

Supplementary Table S1. Evidence table of the 28 eligible DECT CTPA studies: design, platform, population, tier contribution, reference standard, principal endpoint, OCEBM level, and principal limitation											
Study (ref)	Design	Sample size	DECT platform	Patient population	Tier I	Tier II	Tier III	Reference standard	Principal endpoint/key result	OCEBM level	Major limitation (per original publication)
Monti et al. ³	Systematic review + meta-analysis	17 studies	Mixed platforms	Suspected acute PE		✓		Composite standards of included studies	Pooled Sen 0.87–0.90/Spe 0.90–0.93; no advantage over SECT	1a	Subsegmental emboli excluded from pooling owing to heterogeneity; composite reference standards rather than head-to-head SECT comparison
Wannasopha et al. ⁴	Retrospective	64	Dual-source	Suspected acute PE		✓		Standard CTPA consensus read	40-keV VMI+ AUROC 0.882; kappa 0.75 vs. 0.88 standard	3	Small sample; agreement decline on VMI+ untested statistically
Krasniqi et al. ⁶	Prospective observational	177 (92 DECT/85 SECT)	Dual-source	Suspected PE	✓			CTPA quantitative image quality (200-HU criterion)	SNR/CNR significantly higher for 45-mL DECT vs. 60-mL SECT	3	More non-diagnostic enhancements in DE-CTPA group (16.1% vs. 5.2%); single-center observational
Ferrández-Ferrández et al. ⁷	Prospective randomized (single-center)	150 (50 × 3 protocols)	Dual-layer spectral (IQon-type)	CTPA to rule out PE	✓	✓		— (image-quality RCT)	Vascular attenuation maintained down to 20 mL CM; perfusion defects seen in all PE cases	1b	Patient characteristics not individualized by design; volumetric iodine density measured over ROI, not whole lung
Almeida et al. ⁹	Retrospective (single-center)	270 (A/B/C groups)	Dual-source SOMATOM Drive	Consecutive suspected PE	✓			CNR main/lower-lobe segmental arteries	Adaptive delay CNR gain vs. fixed delay ($P = 0.03/P = 0.002$)	3	Single center, one vendor/platform, one protocol; hemodynamic data unavailable
Yuanet al. ^{11*}	Prospective randomized	94 (46 SE/48 DE)	(pre-2016 DSDE system; vendor not stated in extract)	Suspected PE	✓			Quantitative/qualitative image quality	Iodine load reduced at preserved attenuation with monochromatic imaging	1b	Focused on image criteria without diagnostic accuracy against a reference standard
Geyer et al. ^{12*}	Feasibility (initial results)	14	Single-source rapid kVp-switching	Suspicion of acute PE		✓		CTPA findings	Per-patient Sen 80.0%/Spe 88.9%; perfusion maps visualized occlusive clots	3	First feasibility study; patient number too small to generalize diagnostic accuracy
Liu et al. ³⁴	Retrospective comparative	48	Dual-source subtraction CTPA	Acute PE work-up		✓		V/Q-SPECT/CT	Sen 0.917/Spe 0.991; segmental 100%, subsegmental 66.7%	3	Reference standard was V/Q-SPECT/CT, with known false-positive risk in interlobar-fissure regions; severe cardiac dysfunction or emphysema may mask perfusion defects and cause misclassification
Wu et al. ⁴³	Retrospective	52 (86 lesions)	Dual-layer spectral detector CT	Confirmed acute APE		✓		CTPA (gold standard)	Detection rates: EDM 54.7%; EDM+Zeff fusion 69.8% (non-contrast)	3	Small sample; only acute PE enrolled, without chronic-PE comparison
Meier et al. ²⁷	Propensity score-matched	82 (41 vs. 41)	Dual-source	Low-pretest-probability; BMI< 30 enrolled	✓			Standard-dose CTPA cohort comparison	CNR non-inferior with 6-g iodine load (15 mL)	3	Comparison arm enrolled retrospectively (PSM mitigation); proprietary reconstruction algorithm
Gertz et al. ³³	Retrospective (single-center)	131 (57 APE/52 CTEPH/22 controls)	Dual-layer spectral DL-DECT	APE vs. CTEPH vs. controls		✓		Expert consensus incl. right-heart catheterization	APE vs. CTEPH iodine-density discrimination AUROC 0.82	3	Controls not healthy volunteers; revised PH definition shifted some controls; no established reference values for DECT perfusion
Suo et al. ³⁵	Retrospective (single-center)	40	Dual-source	Suspected acute PE		✓		CTPA-based reference	Iodine density threshold 1.75 mg/mL: Sen 92.0%/Spe 90.0%	3	Single-center, small sample; some images contained artifacts; few repeat-scan cases
Zhang et al. ²⁸	Prospective BMI-adapted protocol	90 (3 × 30)	Rapid kVp-switching (GE)	BMI < 30 kg/m2 only	✓			— (image-quality/feasibility)	Radiation + iodine reduction without IQ/accuracy loss within validated population	3	Single institution; no patients >30 kg/m2 included, so higher-BMI safety unstudied
Weidman et al. ³⁶	Retrospective	1,144 exams	Dual-source	Routine DE-CTPA readers		✓		Final integrated clinical reports	+27 emboli (77.8% subsegmental); new PE diagnosis 1.0% of exams	3	Maps not independently reviewed, so isolated incremental value undetermined; reader-level bias possible
Leithner et al. ²⁶	Retrospective (suboptimal enhancement)	68	Dual-source	DE-CTPA with suboptimal contrast	✓	✓		— (standard-of-reference per original report; extract inconclusive)	Protocol 3 accuracy 92.6%; AUROC 0.989 vs. 0.874 ($P = 0.003$) vs. M0.6	3	High PE prevalence (63.2%) suggests selection bias; obese patients not investigated; single-session intraobserver rating
Gotta et al. ³⁸	Retrospective radiomics (single-center)	131	Dual-source	Acute PE diagnostics/prognostication		✓	✓	Radiomics model internal validation	Discrimination accuracy 0.94 (AUROC 0.91); outcome biomarkers	3	Single-center by design to limit cross-scanner variability; retrospective design may affect reliability and generalizability; acceptable radiomics quality score, though higher would have strengthened findings
Im et al. ³⁹	Propensity score-matched retrospective	480 (240 vs. 240)	Dual-source	Acute PE		✓	✓	30-day mortality	Perfusion defect volume complementary to RV/LV (C-stat 0.819 vs. 0.759, $P = 0.117$)	3	Single-center with modest sample size; retrospective design may carry selection bias (mitigated by propensity matching); no standardized analytical method for lung perfusion defects (HU threshold, software)
Valizadeh et al. ⁴⁰	Meta-analysis	9 studies/751 participants	Mixed platforms	CTEPH evaluation		✓		Included-study standards (V/Q, RHC-context)	Pooled Sen 0.875/Spe 0.912; AUROC 0.95	1a	Small sample sizes lower power; selection-bias concerns prevalent; platform-specific subgrouping infeasible; constituents largely single-center retrospective
Yang et al. ²⁹	Randomized comparison (2 × 30)	60	GE Apex 256-slice rapid kVp switching	Clinically suspected PE	✓			— (image-quality endpoints)	DLIR (deep-learning image reconstruction) + double-low (70 kVp/35 mL) raises pulmonary artery (PA) attenuation 635.62 vs. 469.54 HU ($P = 0.001$)	3	Small case number; diagnostic accuracy of the double-low protocol not assessed
Yalon et al. ³⁰	Retrospective case-control	150 (3 × 50)	High-pitch dual-source PCD vs. conventional arms	Clinically indicated CTPA cohorts	✓			— (image-quality comparison)	Higher PA enhancement/SNR on PCD high-pitch VMI; motion-artifact reduction	3	No diagnostic-accuracy or reader-confidence comparison between modalities; inherent VMI artifact potential unblinded readers
Remy-Jardin et al. ³¹	Retrospective consecutive-cohort comparison	330 (EID 158 vs. PCD 172)	PCD NAEOTOM Alpha vs. EID SOMATOM Force	Consecutive suspected acute PE	✓	✓		Final CTA reports incl. follow-through reading	All-patient spectral acquisition; radiation dose ~48%; non-diagnostic exams reduced	3	No contrast-resolution advantage evaluated under equal injection design; retrospective scheme limited some artifact analyses
Sauter et al. ³²	Prospective ultra-low-dose feasibility	16	Third-gen dual-source	Confirmed PE follow-up ultra-low-dose CTPA	✓			Standard-dose comparator images	Iterative reconstruction preserves diagnostic confidence at very low dose	3	Very small number of patients
Abdellatif et al. ⁴¹	Systematic review + meta-analysis	7 studies/182 patients	Mixed platforms	Suspected acute PE		✓		Varied gold standards of included studies	Pooled Sen 0.89/Spe 0.95; AUROC 0.935	1a	Only 7 eligible studies (scarcity); heterogeneous populations/reference tests advise caution
Schüssler et al. ⁴²	Retrospective single-center tri-modality	62	Dual-source vs. V/Q-SPECT vs. PA	CTEPH suspected/diagnosed		✓		V/Q-SPECT and pulmonary angiography	Comparable diagnostic performance DECT vs. V/Q-SPECT/PA for CTEPH	3	Retrospective small single-center cohort; observer-agreement not investigated
Xie et al. ⁴⁴	Retrospective	27 (41 lesions)	Dual-layer spectral detector CT	Confirmed acute APE		✓		Spectral CTPA confirmation	Non-contrast multi-param detection 97.6% (40/41 lesions)	3	Retrospective single-center selection bias; small sample, central and mixed subtypes merged for analysis, potentially biasing subtype results
Yan et al. ³⁷	Retrospective paired-image comparison	62	Single-source spectral (rapid kVp switching)	Confirmed PE		✓		Diagnosed PE patients (paired reads)	Grade 5–7 emboli: IM 47 vs. ME 35 ($P < 0.05$); longer diameters shown on IM ($P < 0.001$)	3	Iodine-concentration and CT-value units cannot be unified with current technique, introducing potential bias; paired-image comparison only
Pannenbecker et al. ⁴⁵	Paired retrospective comparison	64 examinations (PCD vs. EID)	PCD-CT vs. EID-CT	Acute PE suspicion CTPA pairs	✓			Matched-pair imaging comparison	~contrast/radiation reduction potential; best subjective rating at 60 keV PC scans	3	Ultra-low-CM protocol diagnostic accuracy not evaluated
Pannenbecker et al. ⁴⁶	Prospective comparative (consecutive, Oct 2022–Apr 2023)	102 (51 PCD vs. 51 matched-EID)	PCD NAEOTOM Alpha vs. SOMATOM Force (ultra-high-pitch, free-breathing)	Acute PE diagnosis	✓			— (image-quality/dose endpoints; authors state no diagnostic reference standard was established)	Excellent/good IQ 96.1% vs. 50.9% (PCD vs. EID); non-diagnostic scans 0 vs. 3 (5.9%); effective dose 1.33±0.47 vs. 1.80±0.82 mSv (all $P < 0.05$)	3	Reconstruction asymmetry (single-energy kV-level EID vs. 60-keV VMI PCD) may bias objective IQ metrics; no pairwise randomization; diagnostic accuracy not evaluated because no diagnostic reference standard was established; single institution.

Table 1 itemizes the predefined eligible studies synthesized in this review, constructed in response to the request for transparent reporting of how individual studies contribute to each evidence tier. Role assignment followed the inclusion and exclusion criteria stated in Section 1.1: primary human-subject investigations and meta-analyses constitute the eligible roster (26 database-derived studies since 2016 plus 2 pre-2016 foundational references). Methodological citations, guidelines and consensus statements, narrative reviews retained as background context, and technical or preclinical investigations (including one task-based phantom optimization study and one swine timing study) are excluded from the roster but remain referenced in the main text where their function requires it. Three additional references^{18,23,36} entered during revision at reviewer request and lie outside the search accounting. Entries marked “suggested (author-confirm)” carry a proposed evidence level pending final author adjudication. All cell content was transcribed from the source publications held in the project literature library; cell-level provenance ledgers are retained by the authors and available on request.

APE, acute pulmonary embolism; AUROC, area under the receiver operating characteristic curve; BMI, body mass index; CM, contrast medium; CNR, contrast-to-noise ratio; CT, computed tomography; CTA, computed tomography angiography; CTEPH, chronic thromboembolic pulmonary hypertension; CTPA, computed tomography pulmonary angiography; DE, dual-energy; DECT, dual-energy computed tomography; DE-CTPA, dual-energy computed tomography pulmonary angiography; DL, deep learning; DL-DECT, deep learning dual-energy computed tomography; DLIR, deep learning image reconstruction; DSDE, dual-source dual-energy; EDM, electron density map; EID, energy-integrating detector; HU, Hounsfield unit; IM, iodine map; IQ, image quality; ME, mixed-energy; PA, pulmonary angiography; PCD, photon-counting detector; PCD-CT, photon-counting detector computed tomography; PE, pulmonary embolism; PH, pulmonary hypertension; PSM, propensity score matching; RHC, right heart catheterization; ROI, region of interest; SE, single-energy; SECT, single-energy computed tomography; Sen, sensitivity; SNR, signal-to-noise ratio; Spe, specificity; VMI, virtual monoenergetic imaging; VMI+, virtual monoenergetic imaging plus; V/Q, ventilation/perfusion; V/Q-SPECT, ventilation/perfusion single-photon emission computed tomography.