Appendix 1: literature search strategy

PubMed

Search number	Query
#1	"Atrial Fibrillation"[MeSH]
#2	(((((Atrial Fibrillations [Title/Abstract]) OR (atrium fibrillation [Title/Abstract])) OR (auricular fibrillation [Title/Abstract])) OR (heart fibrillation atrium [Title/Abstract])) OR (Auricular Fibrillation [Title/Abstract])) OR (Auricular Fibrillations [Title/Abstract])
#3	#1 OR #2
#4	"Catheter Ablation"[MeSH]
#5	(((((Electric Catheter Ablation [Title/Abstract]) OR (Transvenous Electric Ablation [Title/Abstract])) OR (Electrical Ablation, Transvenous [Title/Abstract])) OR (Transvenous Electrical Ablation [Title/Abstract])) OR (Percutaneous Catheter Ablation [Title/Abstract])) OR (Ablation, Percutaneous Catheter [Title/Abstract])
#6	#4 OR #5
#7	"Cryosurgery"[MeSH]
#8	(((Cryosurgeries [Title/Abstract]) OR (Cryoablation [Title/Abstract])) OR (Cryoablations [Title/Abstract])) OR (cryogenic surgery [Title/Abstract])
#9	#7 OR #8
#10	"Radiofrequency Ablation"[MeSH]
#11	((((Ablation, Radiofrequency [Title/Abstract]) OR (Radio Frequency Ablation [Title/Abstract])) OR (Radio-Frequency Ablation [Title/Abstract])) OR (RFA therapy[Title/Abstract])) OR (RFA[Title/Abstract])
#12	(Pulsed Field Ablation [Title/Abstract]) OR (PFA[Title/Abstract])
#13	#6 OR #9 OR #12
#14	#3 AND #13

Cochrane Library

Search number	Query
#1	MeSH descriptor: [Atrial Fibrillation] explode all trees
#2	(Atrial Fibrillations):ab,ti,kw OR (atrium fibrillation):ab,ti,kw OR (auricular fibrillation):ab,ti,kw OR (heart fibrillation atrium):ab,ti,kw OR (Auricular Fibrillation):ab,ti,kw OR (Auricular Fibrillations):ab,ti,kw
#3	#1 OR #2
#4	MeSH descriptor: [Catheter Ablation] explode all trees
#5	(Electric Catheter Ablation):ab,ti,kw OR (Transvenous Electric Ablation):ab,ti,kw OR (Electrical Ablation, Transvenous):ab,ti,kw OR (Transvenous Electrical Ablation):ab,ti,kw OR (Percutaneous Catheter Ablation):ab,ti,kw OR (Ablation, Percutaneous Catheter):ab,ti,kw
#6	#4 OR #5
#7	MeSH descriptor: [Cryosurgery] explode all trees
#8	(Cryosurgeries):ab,ti,kw OR (Cryoablation):ab,ti,kw OR (Cryoablations):ab,ti,kw OR (cryogenic surgery):ab,ti,kw
#9	#7 OR #8
#10	MeSH descriptor: [Radiofrequency Ablation] explode all trees
#11	(Ablation, Radiofrequency):ab,ti,kw OR (Radio Frequency Ablation):ab,ti,kw OR (Radio-Frequency Ablation):ab,ti,kw OR (RFA therapy):ab,ti,kw OR (RFA):ab,ti,kw
#12	#10 OR #11
#13	(Pulsed Field Ablation):ab,ti,kw OR (PFA):ab,ti,kw
#14	#13 OR #12 OR #9 OR #6
#15	#14 AND #3
#16	(Randomized Controlled Trial):ab,ti,kw OR (randomized):ab,ti,kw OR (Parallel Controlled Trial):ab,ti,kw OR (parallel-group):ab,ti,kw OR (parallel group):ab,ti,kw OR (RCT):ab,ti,kw
#17	#15 AND #16

Embase

Search number	Query
#1	'atrial fibrillation'/exp
#2	'atrial fibrillations':ab,ti OR 'atrium fibrillation':ab,ti OR 'heart fibrillation atrium':ab,ti OR 'auricular fibrillation':ab,ti OR 'auricular fibrillations':ab,ti
#3	#1 OR #2
#4	'catheter ablation'/exp
#5	'electric catheter ablation':ab,ti OR 'transvenous electric ablation':ab,ti OR 'electrical ablation, transvenous':ab,ti OR 'transvenous electrical ablation':ab,ti 'percutaneous catheter ablation':ab,ti OR 'ablation, percutaneous catheter':ab,ti
#6	#4 OR #5
#7	'cryosurgery'/exp
#8	cryosurgeries:ab,ti OR cryoablation:ab,ti OR cryoablations:ab,ti OR 'cryogenic surgery':ab,ti
#9	#7 OR #8
#10	'radiofrequency ablation'/exp
#11	'ablation, radiofrequency':ab,ti OR 'radio frequency ablation':ab,ti OR 'radio-frequency ablation':ab,ti OR 'rfa therapy':ab,ti OR rfa:ab,ti
#12	#10 OR #11
#13	'pulsed field ablation':ab,ti OR pfa:ab,ti
#14	#6 OR #9 OR #12 OR #13
#15	#3 AND #14
#16	#15 AND 'randomized controlled trial'/de

Web of Science

Search number	Query
#1	TS = (Atrial Fibrillation OR Atrial Fibrillations OR atrium fibrillation OR auricular fibrillation OR heart fibrillation atrium OR Auricular Fibrillation OR Auricular Fibrillations)
#2	TS = (Catheter Ablation OR Electric Catheter Ablation OR Transvenous Electric Ablation OR Electrical Ablation, Transvenous OR Transvenous Electrical Ablation OR Percutaneous Catheter Ablation OR Ablation, Percutaneous Catheter)
#3	TS = (Cryosurgery OR Cryosurgeries OR Cryoablation OR Cryoablations OR cryogenic surgery)
#4	TS = (Radiofrequency Ablation OR Ablation, Radiofrequency OR Radio Frequency Ablation OR Radio-Frequency Ablation OR RFA therapy OR RFA)
#5	TS = (Pulsed Field Ablation OR PFA)
#6	TS = (Randomized Controlled Trial OR randomized OR Parallel Controlled Trial OR parallel-group OR parallel group OR RCT)
#7	#5 OR #4 OR #3 OR #2
#8	#7 AND #6 AND #1

Appendix 2

Table S1 The baseline characteristics for each study

No.	First author	Year of publication	NCT number	Country	Patient sources	Intervention	Number of cases	Total population	Gender (male/female)	Age (years)	AF type	LAD (mm)	Blanking period	Follow-up duration
1	Sergey Mamchur	2022	–	Russia	Single-center	RFA; CBA	108; 122	130	57/51; 57/65	56.5 (52.5; 61.5); 57 (53.0; 63.0)	PersAF and PAF	–	3m	12m
2	Adil K. Baimbetov	2022	–	Kazakhstan	Single-center	RFA; CBA	50; 50	100	29/21; 31/19	61.6 ±6.5; 61.3±10.2	PersAF	39±7; 41±5	3m	36m
3	Samuel K. Sørensen	2021	NCT03805555	Denmark	Single-center	RFA; CBA	49; 49	98	35/14; 32/17	62 (55, 69); 60 (55, 65)	PAF	40.4±5.3; 40.2±5.2	3m	6m
4	Philipp Seidl	2021	–	Germany	Single-center	RFA; CBA	20; 22	42	9/11; 9/13	67±9; 67±18	PAF	40±6; 41±11	3m	12m
5	Jason G. Andrade	2019	NCT01913522	Canada	Multi-center	RFA; CBA	CF-RF 115; Cryo-4 115; Cryo-2 116	346	79/36; 81/34; 71/45	58.6±9.2; 59.6±9.9; 58.2±10.7	PAF	37.4±8.5; 37.7±10.3; 38.2±7.4	3m	12m
6	Hui-Nam Pak	2021	NCT03920917	Korea.	Single-center	RFA; CBA	158; 156	314	116/40; 108/50	59.0±10.4; 60.8±11.3	PAF	39.6±5.6; 38.8±5.6	3m	12m
7	Mark M. Gallagher	2020	–	UK	Single-center	RFA; CBA	50; 50	100	38/12; 40/10	63±10; 63±9	PersAF	45±7; 45±5	6m	12m, 3y, 5y
8	Julian K. R. Chun	2021	DRKS00012423	Germany	Single-center	CBA; LBA	100; 100	200	58/42; 54/46	65.0±9.2; 66.5±9.4	PAF	39.1±5.3; 39.8±5.2	3m	12m
9	Ling You	2019	–	China	Single-center	RFA; CBA; CBA 3D	70; 70; 70	210	41/29; 38/32; 43/27	57.7±10.0; 59.4±11.3; 60.2±10.2	PAF	35.67±5.05; 35.80±4.42; 34.52±4.25	3m	12m
10	Ryo Watanabe	2018	–	Japan	Single-center	RFA; CBA	25; 25	50	19/6; 17/8	68±9; 62±12	PAF	42±5; 39±6	–	12m
11	Mario Matta	2018	–	Italy	Single-center	RFA; CBA	46; 46	92	38/8; 36/10	59; 59	PAF	–	3m	12m
12	Karl-Heinz Kuck	2016	NCT01490814	Germany	Multi-center	RFA; CBA	376; 374	750	236/140; 221/153	60.1±9.2; 59.9±9.8	PAF	40.6±5.8; 40.8±6.5	3m	12m
13	Armin Luik	2015	NCT00774566	Germany	Multi-center	RFA; CBA	159; 156	315	91/68; 100/56	60 (54, 67); 61 (54, 66)	PAF	–	3m	12m
14	Armin Luik	2017	NCT00774566	Germany	Multi-center	RFA; CBA	147; 145	292	83/64; 93/52	60.0 (55.0, 67.5); 62.0 (54.0, 66.0)	PAF	–	–	30m
15	Helena Malmborg	2013	–	Sweden	Single-center	RFA; CBA	56; 54	110	40/16; 43/11	62±7; 59±9	PersAF and PAF	42±5; 40±6	3m	12m
16	Karl-Heinz Kuck	2016	NCT01490814	Germany	Multi-center	RFA; CBA	376; 374	750	236/140; 221/153	60.1±9.2; 59.9±9.8	PAF	40.6±5.8; 40.8±6.5	3m	12m
17	Nicasio Pérez-Castellano	2014	–	Spain	Single-center	RFA; CBA	25; 25	50	22/3; 17/8	56 (40, 61); 58 (45, 62)	PAF	42 (38, 45); 42 (39, 47)	3m	12m
18	ROSS J. HUNTER	2015	NCT01038115	UK	Single-center	RFA; CBA; combine	77; 78; 79	234	47/30; 56/22; 49/30	61±12; 56±11; 58±12	PAF	43±5; 42±4; 43±4	3m	12m
19	Karapet Davtyan	2018	–	Russia	Single-center	RFA; CBA	44; 45	89	19/25; 22/23	55.6±12.0; 57.6±8.2	PAF	40±4; 41±3	3m	12m
20	Melanie A. Gunawardene	2018	–	Germany	Single-center	RFA; CBA	30; 30	60	24; 18	57.4±10.5; 62.0±9.5	PAF	–	3m	12m
21	Ahmet Adiyaman	2018	NCT00703157	Isala	Single-center	RFA; SA	27; 23	50	20/7; 19/4	59 (54, 66); 55 (48, 61)	PersAF and PAF	40 (38, 44); 39 (37, 42)	3m	24m
22	Emanuele Bertaglia	2016	ISRCTN46898887	Italy	Multi-center	AADs; RFA	69; 68	137	44/25; 37/31	62.3±10.7; 62.3±10.7	PersAF and PAF	45.4±5.5; 46.0±5.0	1m	12y
23	Thomas J. Buist	2018	–	Netherlands	Single-center	RFA; CBA	136; 133	269	99; 92	58.2±10.8; 59.7±9.9	PersAF and PAF	–	3m	12m
24	Boris Schmidt	2017	NCT01863472	Germany.	Multi-center	RFA; LBA	66; 68	134	44/22; 41/27	66±10; 65±9	PersAF	43 (31, 46); 43 (30, 46)	3m	12m
25	Srinivas R. Dukkipati	2015	NCT01456000	America	Multi-center	RFA; LBA	172; 170	342	109/63; 118/52	60.1±8.9; 59.7±10.4	PAF	40±5.5; 40±5.6	3m	12m
26	EkremÜcer	2018	–	Germany	Single-center	RFA; LBA	25; 25	50	12; 13	65.3±11.5; 59.7±10.4	PAF	44.8±7.6; 41.3±5.1	3m	12m
27	Johannes Brachmann	2021	NCT00643188	Germany	Multi-center	RFA; AADs	128; 152	280	113/15; 129/23	63 (55, 69); 65 (57, 74)	PersAF	48.0 (45.0, 54.0); 50.0 (45.0, 55.0)	3m	12m,5y
28	Luigi Di Biase	2016	NCT00729911	America	Multi-center	RFA; AADs	102; 101	203	77/25; 74/27	62±10; 60±11	PersAF	47±4.2; 48±4.9	3m	24m
29	Malte Kuniss	2021	NCT0180343	Germany	Multi-center	CBA; AADs	107; 111	218	76/31; 72/39	50.5 (13.1); 54.1 (13.4)	PAF	37.0 (5.9); 38.0 (4.9)	3m	12m
30	Jason G. Andrade	2021	NCT02825979	Canada	Multi-center	CBA; AADs	154; 149	303	112/42; 102/47	57.7±12.3; 59.5±10.6	PAF	39.5±5.0; 38.1±6.5	3m	12m
31	Oussama M. Wazni	2021	NCT03118516	America	Multi-center	CBA; AADs	104; 99	203	63/41; 57/42	60.4±11.2; 61.6±11.2	PAF	38.7±5.7; 38.2±5.4	3m	12m
32	Jens Cosedis Nielsen	2012	NCT00133211	Denmark	Multi-center	RFA; AADs	146; 148	294	100/46; 106/42	56±9; 54±10	PAF	40±6; 40±5	3m	24m
33	Carlos A. Morillo	2014	NCT00392054	Canada	Multi-center	RFA; AADs	66; 61	127	51/15; 45/16	56.3 (9.3); 54.3 (11.7)	PAF	40±5; 43±5	3m	24m
34	Jeanne E. Poole	2020	NCT00911508	America	Multi-center	RFA; AADs	611; 629	1,240	400/211; 413/216	<65 years 176/183; 65 to <75 years 342/350; 75 years 93/96	PersAF and PAF	–	3m	12m, 5y
35	Douglas L. Packer	2019	NCT00911508	America	Multi-center	RFA; AADs	1,108; 1,096	2,204	695/413; 690/406	<65 years 375/391; 65–74 years 577/533; ≥75 years 156/152	PersAF and PAF	–	3m	12m, 5y
36	John Hummel	2014	–	America	Multi-center	RFA; AADs	138; 72	210	115/23; 60/12	59.6±8.3; 60.7±8.9	PersAF	45±5; 46±5	3m	6m
37	Ross J. Hunter	2014	NCT01411371	UK	Single-center	RFA; AADs	26; 24	50	25/1; 23/1	55±12; 60±10	PersAF	52±11; 50± 10	3m	6m
38	David G. Jones	2013	NCT00878384	UK	Single-center	RFA; AADs	26; 26	52	21/5; 24/2	64±10; 62±9	PersAF	50±6; 46±7	2m	12m
39	M.J. Pekka Raatikainen	2015	NCT00133211	Finland	Multi-center	RFA; AADs; Crossover	110; 92; 84	286	78/22; 63/29	56±10; 56±10	PAF	40±5; 40±5	3m	24m
40	H.Walfridsson	2015	NCT00133211	Sweden	Multi-center	RFA; AADs	146; 148	294	100/46; 106/42	56±9; 54±10	PAF	40±5; 40±5	3m	24m
41	Pierre Jaïs	2008	–	France	Multi-center	RFA; AADs	53; 59	112	45/8; 49/10	49.7±10.7; 52.4±11.4	PAF	39.5±5.6; 40.0±5.7	3m	12m
42	Karl-Heinz Kuck	2021	NCT01570361	Germany	Multi-center	RFA; AADs	128; 127	255	54/74; 53/74	67.8±4.8; 67.6±4.6	PAF	42.1±6.1; 43.4± 5.6	3m	2y, 3y
43	Michael R MacDonald	2010	NCT00292162	UK	Single-center	RFA; AADs	22; 19	41	17/5; 15/4	62.3 (6.7); 64.4 (8.3)	PersAF	–	3m	6m
44	Nassir F. Marrouche	2018	NCT00643188	America	Multi-center	RFA; AADs	179; 184	363	156; 155	64 (56, 71); 64 (56, 73.5)	PersAF and PAF	48.0 (45.0, 54.0); 49.5 (5.0, 55.0)	3m	60m
45	Lluís Mont	2014	NCT00863213	Spain	Multi-center	RFA; AADs	98; 48	146	76/22; 37/11	55 (9); 55 (9)	PersAF	41.3 (4.6); 42.7 (5.1)	3m	12m
46	Douglas L. Packer	2013	NCT00523978	America	Multi-center	CBA; AADs	163; 82	245	125/38; 84/2	57±9; 56±9	PAF	40±5; 41±6	3m	12m
47	Carlo Pappone	2011	NCT00340314	Italy	Single-center	RFA; AADs	99; 99	198	69/30; 64/35	55±10; 57± 10	PAF	40±6; 38±6	6-week	4y
48	Ratika Parkash	2022	NCT01420393	Canada	Multi-center	CBA; AADs	214; 197	411	157/57; 148/49	65.9±8.6; 67.5±8.0	PersAF and PAF	46.8±5.4; 46.1±6.0	3m	24m
49	Giuseppe Stabile	2006	–	Italy	Multi-center	CBA; AADs	68; 69	137	37/31; 44/25	62.2±9; 62.3±10.7	PersAF and PAF	46±5; 45.4±5.5	1m	13m
50	Oussama M. Wazni	2005	–	America	Multi-center	RFA; AADs	33; 37	70	–	53 (8); 54 (8)	PersAF and PAF	41 (8); 42 (7)	3m	12m
51	David J. Wilber	2010	NCT00116428	America	Multi-center	CBA; AADs	106; 61	167	73/33; 38/23	55.5 (53.7, 57.3); 56.1 (52.9, 59.4)	PAF	40.0 (38.9, 41.1); 40.5 (39.0, 41.9)	3m	12m
52	GangWu	2021	NCT01341353	China	Multi-center	RFA; AADs	327; 321	648	218/109; 203/118	64.8±12.6; 64.4±13.6	PersAF and PAF	45±8.5; 46±7.8	3m	60m
53	Yanmin Xu	2012	–	China	Single-center	RFA; AADs	66; 57	123	45/21; 35/22	61.5±10.1; 60.9±13.7	PersAF and PAF	39.2±5.6; 39.1±5.9	3m	6m
54	Carina Blomström-Lundqvist	2019	2008-001384-11	Sweden	Multi-center	RFA; AADs	79; 76	155	58/21; 62/14	55.8 (10.6); 56.3 (8.9)	PersAF and PAF	41.7 (6.4); 41.7 (4.9)	3m	48m
55	Karl-Heinz Kuck	2019	NCT00652522	Germany	Multi-center	RFA; AADs	68; 72	140	60/8; 66/6	65±8; 65±8	PersAF and longstanding PersAF	50±6; 51±5	3m	12m
56	Thomas J. Buist	2020	NCT00703157	Netherlands	Single-center	RFA; SA	25; 25	50	19/6; 20/5	59 (55, 66); 55 (47, 62)	PersAF and PAF	41 (38, 44); 39 (37, 42)	3m	12m
57	Shouvik Haldar	2020	NCT02755688	UK	Multi-center	RFA; SA	60; 60	120	45/15; 44/16	60.8±10.1; 63.8±8.9	Long-standing persAF	44.6±6; 44.7±5.8	3m	12m
58	Carlo Pappone	2006	NCT00340314	Italy	Single-center	RFA; AADs	99; 99	198	69/30; 64/35	55±10; 57±10	PAF	40±6; 38±6	3m	12m
59	Gang Xu	2021	–	China	Single-center	RFA; CBA	35; 39	74	24/11; 27/12	63.2±9.6; 64.7±9.6	persAF and Longstanding PersAF	42.1±4.9; 40.6±4.9	3m	12m
60	GIOVANNI B. FORLEO	2009	–	Italy	Multi-center	RFA; AADs	35; 35	70	20/15; 23/12	63.2±8.6; 64.8±6.5	PersAF and PAF	44.3±5.6; 45.2±5.2	3m	12m
61	BORIS SCHMIDT	2013	–	Germany	Single-center	RFA; CBA; LBA	33; 33; 33	99	–	63±10; 66±10; 65 ±8	PAF	41±6; 40±5; 40±5	3m	12m
62	Nikola Pavlovic	2021	NCT01803438	Croatia	Multicenter	CBA; AADs	107; 111	218	76/31; 72/39	50.5 (13.1); 54.1 (13.4)	PAF	37.0 (5.9); 38.0 (4.9)	3m	12m
63	Panagiotis Mililis	2023	–	Greece	Single-center	RFA; CBA	133; 66	199	111/22; 51/15	60.22±9.87; 62.74±9.09	PersAF	44.89±4.79; 43.55±4.74	3m	12m

NCT, National Clinical Trial; PAF, paroxysmal AF; PersAF, persistent AF; 3D, three-dimensional.

Appendix 3: characteristics of included studies

There were 17,522 patients in the 63 RCTs: 2,352 underwent RFA, 5,847 received CBA, 396 underwent LBA, and 108 received SA. Overall, 22 RCTs (20,35-55) compared RFA with CBA, 3 RCTs (21,56,57) compared RFA with LBA, 3 RCTs (28,30,58) compared RFA with SA, 28 RCTs (19,59-85) compared RFA with AADs, 5 RCTs (86-90) compared CBA with AADs, only one RCT (22) compared LBA with CBA, and one RCT (91) made comparisons between three ablation approaches (RFA *vs.* CBA *vs.* LBA). Of the 63 RCTs included in this analysis, 35 were multi-center trials. Moreover, 32 RCTs only enrolled patients with PAF, and 12 RCTs enrolled only patients with PersAF, whereas the remaining 19 RCTs investigated both types of AF. The mean age of patients in the studies was 58.4 years and 68% of them were male.

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Appendix 4: risk of bias assessment

Two researchers (Q.C. and X.X.) used the RCT risk of bias assessment tool from the Cochrane Collaboration Network to assess the risk of bias across included studies. The following parameters were considered for study quality assessment: generation of random sequences, allocation concealment, blinding of subjects and intervention providers, blinding of outcome evaluators, incomplete outcome data, selective outcome reporting, and other sources of bias. A study was rated as having low, high, or unclear risk of bias regarding each of the abovementioned parameters.

Figure S1 Risk of bias assessment.

Appendix 5: results of NMA on AF recurrence of subgroup analysis based on the follow-up duration

Follow-up duration <2 years

For the outcome of this subgroup, forty-one studies had a follow-up time of less than 2 years (range, 6–12 months), which involved RFA, CBA, LBA, SA, and AADs. Among them, RFA, CBA, and AADs were the main ones in most studies (*Figure S2A*). A random-effect model was adopted. The results of the NMA showed that RFA, CBA, and LBA all significantly reduced the risk of recurrence compared with AADs, with no significant difference among RFA (RR =0.395, 95% CI: 0.288–0.526), CBA (RR =0.398, 95% CI: 0.286–0.538), and LBA (RR =0.407, 95% CI: 0.165, 0.969) (*Figure S2B*) in the risk of recurrence (*Table S2*). The ranking results showed LBA > RFA > CBA > AADs (*Figure S2C*).
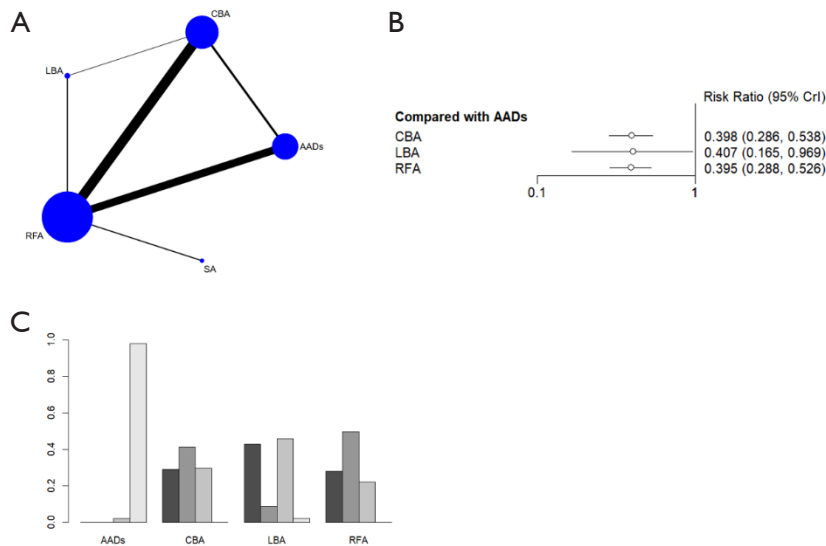

Figure S2 (A) Network graph for AF recurrence in follow-up duration <2 years group; (B) forest plot; (C) ranking diagram for the risk of recurrent AF. (Specific explanations of figure captions are shown in *Figure 3*).

Table S2 The league table of AF recurrence in follow-up duration <2 years group after treatment

Treatment for AF	AADs	CBA	LBA	RFA
AADs		0.398 (0.286, 0.538)	0.407 (0.165, 0.969)	0.395 (0.288, 0.526)
CBA	2.512 (1.86, 3.498)		1.022 (0.43, 2.428)	0.992 (0.784, 1.255)
LBA	2.458 (1.032, 6.048)	0.978 (0.412, 2.328)		0.972 (0.422, 2.231)
RFA	2.532 (1.901, 3.47)	1.008 (0.797, 1.275)	1.029 (0.448, 2.369)	

Table S2 shows a league table of AF recurrence in follow-up duration <2 years group after treatment. The row and column titles list AF treatments, including AADs, CBA, LBA, RFA, and SA. The diagonal divides the table into an upper triangle and a lower triangle. In the lower triangle, the reference treatment is on the right side of each comparison, while in the upper triangle, the reference treatment is on the left side. The presented RRs and their 95% CIs are crucial for interpreting the relative effectiveness of the treatments. When the 95% CI of RR does not include 1, the difference is statistically significant, with a P value less than 0.05. AAD, antiarrhythmic drug; AF, atrial fibrillation; CBA, cryoablation; CI, confidence interval; LBA, laser balloon ablation; RFA, radiofrequency ablation; RR, risk ratio; SA, surgical ablation.

Follow-up duration ≥2 years

Thirteen studies had a follow-up time of more than 2 years (range, 2–7 years), which involved RFA, CBA, SA, and AADs. Among them, RFA and AADs were the main ones in most studies (*Figure S3A*). However, this subgroup does not encompass LBA. A random-effect model was employed. The results of the NMA showed that RFA (RR =0.512, 95% CI: 0.392–0.65), CBA (RR =0.541, 95% CI: 0.321–0.909), and SA (RR =0.797, 95% CI: 0.419–1.52) all significantly reduced the risk of recurrence compared with AADs (*Figure S3B*). There was no significant difference in recurrence risk between RFA, CBA, and SA (*Table S3*). The ranking results showed RFA > CBA > SA > AADs (*Figure S3C*).
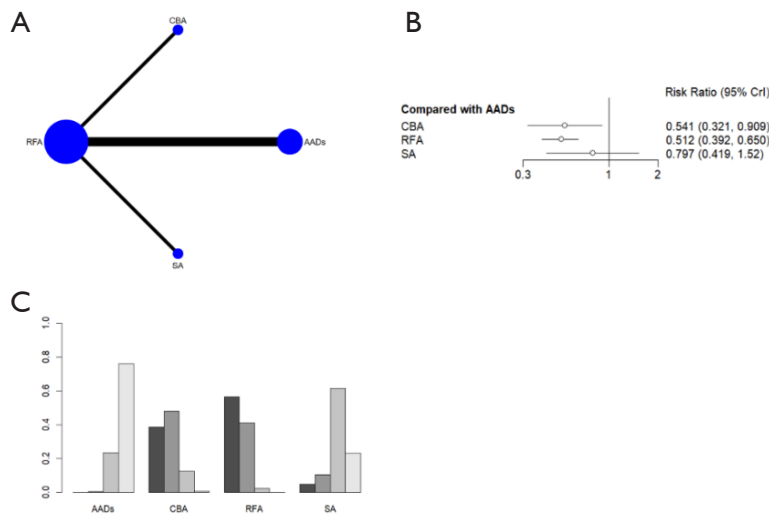

Figure S3 (A) Network graph for AF recurrence in follow-up duration ≥2 years group; (B) forest plot; (C) ranking diagram for the risk of recurrent AF. (Specific explanations of figure captions are shown in *Figure 3*).

Table S3 The league table of AF recurrence in follow-up duration ≥2 years group after treatment

Treatment for AF	AADs	CBA	RFA	SA
AADs		0.541 (0.321, 0.909)	0.512 (0.392, 0.65)	0.797 (0.419, 1.52)
CBA	1.848 (1.1, 3.114)		0.946 (0.594, 1.477)	1.476 (0.698, 3.109)
RFA	1.952 (1.537, 2.552)	1.057 (0.677, 1.683)		1.558 (0.87, 2.854)
SA	1.255 (0.658, 2.388)	0.678 (0.322, 1.433)	0.642 (0.35, 1.15)	

Table S3 shows a league table of AF recurrence in follow-up duration ≥2 years group after treatment. The row and column titles list AF treatments, including AADs, CBA, LBA, RFA, and SA. The diagonal divides the table into an upper triangle and a lower triangle. In the lower triangle, the reference treatment is on the right side of each comparison, while in the upper triangle, the reference treatment is on the left side. The presented RRs and their 95% CIs are crucial for interpreting the relative effectiveness of the treatments. When the 95% CI of RR does not include 1, the difference is statistically significant, with a P value less than 0.05. AAD, antiarrhythmic drug; AF, atrial fibrillation; CBA, cryoablation; CI, confidence interval; LBA, laser balloon ablation; RFA, radiofrequency ablation; RR, risk ratio; SA, surgical ablation.

Appendix 6: results of NMA on AF recurrence of subgroup analysis based on the AF type

PAF

For the outcome of AF recurrence, 31 RCTs only investigated PAF, which involved RFA, CBA, LBA, SA, and AADs. Among them, RFA, CBA and AADs were the main ones in most studies (*Figure S4A*). A random-effect model was adopted. The results of the NMA showed that RFA, CBA, and LBA were associated with a significantly lower risk of recurrence compared with AADs, except SA, with no significant difference among RFA (RR =0.413, 95% CI: 0.328–0.511), CBA (RR =0.411, 95% CI: 0.315–0.526), LBA (RR =0.426, 95% CI: 0.194–0.907), and SA (RR =0.651, 95% CI: 0.269–1.58) (*Figure S4B*) in the risk of recurrence (*Table S4*). The ranking results showed LBA > CBA > RFA > SA > AADs (*Figure S4C*). Given that merely a single piece of literature concerning SA was incorporated into this subgroup analysis, certain uncertainty inevitably existed on the outcomes or rankings of the comparisons between SA and other ablation modalities. Consequently, we should exercise caution both when interpreting these rankings and making clinical decisions.
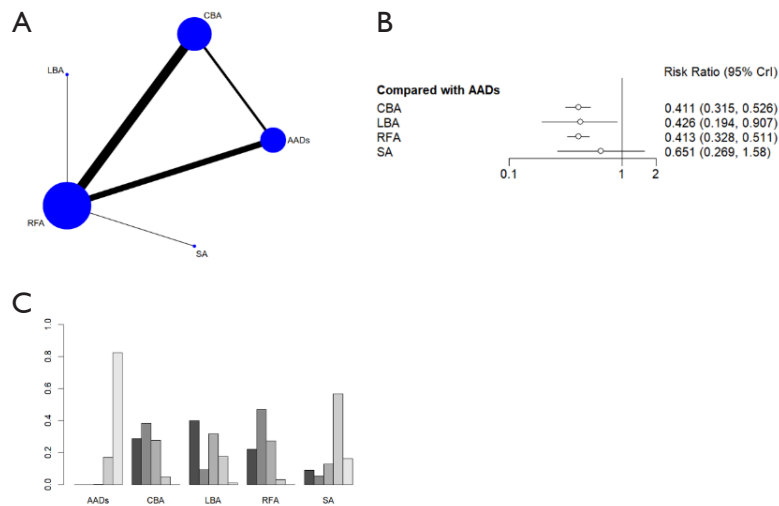

Figure S4 (A) Network graph for PAF recurrence; (B) forest plot; (C) ranking diagram for the risk of recurrent PAF. (Specific explanations of figure captions are shown in *Figure 3*).

Table S4 The league table of recurrence in PAF subgroup after treatment

Treatment for AF	AADs	CBA	LBA	RFA	SA
AADs	AADs	0.638 (0.233, 1.735)	0.635 (0.123, 3.225)	0.651 (0.333, 1.256)	0.671 (0.14, 3.137)
CBA	1.567 (0.576, 4.292)	CBA	0.995 (0.187, 5.22)	1.019 (0.481, 2.16)	1.051 (0.213, 5.188)
LBA	1.576 (0.31, 8.143)	1.005 (0.192, 5.34)	LBA	1.028 (0.231, 4.519)	1.06 (0.137, 8.185)
RFA	1.536 (0.796, 3.007)	0.981 (0.463, 2.078)	0.973 (0.221, 4.325)	RFA	1.031 (0.252, 4.211)
SA	1.49 (0.319, 7.144)	0.951 (0.193, 4.697)	0.943 (0.122, 7.274)	0.97 (0.237, 3.969)	SA

Table S4 shows a league table of recurrence in PAF subgroup after treatment. The row and column titles list AF treatments, including AADs, CBA, LBA, RFA, and SA. The diagonal divides the table into an upper triangle and a lower triangle. In the lower triangle, the reference treatment is on the right side of each comparison, while in the upper triangle, the reference treatment is on the left side. The presented RRs and their 95% CIs are crucial for interpreting the relative effectiveness of the treatments. When the 95% CI of RR does not include 1, the difference is statistically significant, with a P value less than 0.05. AAD, antiarrhythmic drug; AF, atrial fibrillation; CBA, cryoablation; CI, confidence interval; LBA, laser balloon ablation; RFA, radiofrequency ablation; RR, risk ratio; SA, surgical ablation.

PersAF

Eleven RCTs reported on the outcome of AF recurrence in patients with PersAF, which involved RFA, CBA, LBA, SA, and AADs. Among them, RFA, CBA, and AADs were the main ones in most studies (*Figure S5A*). A random-effect model was employed. The results of our NMA showed that four types of ablation techniques (RFA, CBA, LBA, and SA) were not associated with a significant risk of recurrent PersAF compared to AADs. With RR =0.651 (95% CI: 0.333–1.256) for RFA, RR =0.638 (95% CI: 0.233–1.735) for CBA, RR =0.635 (95% CI: 0.123–3.225) for LBA, and RR =0.671 (95% CI: 0.14–3.137) for SA (*Figure S5B*), and no significant differences were observed between four ablation approaches regarding the risk of relapse (*Table S5*). The performance ranking showed LBA > SA > CBA > RFA > AADs (*Figure S5C*).
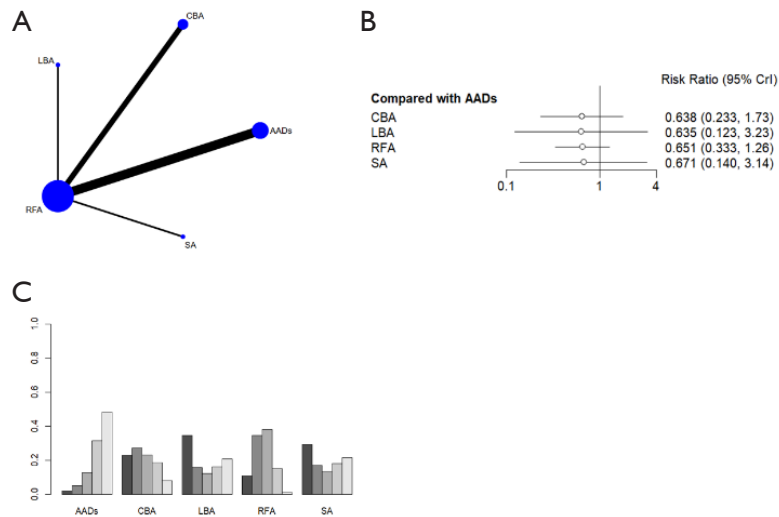

Figure S5 (A) Network graph for PersAF recurrence; (B) forest plot; (C) ranking diagram for the risk of recurrent PersAF. (Specific explanations of figure captions are shown in *Figure 3*).

Table S5 The league table of recurrence in PersAF subgroup after treatment

Treatment for AF	AADs	CBA	LBA	RFA	SA
AADs	AADs	0.625 (0.195, 1.979)	0.626 (0.111, 3.497)	0.648 (0.318, 1.306)	0.671 (0.126, 3.502)
CBA	1.601 (0.505, 5.14)	CBA	1.002 (0.162, 6.229)	1.037 (0.411, 2.616)	1.073 (0.185, 6.244)
LBA	1.597 (0.286, 9.007)	0.998 (0.161, 6.172)	LBA	1.035 (0.214, 4.976)	1.07 (0.122, 9.378)
RFA	1.543 (0.766, 3.141)	0.964 (0.382, 2.431)	0.966 (0.201, 4.67)	RFA	1.036 (0.23, 4.637)
SA	1.49 (0.286, 7.926)	0.932 (0.16, 5.414)	0.935 (0.107, 8.183)	0.965 (0.216, 4.346)	SA

Table S5 shows a league table of recurrence in PersAF subgroup after treatment. The row and column titles list AF treatments, including AADs, CBA, LBA, RFA, and SA. The diagonal divides the table into an upper triangle and a lower triangle. In the lower triangle, the reference treatment is on the right side of each comparison, while in the upper triangle, the reference treatment is on the left side. The presented RRs and their 95% CIs are crucial for interpreting the relative effectiveness of the treatments. When the 95% CI of RR does not include 1, the difference is statistically significant, with a P value less than 0.05. AAD, antiarrhythmic drug; AF, atrial fibrillation; CBA, cryoablation; CI, confidence interval; LBA, laser balloon ablation; RFA, radiofrequency ablation; RR, risk ratio; SA, surgical ablation.

Procedure duration

Twenty-eight studies reported on the outcome of procedure duration, which involved RFA, CBA, LBA, and SA. Among them, RFA, CBA, and LBA were the main ones in most studies (*Figure S6A*). A random-effect model was adopted. RFA, LBA, and SA took longer time to complete compared with CBA, with RR =17.22 (95% CI: 6.79–27.42) for RFA, RR =38.66 (95% CI: 18.5–58.36) for LBA, and RR =38.66 (95% CI: 12.68–64.64) for SA (*Figure S6B*), and there was no significant difference in procedure duration between RFA, LBA, and SA (*Table S6*). The performance ranking showed CBA > RFA > LBA > SA (*Figure S6C*).
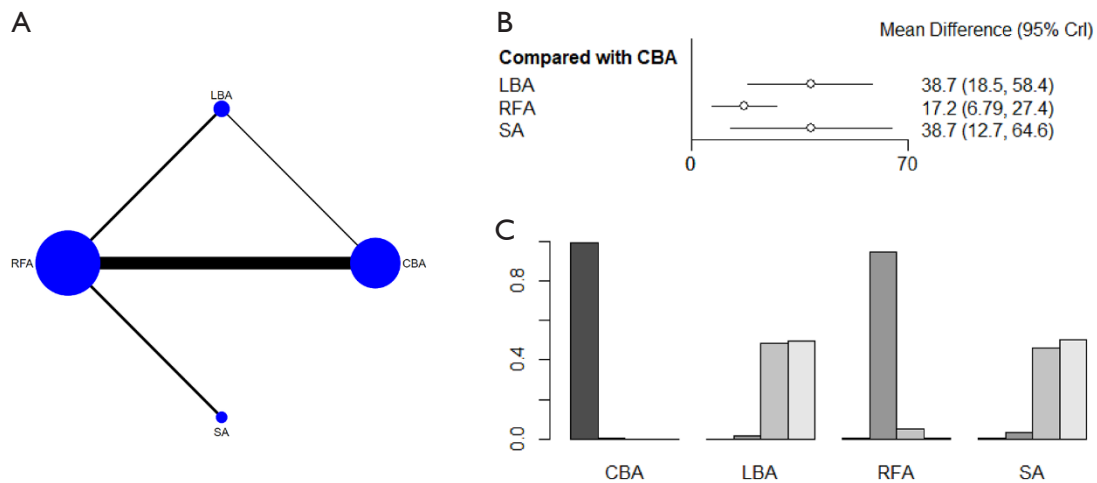

Figure S6 (A) Network graph for procedure duration; (B) forest plot; (C) ranking diagram for the risk of procedure duration. (Specific explanations of figure captions are shown in *Figure 3*).

Table S6 The league table of procedure duration in patients with AF receiving ablation

Treatment for AF	CBA	LBA	RFA	SA
CBA		38.66 (18.5, 58.36)	17.22 (6.79, 27.42)	38.66 (12.68, 64.64)
LBA	−38.66 (−58.36, −18.5)		−21.44 (−40.56, −2.09)	0.05 (−30.46, 30.89)
RFA	−17.22 (−27.42, −6.79)	21.44 (2.09, 40.56)		21.49 (−2.36, 45.4)
SA	−38.66 (−64.64, −12.68)	−0.05 (−30.89, 30.46)	−21.49 (−45.4, 2.36)	

Table S6 shows a league table of procedure duration in patients with AF receiving ablation. The row and column titles list AF treatments, including CBA, LBA, RFA, and SA. The diagonal divides the table into an upper triangle and a lower triangle. In the lower triangle, the reference treatment is on the right side of each comparison, while in the upper triangle, the reference treatment is on the left side. The presented RRs and their 95% CIs are crucial for interpreting the relative effectiveness of the treatments. When the 95% CI of RR does not include 1, the difference is statistically significant, with a P value less than 0.05. AF, atrial fibrillation; CBA, cryoablation; CI, confidence interval; LBA, laser balloon ablation; RFA, radiofrequency ablation; RR, risk ratio; SA, surgical ablation.

Fluoroscopy time

Nineteen studies reported on the outcome of fluoroscopy time, which involved RFA, CBA and LBA. Among them, RFA and CBA were the main ones in most studies (*Figure S7A*). Only studies involving RFA, LBA, and CBA were included in this analysis. A random-effect model was adopted. No statistically significant emerged between the two ablation groups (RFA, LBA) regarding the fluoroscopy time, compared to CBA, with RR =−3.23 (95% CI: −8.42, 2.04) for RFA, RR =4.68 (95% CI: −6.24, 15.7) for LBA (*Figure S7B*), and there was no significant difference in fluoroscopy time between RFA, LBA, and CBA (*Table S7*). The performance ranking showed RFA > CBA > LBA (*Figure S7C*).
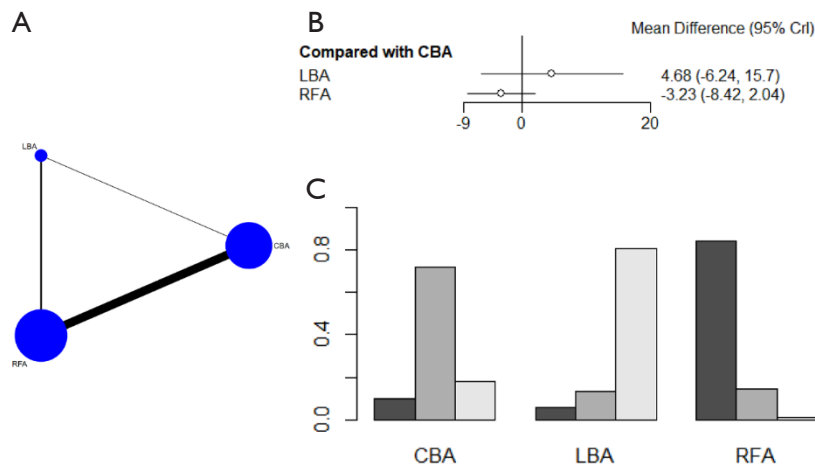

Figure S7 (A) Network graph for fluoroscopy time; (B) forest plot; (C) ranking diagram for the risk of fluoroscopy time. (Specific explanations of figure captions are shown in *Figure 3*).

Table S7 The league table of fluoroscopy time after treatment

Treatment for AF	CBA	LBA	RFA
CBA		4.68 (−6.24, 15.7)	−3.23 (−8.42, 2.04)
LBA	−4.68 (−15.7, 6.24)		−7.91 (−18.28, 2.44)
RFA	3.23 (−2.04, 8.42)	7.91 (−2.44, 18.28)	

Table S7 shows a league table of fluoroscopy time in patients with AF receiving ablation. The row and column titles list AF treatments, including CBA, LBA, RFA. The diagonal divides the table into an upper triangle and a lower triangle. In the lower triangle, the reference treatment is on the right side of each comparison, while in the upper triangle, the reference treatment is on the left side. The presented RRs and their 95% CIs are crucial for interpreting the relative effectiveness of the treatments. When the 95% CI of RR does not include 1, the difference is statistically significant, with a P value less than 0.05. AF, atrial fibrillation; CBA, cryoablation; CI, confidence interval; LBA, laser balloon ablation; RFA, radiofrequency ablation; RR, risk ratio.