

Supplementary Online Content

Lee SW, Shim SR, Jeong SY, Kim SJ. Direct comparison of preoperative imaging modalities for localization of primary hyperparathyroidism: a systematic review and network meta-analysis. *JAMA Otolaryngol Head Neck Surg*. Published online June 3, 2021. doi:10.1001/jamaoto.2021.0915

eFigure 1. Risk of Bias and Applicability Concerns Graph Based on 15-Item Modified Quality Assessment of Diagnostic Accuracy Studies

eFigure 2. Funnel Plots for Eight Representative Categories of Various Imaging Modalities for pHPT Localization in Both Patient- and Lesion-Based Analyses

eFigure 3. Evidence Network Plots of Diagnostic Value of Eight Representative Categories of Various Imaging Modalities for pHPT Localization in Both Patient- and Lesion-Based Analyses

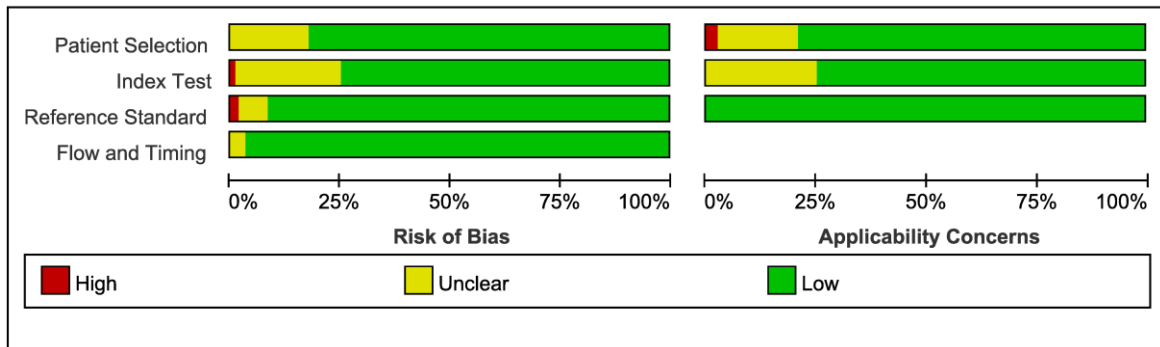
eTable 1. Search Queries

eTable 2. Characteristics of the Enrolled Studies

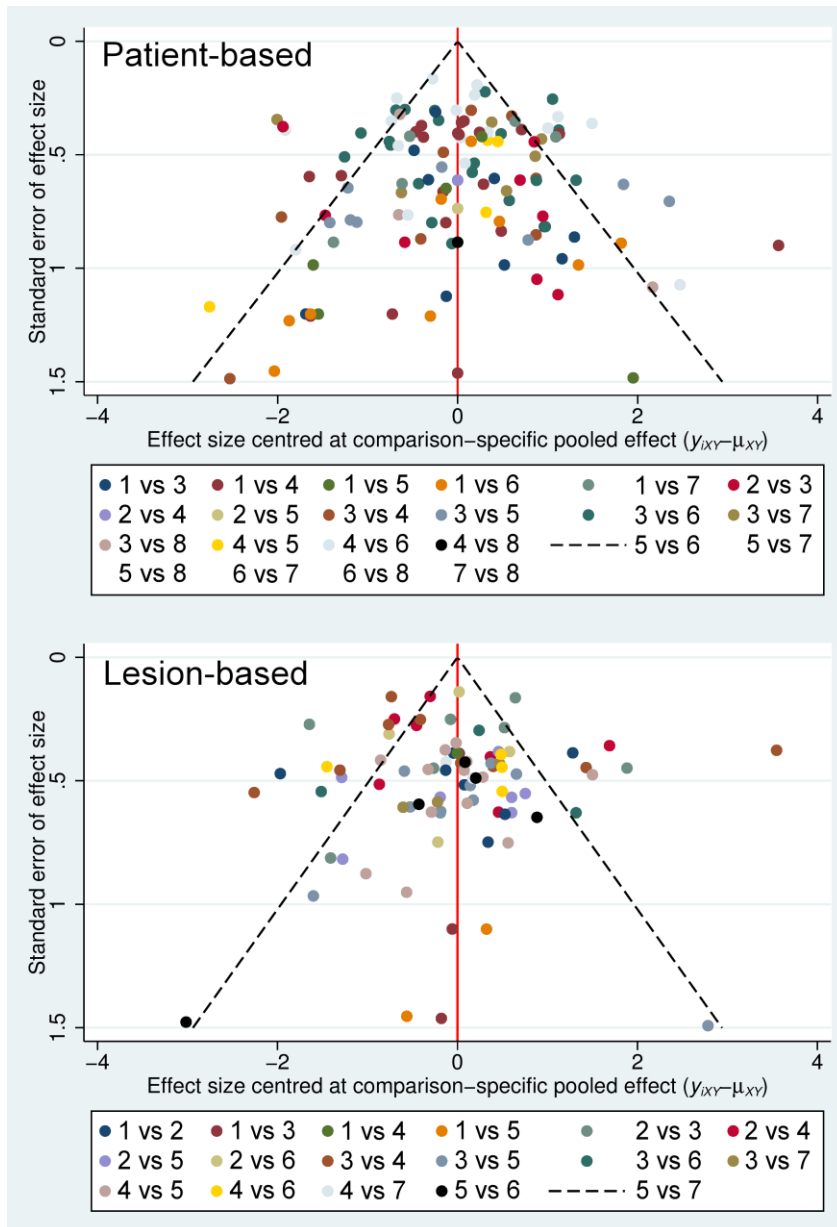
eReferences

This supplementary material has been provided by the authors to give readers additional information about their work.

eFigure 1. Risk of Bias and Applicability Concerns Graph Based on 15-Item Modified Quality Assessment of Diagnostic Accuracy Studies. Overall quality of the included studies was deemed satisfactory.

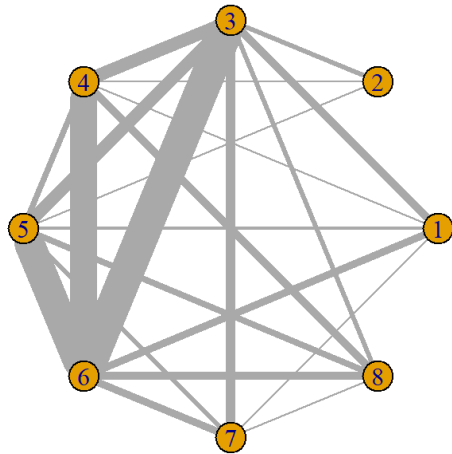


eFigure 2. Funnel Plots for Eight Representative Categories of Various Imaging Modalities for pHPT Localization in Both Patient- and Lesion-Based Analyses. (1, Choline PET/CT; 2, MET PET/CT; 3, MIBI SPECT; 4, MIBI planar; 5, Dual tracer; 6, US; 7, CT; 8, MRI)

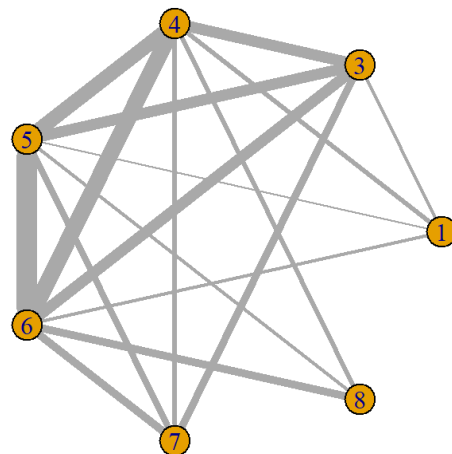


eFigure 3. Evidence Network Plots of Diagnostic Value of Eight Representative Categories of Various Imaging Modalities for pHPT Localization in Both Patient- and Lesion-Based Analyses. (1, Choline PET/CT; 2, MET PET/CT; 3, MIBI SPECT; 4, MIBI planar; 5, Dual tracer; 6, US; 7, CT; 8, MRI)

Patient-based



Lesion-based



eTable 1. Search Queries

<p><u>PubMed and Cochrane library</u></p> <ol style="list-style-type: none">1. Disease ("hyperparathyroidism, primary"[MeSH] OR "primary hyperparathyroidism"[tiab] OR "parathyroid adenoma"[tiab])2. Intervention ("pet"[tiab] OR "positron emission tomography"[MeSH] OR "spect"[tiab] OR "single photon emission computed tomography"[tiab] OR "scan"[tiab] OR "scintigraphy"[tiab] OR "us"[tiab] OR "ultrasonography"[MeSH] OR "ultrasound"[tiab] OR "ct"[tiab] OR "computed tomography"[tiab] OR "mri"[tiab] OR "magnetic resonance imaging"[MeSH])3. Outcome ("detection"[tiab] OR "localization"[tiab] OR "diagnosis"[MeSH])
<p><u>Embase</u></p> <ol style="list-style-type: none">1. Disease (primary hyperparathyroidism'/exp OR (primary AND hyperparathyroidism) OR 'parathyroid adenoma'/exp OR (parathyroid AND adenoma))2. Intervention (pet:ab,ti OR 'positron emission tomography':ab,ti OR spect:ab,ti OR 'single photon emission computed tomography':ab,ti OR scan:ab,ti OR scintigraphy:ab,ti OR us:ab,ti OR ultrasonography:ab,ti OR ultrasound:ab,ti OR ct:ab,ti OR 'computed tomography':ab,ti OR mri:ab,ti OR 'magnetic resonance imaging':ab,ti)3. Outcome (detection:ab,ti OR localization:ab,ti OR diagnosis:ab,ti)

eTable 2. Characteristics of the Enrolled Studies

Author	Year	Patient-based	Lesion-based	Design	Number of patients*	Age (mean)	Female	Imaging modality [§]	Modality category
Cuderman ¹	2020		o	P	103	64 [‡]	78	FCH PET/CT vs. MIBI SPECT/CT vs. MIBI planar vs. DT (MIBI-Tc)	1, 3, 4, 5
Juweid ²	2020	o		R	34	54.9	28	MIBI pinhole vs. DT (MIBI-Tc)	4, 5
Okudan ³	2019	o		R	125	51.3	96	MIBI SPECT/CT vs. US	3, 6
Parra Ramírez ⁴	2019	o	o	P	29	58.7	22	MIBI SPECT vs. CE-US	3, 6
Vitetta ⁵	2019	o		P&R	136	59	102	MIBI planar vs. CDHR-US	4, 6
Yeh ⁶	2019		o	R	400	61	319	MIBI SPECT/CT vs. 4D-CT	3, 7
Amadou ⁷	2019		o	R	29	63	25	FCH PET/CT vs. MIBI planar vs. US	1, 4, 6
Borumandi ⁸	2019	o		R	117	66 [‡]	102	MIBI SPECT vs. US	3, 6
Bossert ⁹	2019	o		P	17	64.1	10	FCH PET/CT vs. DT (MIBI-Tc) vs. US	1, 5, 6
Piccardo ¹⁰	2019	o		P	44	65.5 [‡]	35	FCH PET/CT vs. 4D-CT	1, 7
Scattergood ¹¹	2019	o		P	184	66	150	MIBI planar vs. US	4, 6
Vu ¹²	2019	o		R	31	56 [‡]	25	MIBI SPECT vs. 4D-CT	3, 7
Khafif ¹³	2019	o		P	19	60.5	15	FCH PET/MRI vs. MIBI SPECT vs. US	1, 3, 6
Asseeva ¹⁴	2019	o		R	90	64.5 [‡]	68	DT (MIBI-I) pinhole & SPECT/CT vs. US	5, 6
Zajíčková ¹⁵	2018	o		R	13	64.3	12	FCH PET/CT vs. MIBI SPECT/CT vs. US	1, 3, 6
Argirò ¹⁶	2018	o		P	57	63.3	50	MIBI SPECT vs. US vs. 3T-MRI	3, 6, 8
Beheshti ¹⁷	2018	o	o	P	82	59.8	66	FCH PET/CT vs. MIBI/TF SPECT/CT	1, 3
Cunha-Bezerra ¹⁸	2018		o	NR	18	55.1	15	MIBI planar vs. US vs. 4D-CT	4, 6, 7

Hiebert ¹⁹	2018	o		R	97	64	65	MIBI SPECT/CT vs. US vs. DE-CT	3, 6, 7
Araz ²⁰	2018	o		R	35	55.3	24	FCH PET/CT vs. MIBI SPECT/CT	1, 3
Thanseer ²¹	2017	o	o	P	54	47.7	38	FCH PET/CT vs. MIBI planar vs. US	1, 4, 6
Tunca ²²	2017	o		R	183	52.2	148	MIBI SPECT vs. US	3, 6
Frank ²³	2017	o		R	52	60	41	MIBI SPECT/CT vs. 3D-US	3, 6
Seyednejad ²⁴	2016	o		R	24	64	21	MIBI SPECT/CT vs. US vs. DE-CT	3, 6, 7
Tan ²⁵	2016	o		R	58	58	35	MIBI planar vs. US	4, 6
Krakauer ²⁶	2016		o	P	91	66 [‡]	67	MIBI planar vs. DT (MIBI-I) vs. 4D-CT	4, 5, 7
Galvin ²⁷	2016	o	o	R	40	60	31	MIBI SPECT/CT vs. 4D-CT	3, 7
Heiba ²⁸	2015		o	R	155	58	108	MIBI SPECT/CT vs. MIBI pinhole vs. DT (MIBI-I) SPECT/CT	3, 4, 5
Brown ²⁹	2015	o		R	100	62.1	78	MIBI SPECT/CT vs. US vs. 4D-CT	3, 6, 7
Suh ³⁰	2015		o	R	38	55.8	27	MIBI SPECT/CT vs. US vs. 4D-CT	3, 6, 7
Hayakawa ³¹	2015	o		NR	23	60.9	19	MET PET/CT vs. MIBI SPECT/CT vs. MIBI planar	2, 3, 4
Michaud ³²	2015	o		P	11			FCH PET/CT vs. DT (MIBI-I) vs. US	1, 5, 6
Berner ³³	2015		o	R	64 [†]	55	48	DT (MIBI-Tc) SPECT/CT vs. US	5, 6
Guerin ³⁴	2015	o		NR	199	64	163	DT (MIBI-I) pinhole & SPECT vs. US	5, 6
Ozkaya ³⁵	2015		o	R	39	41	27	MIBI SPECT vs. US	3, 6
Noda ³⁶	2014	o		R	61	63.5	52	MIBI planar vs. US	4, 6
Orevi ³⁷	2014	o		P	26			CCH PET/CT vs. MIBI SPECT/CT	1, 3
Ersoy ³⁸	2014	o		P	47	51.5	39	MIBI planar vs. E-US	4, 6
D'Agostino ³⁹	2013		o	P	27	56.9	21	DT (MIBI-I) SPECT/CT vs. CT	5, 7

Schalin-Jäntti ⁴⁰	2013	o	P	19	58.4	15	MET PET/CT vs. MIBI SPECT/CT vs. DT (MIBI-I)	2, 3, 5
Kwon ⁴¹	2013	o	R	105	53.8	77	MIBI planar vs. US	4, 6
Kim ⁴²	2012	o	NR	24			MIBI SPECT/CT vs. MIBI planar	3, 4
Aschenbach ⁴³	2012	o	R	30	45 [‡]	24	MIBI planar vs. dMRA	4, 8
Shafiei ⁴⁴	2012	o	P	48	59.4	33	MIBI SPECT/CT vs. MIBI planar	3, 4
Akbaba ⁴⁵	2012	o	NR	98	53.8	74	MIBI SPECT vs. MIBI planar vs. US vs. MRI	3, 4, 6, 8
Agha ⁴⁶	2012	o	NR	30	58	25	MIBI planar vs. CE-US vs. MRI	4, 6, 8
Grayev ⁴⁷	2012	o	P	25	59.7	22	MIBI planar vs. 3T-MRI	4, 8
Adler ⁴⁸	2011	o	P	310	60	226	MIBI planar vs. US	4, 6
Eichhorn-Wharry ⁴⁹	2011	o	R	135	59.2	109	MIBI SPECT vs. 4D-CT	3, 7
Patel ⁵⁰	2010	o	R	63	59 [‡]	42	MIBI SPECT/CT vs. US	3, 6
Prommegger ⁵¹	2009	o	P	116	59	80	MIBI SPECT/CT vs CT	3, 7
Thomas ⁵²	2009	o	P	36		25	MIBI SPECT vs. MIBI planar	3, 4
Tresoldi ⁵³	2009	o	R	65			DT (MIBI-Tc) vs. US	5, 6
Tublin ⁵⁴	2009	o	P	144	63.2	117	MIBI SPECT vs. US	3, 6
Tang ⁵⁵	2008	o	P	22			MET PET/CT vs. MIBI SPECT	2, 3
Ho Shon ⁵⁶	2008	o	R	62	59	47	MIBI SPECT vs. MIBI pinhole vs DT (MIBI-Tc) SPECT	3, 4, 5
Ansquer ⁵⁷	2008	o	R	49	69 [‡]	38	MIBI SPECT vs. DT (MIBI-Tc) vs. US	3, 5, 6
Nichols ⁵⁸	2008	o	R	462	58.5	336	MIBI SPECT vs. MIBI planar vs. DT (MIBI-Tc) pinhole	3, 4, 5
Carrier ⁵⁹	2008	o	P	51	56	38	MIBI pinhole SPECT vs. DT (MIBI-Tc) vs. US	3, 5, 6

Boudreaux ⁶⁰	2007	o	R	249			MIBI planar vs. US	4, 6
Taïeb ⁶¹	2007		P	35	61	30	MIBI SPECT vs. DT (MIBI-I) pinhole vs. US	3, 5, 6
Prasannan ⁶²	2007	o	P	130	59.1	97	MIBI planar vs. S-US	4, 6
Lavelly ⁶³	2007	o	R	98	59.9	68	MIBI SPECT/CT vs. MIBI planar	3, 4
Ruf ⁶⁴	2007	o	R	26	51.6	14	MIBI SPECT/CT vs. MIBI planar	3, 4
Lo ⁶⁵	2007	o	P	100	55.5 [‡]	70	MIBI planar vs. US	4, 6
Rodgers ⁶⁶	2006		P&R	75	60	63	MIBI SPECT/CT vs. US vs. 4D-CT	3, 6, 7
Steward ⁶⁷	2006	o	R	103			MIBI planar vs. S-US	4, 6
Barczynski ⁶⁸	2006	o	P	121	56.1	106	DT (MIBI-Tc) vs. US	5, 6
Saeed ⁶⁹	2006	o	R	29	46	18	MIBI planar vs. MRI	4, 8
Krausz ⁷⁰	2006	o	R	36	53	25	MIBI SPECT/CT vs. MIBI planar	3, 4
Solorzano ⁷¹	2006	o	R	226	58	178	MIBI SPECT vs. S-US	3, 6
Lorberboym ⁷²	2005	o	P	41	63.5	30	MIBI SPECT vs. DT (MIBI-Tc)	3, 5
Masatsugu ⁷³	2005	o	NR	110	59.1	97	MIBI planar vs. US	4, 6
Ruf ⁷⁴	2004	o	NR	17	51.2	9	MIBI SPECT vs. MRI	3, 8
Schachter ⁷⁵	2004	o	NR	82	63.5	54	MIBI SPECT vs. DT (MIBI-Tc)	3, 5
Saint Marc ⁷⁶	2004	o	P	149	65.3	112	MIBI planar vs. US	4, 6
Lumachi ⁷⁷	2004	o	P	44	59	31	DT (MIBI-Tc) vs. CT	5, 7
Kebapci ⁷⁸	2004		NR	52	53	43	MIBI planar vs. US	4, 6
Lumachi ⁷⁹	2003	o	R	112	56.2	83	DT (MIBI-Tc) vs. US	5, 6
Wakamatsu ⁸⁰	2003		NR	35	57.6	33	MIBI planar vs. DT (MIBI-I) vs. US vs. MRI	4, 5, 6, 8
Lorberboym ⁸¹	2003	o	P	52	63.5	38	MIBI SPECT vs. MIBI planar vs. DT (MIBI-Tc)	3, 4, 5

Prager ⁸²	2003	o	P	150	59.6	113	MIBI SPECT vs. US	3, 6
Leslie ⁸³	2002	o	NR	68	57	46	MIBI planar vs. DT (MIBI-Tc)	4, 5
Haber ⁸⁴	2002	o	NR	74			DT (MIBI-I) vs. US	5, 6
Berczi ⁸⁵	2002	o	P	63	54	50	DT (MIBI-Tc) vs. US	5, 6
Wakamatsu ⁸⁶	2001	o	R	25	60	20	DT (TF-Tc, MIBI-Tc, Tl-Tc) vs. US vs. MRI	5, 6, 8
Ho Shon ⁸⁷	2001	o	R	85	62	77	MIBI planar vs. DT (MIBI-Tc)	4, 5
Scheiner ⁸⁸	2001	o	NR	31	61	22	MIBI SPECT vs. US	3, 6
Casara ⁸⁹	2001	o	NR	143	47.3	84	DT (MIBI-Tc) vs. US	5, 6
Prager ⁹⁰	2001	o	P	100	63	79	MIBI SPECT vs. US	3, 6
Feingold ⁹¹	2000	o	R	62	55	41	MIBI SPECT vs. US	3, 6
Krausz ⁹²	2000	o	P	77	58	58	DT (MIBI-Tc) vs. US	5, 6
Lumachi ⁹³	2000	o	NR	91	59	65	DT (MIBI-Tc) vs. US	5, 6
Gallowitsch ⁹⁴	2000	o	NR	23	62.7	18	TF SPECT vs. DT (TF-Tc) vs. US	3, 5, 6
Moka ⁹⁵	2000	o	NR	92	60	58	MIBI SPECT vs. DT (MIBI-Tc)	3, 5
Moka ⁹⁶	2000	o	NR	72	58	46	MIBI SPECT vs. DT (MIBI-Tc)	3, 5
Hiromatsu ⁹⁷	2000	o	NR	20	51	20	DT (TF-Tc) vs. US vs. CT vs. MRI	5, 6, 7, 8
De Feo ⁹⁸	2000	o	P	16	61	16	MIBI planar vs. US vs. CT vs. MRI	4, 6, 7, 8
Catargi ⁹⁹	1999	o	P	14	49.3	12	DT (MIBI-Tc) vs. E-US	5, 6
Takami ¹⁰⁰	1999	o	NR	52			MIBI planar vs. DT (Tl-Tc) vs. US vs. CT	4, 5, 6, 7
Gallowitsch ¹⁰¹	1997	o	NR	35	62.8	29	TF SPECT vs. TF planar vs. US	3, 4, 6
Hewin ¹⁰²	1997	o	P	49	57	38	DT (Tl-Tc) vs. US vs. MRI	5, 6, 8
Chen ¹⁰³	1997	o	NR	49 [†]			MIBI SPECT vs. MIBI planar vs. DT (MIBI-Tc)	3, 4, 5

Fayet ¹⁰⁴	1997	o	P	18	59	15	MIBI planar vs. MRI	4, 8
Bonjer ¹⁰⁵	1997	o	R	21			MIBI planar vs. US	4, 6
Arkles ¹⁰⁶	1996	o	R	105			DT (Tl-Tc) vs. US	5, 6
Rauth ¹⁰⁷	1996	o	R	14		10	MIBI planar vs. DT (Tl-Tc)	4, 5
Light ¹⁰⁸	1996	o	P	21 [†]		17	MIBI planar vs. US	4, 6
Liou ¹⁰⁹	1996	o	R	16	56.3	9	DT (Tl-Tc) vs. US	5, 6
Billy ¹¹⁰	1995	o	P	17	48	12	MIBI planar vs. US	4, 6
Gallacher ¹¹¹	1993	o	P	30	62.5	23	DT (Tl-Tc) vs. US	5, 6
Uden ¹¹²	1990	o	NR	50	70 [‡]	46	DT (Tl-Tc) vs. US vs. CT	5, 6, 7
Whelan ¹¹³	1989	o	P	16			US vs. MRI	6, 8
Summers ¹¹⁴	1989	o	NR	30			DT (Tl-Tc) vs. US	5, 6
Roses ¹¹⁵	1989	o	P	36	55	20	DT (Tl-Tc) vs. US vs. CT	5, 6, 7
Auffermann ¹¹⁶	1988	o	P	20			DT (Tl-Tc) vs. US vs. MRI	5, 6, 8
Peck ¹¹⁷	1987	o	P	18			DT (Tl-Tc) vs. MRI	5, 8
Gooding ¹¹⁸	1986	o	P	34			DT (Tl-Tc) vs. US	5, 6
Winzelberg ¹¹⁹	1985	o	P	24			DT (Tl-Tc) vs. US	5, 6

R, retrospective; P, prospective; NR, not reported; MIBI, ^{99m}Tc-sestamibi; DT, dual tracer; Tc, ^{99m}Tc-pertechnetate; SPECT, single photon emission computed tomography; CT, computed tomography; US, ultrasonography; CE-US, contrast enhanced US; FCH, ¹⁸F-fluorocholine; PET, positron emission tomography; CDHR-US, high resolution US with color-Doppler; 4D-CT, 4 dimensional CT; MRI, magnetic resonance imaging; I, ¹²³I; TF, ^{99m}Tc-tetrofosmin; DE-CT, dual energy CT; 3D-US, 3 dimensional US; MET, ¹¹C-methionine; CCH, ¹¹C-choline; E-US, endoscopic US; dMRA, dynamic magnetic resonance angiography; S-US, surgeon performed US; Tl, ²⁰¹Tl

*The number of patients with primary hyperparathyroidism with direct comparison data for each imaging test was indicated.

†The total number of patients with hyperparathyroidism was indicated because there were no separate data only for patients with primary hyperparathyroidism.

‡Median value was indicated due to no available mean value.

§Imaging modalities without available direct comparison data were excluded.

||Imaging categories are as follows; 1. Choline PET/CT including FCH PET/CT, FCH PET/MRI, and CCH PET/CT; 2. MET PET/CT; 3. MIBI SPECT including MIBI SPECT/CT, MIBI pinhole SPECT, MIBI SPECT/contrast enhanced CT, TF SPECT, and TF SPECT/CT; 4. MIBI planar including MIBI pinhole and TF planar; 5. Dual tracer including MIBI-Tc subtraction, MIBI-I subtraction, TF-Tc subtraction, and TI-Tc subtraction with planar, pinhole, SPECT, or SPECT/CT; 6. US including CE-US, CDHR-US, 3D-US, E-US, and S-US; 7. CT including 4D-CT and DE-CT; 8. MRI including 3T-MRI and dMRA

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