style-type: none"> Group A (having either chronic mild CSD (right bundle branch block and/or axis deviation) Group B (new onset AVB; Mobitz type II or 3rd degree AVB) 	(18)F-FDG PET-CT	CMR	Diagnostic ability	<ul style="list-style-type: none"> (18)F-FDG PET-CT may be useful for detecting cardiac involvement due to CS in patients presenting with new-onset AVB and a negative CMR study
Danwade, 2018 ⁷	<ul style="list-style-type: none"> Prospective study 35 patients (ages 18-55) presenting with unexplained AVB and requiring a permanent pacemaker 	(18)F-FDG PET-CT	Transthoracic echocardiography	<ul style="list-style-type: none"> Prognostic value of (18)F-FDG PET-CT to detect IE 	<ul style="list-style-type: none"> Patients with abnormal myocardial (18)F-FDG PET-CT uptake and high-degree AVB were observed to have more AEs and worse outcomes
Salaun, 2018 ⁸	<ul style="list-style-type: none"> Prospective study 16 patients referred for TAVR-IE suspicion 	(18)F-FDG PET-CT	<ul style="list-style-type: none"> Echocardiography Multislice CT 	Value of multi-imaging approaches in diagnosing TAVR-IE	<ul style="list-style-type: none"> “Conventional modified Duke criteria have a low diagnostic value; while multi-imaging approach (ESC-2015 modified criteria) have an excellent sensitivity in this setting, thanks to the use of multimodality imaging.”⁸
Lauridsen, 2017 ⁹	<ul style="list-style-type: none"> Prospective study 55 IE patients 	(18)F-FDG PET-CT	WBC-SPECT-CT	Clinical utility (positive findings detected by each imaging modality and clinical relevance of these findings)	<ul style="list-style-type: none"> 91 pathological foci identified by (18)F-FDG PET-CT while 37 were identified by WBC-SPECT-CT Clinical utility significantly higher using (18)F-FDG PET-CT compared with WBC-SPECT-CT In terms of diagnosing extra-cardiac IE the inter-observer reproducibility was substantial to excellent for (18)F-FDG

First Author, Year	Study and Population Characteristics	Intervention	Comparator(s)	Outcome(s)	Conclusions
					PET-CT (potentially superior to WBC-SPECT-CT)
Saponjki, 2017 ¹⁰	<ul style="list-style-type: none"> • Cohort retrospective study • 73 cardiovascular patients with persistent inflammatory symptoms 	(18)F-FDG PET-CT	<ul style="list-style-type: none"> • Biopsy of blood vessel (gold standard) and histopathological verification 	Detection of active disease	<ul style="list-style-type: none"> • (18)F-FDG PET-CT could be useful method to detect signs of metabolically active disease in patients with persistent symptoms of infection and inflammation of CV disease • Could also be useful in monitoring therapy response
Pizzi, 2015 ¹¹	<ul style="list-style-type: none"> • Prospective study • 92 admitted patients suspected of having prosthetic valve or cardiac device IE 	(18)F-FDG PET-CT	(18)F-FDG PET/CTA	Diagnostic accuracy	<ul style="list-style-type: none"> • In patients with suspected IE and prosthetic valves or cardiac devices, (18)F-FDG PET-CT improves diagnostic accuracy of modified Duke criteria

AE = adverse event; AVB = atrioventricular block; BMIPP = (123)I-radioiodinated 15-(p-iodophenyl)-3(R,S)-methylpentadecanoic acid; CMR = cardiac magnetic resonance; CS = cardiac sarcoidosis; CSD = conduction system disease; CT = computed tomography; CV = cardiovascular; FDG = fluorodeoxyglucose; (18)F-FLT = 3'-deoxy-3'-(18)F-fluorothymidine; ECG = electrocardiogram; Ga = gallium; IE = infective endocarditis; MA = meta-analysis; MDCTA = electrocardiogram-gated multidetector CT angiography; MRI = magnetic resonance imaging; NA = not applicable; NVA = native valve endocarditis; PET-CT = Positron Emission Tomography-computed tomography; PET-CTA = (18)F-FDG PET/CT angiography; PVE = prosthetic valve endocarditis; PVGI = prosthetic vascular graft infection; SPECT = single-photon emission computed tomography; SUVmax = maximum standardized uptake value; TAVR = transcatheter aortic valve replacement; TL = thallium-201; WBC = white blood cell.

^a No (67)Ga citrate study met the inclusion criteria.

References Summarized

Health Technology Assessments

No literature identified.

Systematic Reviews and Meta-analyses

Infective Endocarditis and/or Prosthetic Vascular Graft Infection

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[PubMed: PM29086386](#)
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Randomized Controlled Trials

No literature identified.

Non-Randomized Studies

Cardiac Sarcoidosis

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Infective Endocarditis

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Infective Endocarditis and/or Prosthetic Vascular Graft Infection

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[PubMed: PM29324913](#)

Prosthetic Vascular Graft Infection

11. Pizzi MN, Roque A, Fernandez-Hidalgo N, et al. Improving the diagnosis of infective endocarditis in prosthetic valves and intracardiac devices with 18F-fluorodeoxyglucose positron emission tomography/computed tomography angiography: initial results at an infective endocarditis referral center. *Circulation*. 2015 Sep 22;132(12):1113-1126.

[PubMed: PM26276890](#)

Economic Evaluations

No literature identified.

Guidelines and Recommendations

No literature identified.

Appendix — Further Information

Previous CADTH Reports

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Systematic Reviews and Meta-Analyses – Alternative Outcome

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Scoping Review

16. Kelly J. Does the addition of positron emission tomography/computed tomography (PET/CT) to the routine investigation and assessment of patients with sarcoidosis yield clinical and economic benefits? (*Technologies scoping report*). Glasgow: Health Improvement Scotland; 2013 Jan. CDR abstract: <https://www.crd.york.ac.uk/CRDWeb/ShowRecord.asp?AccessionNumber=32013000485&UserID=0>

Non-Randomized Studies – No Comparator

Cardiac Sarcoidosis

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Infective Endocarditis

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[PubMed: PM27596984](#)

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[PubMed: PM25636930](#)

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Prosthetic Vascular Graft Infection

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Economic Evaluations – Costing Study

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See: Table 2: Jurisdictional scan of public provision and funding of PET-CT imaging for non-cancer indications, pages 8-11

Clinical Practice Guidelines – Methodology Not Specified

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*See: PET, PET/CT, AND PET/MR INSTRUMENTATION;
 PET AND PET/CT OR PET/MR IMAGING QC;
 Combined PET/CT QC Procedures*
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Position Statements

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