




SYSTEMATIC REVIEW AND META-ANALYSIS

Duration of Antiplatelet Therapy Following Transcatheter Aortic Valve Replacement: Systematic Review and Network Meta-Analysis

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BACKGROUND: Although current guidelines recommend dual antiplatelet therapy (DAPT) for 3 to 6 months following transcatheter aortic valve replacement (TAVR), there are no studies directly comparing outcomes of different durations of DAPT following TAVR.

METHODS AND RESULTS: PubMed, EMBASE, and Cochrane Database were searched through November 2020 to identify clinical studies that investigated single antiplatelet therapy versus DAPT use following TAVR. Studies using oral anticoagulants and antiplatelet therapy concomitantly were excluded. The DAPT group was subdivided by the duration of DAPT. We extracted the risk ratios (RRs) of major or life-threatening bleeding, stroke, and all-cause mortality. Four randomized controlled trials, 2 propensity-score matched studies, and 1 observational study were identified, yielding a total of 2498 patients who underwent TAVR assigned to the single antiplatelet therapy group (n=1249), 3-month DAPT group (n=485), or 6-month DAPT group (n=764). Pooled analyses demonstrated that when compared with the single antiplatelet therapy group, the rates of major or life-threatening bleeding were significantly higher in the 3- and 6-month DAPT groups (RR [95% CI]=2.13 [1.33–3.40], $P=0.016$; RR [95% CI]=2.54 [1.49–4.33], $P=0.007$, respectively) with no difference between the 3-month DAPT versus 6-month DAPT groups. The rates of stroke and all-cause mortality were similar among the 3 groups.

CONCLUSIONS: In this network meta-analysis of antiplatelet therapy following TAVR, single antiplatelet therapy with aspirin had lower bleeding without increasing stroke or death when compared with either 3- or 6-month DAPT.

Key Words: aspirin ■ clopidogrel ■ dual antiplatelet therapy ■ transcatheter aortic valve replacement

See Editorial by Ko and Park

Transcatheter aortic valve replacement (TAVR) has become an established treatment for patients with symptomatic severe aortic stenosis.^{1–7} Selection of optimal antithrombotic regimens in patients with TAVR are complex because these patients are often at high risk for both bleeding and stroke

because of older age and high burden of atherosclerotic comorbidities. Furthermore, concomitant presence of atrial fibrillation is common, and the selection of antithrombotic regimen becomes even more challenging.^{1–7} As such, various regimens including single antiplatelet therapy (SAPT), dual antiplatelet therapy

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CLINICAL PERSPECTIVE

What Is New?

- A network meta-analysis of 7 studies of antiplatelet therapy following transcatheter aortic valve replacement demonstrated that when compared with the single antiplatelet therapy group, the rates of major or life-threatening bleeding were significantly higher in the 3- and 6-month dual antiplatelet therapy groups with no difference between the 3-month dual antiplatelet therapy versus 6-month dual antiplatelet therapy groups.
- The rates of stroke and all-cause mortality were similar among the 3 groups.

What Are the Clinical Implications?

- The clinical implication of our results is to avoid the prescription of dual antiplatelet therapy in patients after transcatheter aortic valve replacement.

Nonstandard Abbreviations and Acronyms

DAPT	dual antiplatelet therapy
SAPT	single antiplatelet therapy
TAVT	transcatheter aortic valve replacement

(DAPT), and oral anticoagulants have been used in patients after TAVR.

A randomized controlled trial (RCT) has recently demonstrated that oral anticoagulant without concomitant use of antiplatelet had lower bleeding risk when the patient had clinical indication for oral anticoagulant (ie, atrial fibrillation).⁸ Another study showed that SAPT had lower bleeding events compared with DAPT at 1 year in TAVR recipients.⁹ Although there is an accumulating evidence for the regimen of antithrombotics in patients with TAVR, the optimal duration of antithrombotic remains largely under investigated. Current guidelines recommend DAPT for 3 to 6 months following TAVR^{10,11} but this is based on expert opinion and underlying evidence is scarce.

Herein, we conducted a network meta-analysis to compare the outcome of antiplatelet-based strategies based on different duration; SAPT versus DAPT for 3 months versus DAPT for 6 months, following TAVR.

METHODS

All data in our study are available as published papers given its nature of systematic review and meta-analysis.

Search Strategy

All RCTs and observational studies which investigated SAPT versus DAPT following TAVR were identified using a 2-level strategy. First, databases including MEDLINE, EMBASE and Cochrane Database were searched through November 6, 2020 using web-based search engines (PubMed, OVID, and Cochrane Central Register of Controlled Trials). Second, relevant studies were identified through a manual search of secondary sources including references of initially identified articles, reviews, and commentaries. All references were downloaded for consolidation, elimination of duplicates, and further analyses. Search terms included “transcatheter aortic valve replacement/implantation,” and “antithrombotic,” “antiplatelet,” “aspirin,” or “clopidogrel” (Figure S1). We did not apply language restriction. Two authors (Y.Y. and T.K.) reviewed the search results independently to select the studies based on inclusion and exclusion criteria. Disagreements were resolved by consensus.

Inclusion/Exclusion and Quality Assessment

Included studies met the following criteria: (1) the study design was a RCT or an observational study of patients who underwent TAVR; (2) enrolled patients were assigned to or were in SAPT or DAPT group, and (3) outcomes included the rate of major or life-threatening bleeding. Studies with undefined duration of DAPT or concomitant use of oral anticoagulants with antiplatelet therapy were excluded. Study quality was assessed using the Cochrane Collaboration risk of bias 2.0 tool for an RCT,¹² and the Newcastle-Ottawa Scale for observational studies^{13,14} by 2 investigators (Y.Y. and T.K.).

Outcomes

The primary outcome was the rate of major or life-threatening bleeding. The secondary outcomes were the rates of stroke and all-cause mortality. Outcomes were defined according to Valve Academic Research Consortium¹⁵ or Valve Academic Research Consortium-2¹⁶ criteria. Stroke was defined as both disabling and non-disabling strokes and transient ischemic attack was not included.

Statistical Analysis

The review was conducted according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses statement standards.¹⁷ Risk ratios (RRs) for all-cause mortality, major or life-threatening bleeding, and stroke with their 95% CI were extracted from each study. We performed network meta-analysis using “netmeta” 3.6.2 package (R Foundation for Statistical Computing, Vienna, Austria).¹⁸ Within the framework,

I^2 and the Q statistics, which represent the proportion of total variation in point estimates among studies that is attributable to heterogeneity, were used to quantify heterogeneity.^{19,20} The I^2 statistic represents the proportion of variability that is not attributable to chance. I^2 values $>50\%$ indicate substantial heterogeneity. The Q statistics are the sum of a statistic for heterogeneity, and a statistic for inconsistency, which represents the variability of treatment effect between direct and indirect comparisons at the meta-analytic level.²¹ We used random-effects model for the analysis. The treatments were ranked using the P-score, which was considered 100% when a treatment was certain to be the best and 0% when a procedure was certain to be the worst.²² Potential publication bias was assessed by the Funnel plot asymmetry. Significant heterogeneity was considered to be present when the I^2 index was $>50\%$ or P for heterogeneity was <0.05 . As a sensitivity analysis, we conducted a sensitivity analysis including only RCTs.

RESULTS

Our search identified 7 eligible studies (including 4 RCT,^{9,23–25} 2 propensity-score matched studies,^{26,27} and 1 retrospective study²⁸). Two studies investigated SAPT versus 3-month DAPT, and 4 studies

investigated SAPT versus 6-month DAPT, and a total of 2498 patients who underwent TAVR were enrolled and assigned to or were on SAPT ($n=1249$), 3-month DAPT ($n=485$), or 6-month DAPT ($n=764$) (Figure 1). Studies investigating duration of DAPT longer than 6 months were excluded. Follow-up period ranged from 3 to 45 months. The characteristics of the network are shown in Figure 2. Study profile and patient characteristics are summarized in Table 1. Aspirin was used in the SAPT group in all the studies, clopidogrel was used in the DAPT group in 5 studies, and clopidogrel or ticlopidine was used in the DAPT group in 2 studies. Aspirin was continued throughout the follow-up period of the DAPT arm in 6 studies^{9,23–26,28} and at least 6 months in 1 study.²⁷ Variables used for the propensity-score matching are summarized in Table S1. The risk of bias for each study is summarized in Figure S2 and Table S2, and all the observational studies were considered as having low risk of bias.

Outcomes were defined according to Valve Academic Research Consortium criteria¹⁵ in 4 studies and Valve Academic Research Consortium-2 criteria¹⁶ in 3 studies (Table 2). Pooled analyses demonstrated that when compared with the SAPT group, the rates of major or life-threatening bleeding were significantly higher in the 3- and 6-month DAPT groups (RR [95%

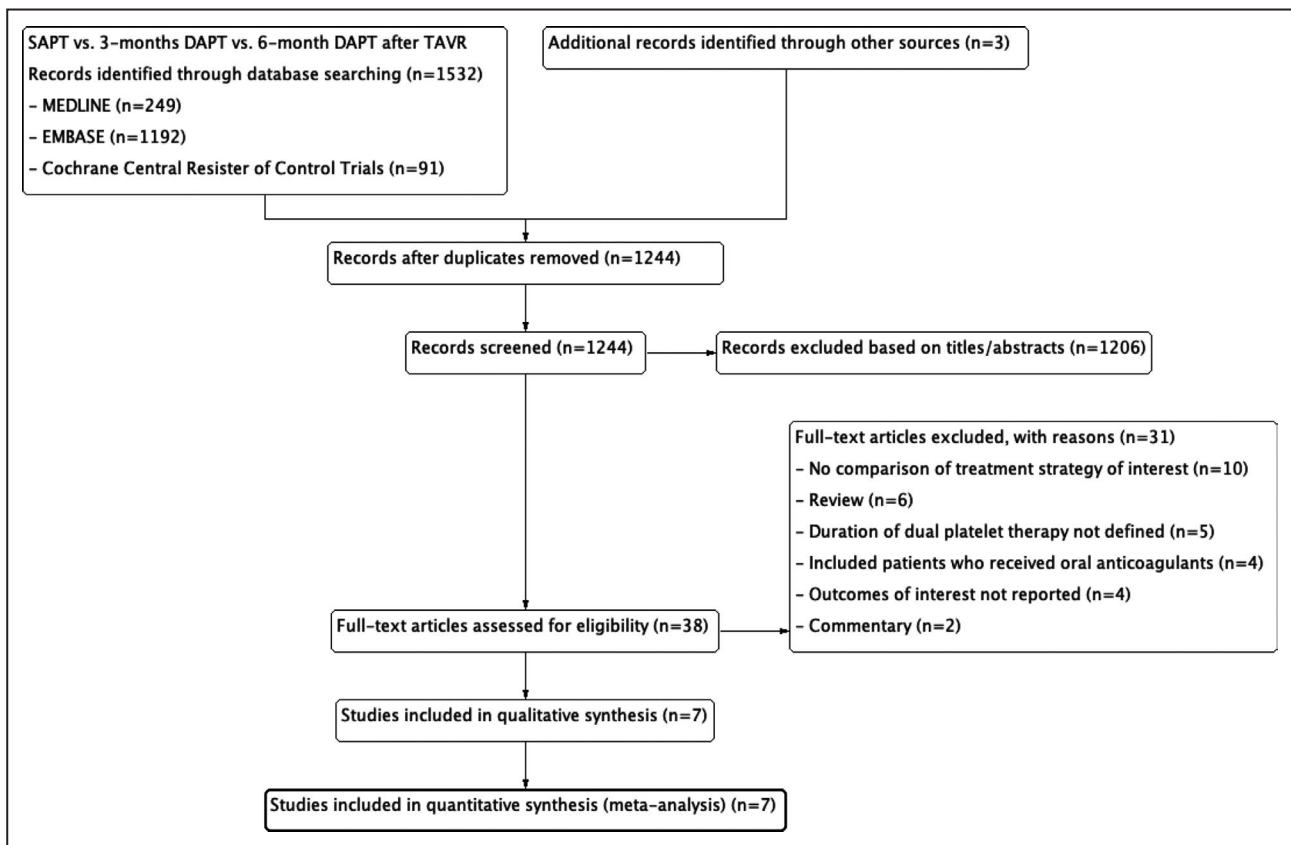


Figure 1. Study search.

DAPT indicates dual antiplatelet therapy; SAPT, single antiplatelet therapy; and TAVR, transcatheter aortic valve replacement.

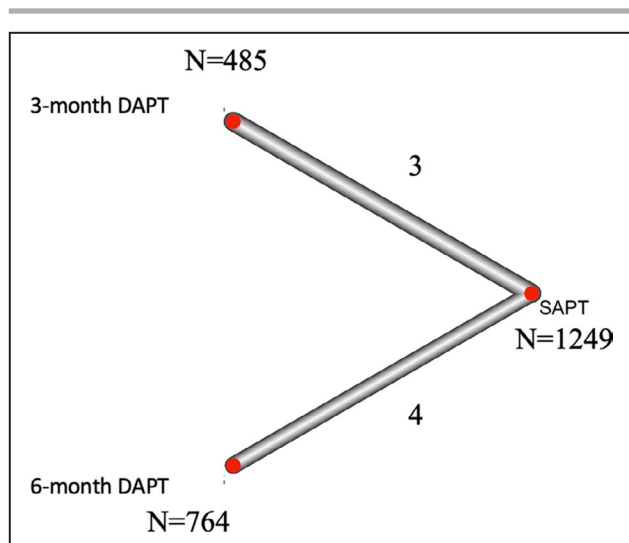


Figure 2. A network plot of eligible comparisons among the antiplatelet strategies following transcatheter aortic valve replacement.

The width of connecting lines between the strategies reflects the number of studies available for each comparison. DAPT indicates dual antiplatelet therapy; and SAPT, single antiplatelet therapy.

CI]=2.13 [1.33–3.40], $P=0.016$; RR [95% CI]=2.54 [1.49–4.33], $P=0.007$, respectively) with no difference between the 3-month DAPT versus 6-month DAPT groups (RR [95% CI]=1.19 [0.59–2.43], $P=0.64$) (Figure 3). P-scores were 99.9% (SAPT), 34.4% (3-month DAPT), and 15.6% (6-month DAPT). There was no significant heterogeneity ($I^2=0\%$, $P=0.82$). Q value was 2.22. The rates of stroke were similar among the groups (Figure 4). P-scores were 70.9% (SAPT), 48.6% (3-month DAPT), and 30.5% (6-month DAPT). Similarly, there were no significant differences in all-cause mortality (Figure 5). P-scores were 58.1% (SAPT), 56.2% (3-month DAPT), and 35.7% (6-month DAPT). There was no significant heterogeneity in both the above analyses ($I^2=0\%$, $P=0.72$; $I^2=0\%$, $P=0.90$, respectively). Q values were 2.87 and 1.61, respectively.

We conducted a sensitivity analysis including only 4 RCTs. Pooled analyses demonstrated that when compared with the SAPT group, the rates of major or life-threatening bleeding were significantly higher in the 3-month DAPT group (RR [95% CI]=2.13 [1.33–3.40], $P=0.016$) with no difference among other comparisons (Figure S3). P-scores were 82.5% (SAPT), 53.7% (6-month DAPT), and 13.7% (3-month DAPT). There was no significant heterogeneity ($I^2=0\%$, $P=0.65$); Q value was 0.83. The rates of stroke were similar among the groups (Figure S4). P-scores were 72.9% (6-month DAPT), 46.9% (SAPT), and 30.2% (3-month DAPT). Similarly, there were no significant differences in all-cause mortality (Figure S5). P-scores were 51.9% (3-month DAPT), 49.6% (6-month

DAPT), and 48.6% (SAPT). There was no significant heterogeneity in both the above analyses ($I^2=0\%$, $P=0.54$; $I^2=0\%$, $P=0.57$, respectively); Q values were 1.22 and 1.11.

Funnel plots suggested no evidence of publication bias in any of the analysis (Figure S6).

DISCUSSION

This network meta-analysis demonstrated that DAPT for 3 and 6 months following TAVR was associated with increased risk of major or life-threatening bleeding when compared with SAPT. There were no differences in major or life-threatening bleeding between the DAPT for 3 months and DAPT for 6 months. In addition, no differences were observed in stroke and all-cause mortality among groups.

The duration of optimal DAPT has been extensively discussed in post-percutaneous coronary intervention.²⁹ The rationale for antiplatelet therapy following TAVR is to prevent platelet activation and thrombogenicity caused by the deployed stented valve and to decrease early thromboembolic events³⁰ and is similar to what has been discussed in the coronary stent literature since platelet activation also occurs after percutaneous coronary intervention, which can be suppressed with antiplatelet therapy.³¹ However, there has been little report on the comparative outcomes among SAPT and different duration of DAPT group. Although a previous meta-analysis of mainly single-arm studies assessed the optimal duration of DAPT,³² to the best of knowledge, our study is the first network meta-analysis to compare different DAPT durations and SAPT following TAVR. Previous studies demonstrated the similar outcomes. Maes et al conducted a meta-analysis of 3 RCTs which included 421 patients and showed that the composite of death, major or life-threatening bleeding, and major vascular complications at 30 days was more frequent with DAPT than SAPT following TAVR.³³ Similarly, Raheja et al performed a meta-analysis of 3 RCTs and 3 observational studies, which demonstrated that DAPT was related to higher risk of bleeding, while there was no significant difference in stroke and all-cause mortality between SAPT and DAPT.³⁴ Furthermore, a previous study conducted a network meta-analysis comparing SAPT, DAPT, oral anticoagulant, oral anticoagulant with SAPT, and oral anticoagulant with DAPT, which showed that risk of bleeding was significantly lower with SAPT compared with DAPT, oral anticoagulant with SAPT, and oral anticoagulant with DAPT, although risk of bleeding was similar among the groups.³⁵ However, these studies combined various duration of DAPT ranging from 3 to 6 months. Our study showed that both 3 and 6 months of DAPT resulted in worse bleeding risk compared with SAPT,

Table 1. Baseline Characteristics of Included Studies

Author	Y	Design	Follow-Up (mo)	Regimen of SAPT	Regimen of DAPT	Patient (n)	SAPT	3-mo DAPT	6-mo DAPT	Age±SD (y) SAPT	3-mo DAPT	6-mo DAPT
Ussia et al ²³	2011	RCT	6	Aspirin	Aspirin+3-mo clopidogrel	79	39	40	N/A	81±4	80±6	N/A
Poliacikova et al ²⁸	2013	Retrospective	6	Aspirin	Aspirin+6-mo clopidogrel	114	59	N/A	55	82±7	N/A	82±6
Stabile et al ²⁴	2014	RCT	6	Aspirin	Aspirin+6-mo clopidogrel or ticlopidine	120	60	N/A	60	81±5	N/A	80±6
Ichibori et al ²⁶	2017	PSM	12	Aspirin	Aspirin+6-mo clopidogrel or ticlopidine	88	44	N/A	44	83±6	N/A	84±6
Rodés-Cabau et al ²⁵	2017	RCT	3	Aspirin	Aspirin+3-mo clopidogrel	222	111	111	N/A	79±9	79±9	N/A
D'Ascenzo et al ²⁷	2017	PSM	45	Aspirin	Aspirin+6-mo clopidogrel	1210	605	N/A	605	81±4	N/A	81±5
Brouwer et al ⁹	2020	RCT	12	Aspirin	Aspirin+3-mo clopidogrel	665	331	334	N/A	80±6	80±6	N/A
Men (%)	AF (%)	Hypertension (%)	DM (%)	COPD (%)	CKD (%)	Previous PCI (%)	EuroSCORE	STS Score	Mean Gradient (mm Hg)	Aortic Valve Area (cm ²)		
46	13	84	27	22	14	27	21	7	53	0.6		
54	17	N/A	21	N/A	5	24	N/A	N/A	N/A	0.7		
67	0	95	27	N/A	N/A	N/A	24	10	62	N/A		
36	0	N/A	32	N/A	N/A	25	25	11	53	0.7		
68	0	79	35	28	63	N/A	N/A	6	43	0.4		
38	11	80	26	24	3*	N/A	20	8	N/A	N/A		
51	0	75	24	18	N/A	N/A	N/A	3	N/A	N/A		

AF indicates atrial fibrillation; CKD, chronic kidney disease; COPD, chronic obstructive pulmonary disease; DAPT, dual antiplatelet therapy; DM, diabetes mellitus; EuroSCORE, European System for Cardiac Operative Risk Evaluation; N/A, not available; PCI, percutaneous coronary intervention; PSM, propensity-score matched trial; RCT, randomized controlled trial; SAPT, single antiplatelet therapy; and STS, Society of Thoracic Surgeons risk scores.
*Dialysis.

Table 2. Outcomes of Each Study

Study	Assessment of Outcomes	Patient (n)			Major or Life-Threatening Bleeding (n)			Stroke (n)*			All-Cause Mortality (n)		
		SAPT	3-mo DAPT	6-mo DAPT	SAPT	3-mo DAPT	6-mo DAPT	SAPT	3-mo DAPT	6-mo DAPT	SAPT	3-mo DAPT	6-mo DAPT
Ussia et al ²³	VARC criteria	39	40	N/A	3	4	N/A	2	1	N/A	5	4	N/A
Poliackova et al ²⁸	VARC criteria	59	N/A	55	5	N/A	10	2	N/A	4	4	N/A	6
Stabile et al ²⁴	VARC criteria	60	N/A	60	3	N/A	4	2	N/A	3	3	N/A	3
Ichihori et al ²⁶	VARC-2 criteria	44	N/A	44	2	N/A	8	4	N/A	3	3	N/A	3
Rodés-Cabau et al ²⁵	VARC-2 criteria	111	111	N/A	4	12	N/A	1	3	N/A	4	7	N/A
D'Ascenzo et al ²⁷	VARC-2 criteria	605	N/A	605	8	N/A	24	4	N/A	157	N/A	N/A	163
Brouwer et al ⁹	VARC-2 criteria	331	334	N/A	17	36	N/A	17	19	N/A	21	19	N/A

DAPT indicates dual antiplatelet therapy; N/A, not available; SAPT, single antiplatelet therapy; and VARC, Valve Academic Research Consortium. *Ischemic or hemorrhage stroke was not defined separately in each study.

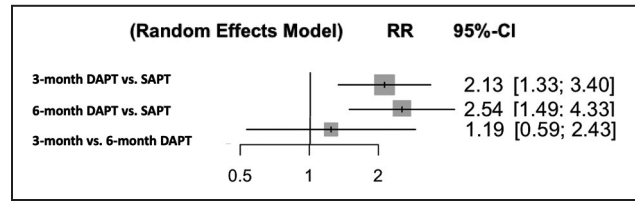


Figure 3. Antiplatelet therapy and risk of major or life-threatening bleeding (random-effects model). DAPT indicates dual antiplatelet therapy; RR, risk ratio; and SAPT, single antiplatelet therapy.

which suggested that adding additional antiplatelet therapy even for the short periods might be related to the worse outcomes. Therefore, although RCTs comparing different duration of DAPT are warranted, the clinical implication of our results is to avoid the prescription of DAPT in patients after TAVR. The exception would be in a patient with clear indication of DAPT such as recent coronary stent placement.

In this analysis, the risk of stroke was similar among 3-months DAPT, 6-month DAPT, and SAPT group. Since the risk of cerebrovascular events post-TAVR peaks within the days following the procedure,³⁶ DAPT following TAVR appears to be of no clear benefits in terms of decreasing the risk of stroke during follow-up. Similarly, we did not observe differences in the rates of bleeding between 3- and 6-month DAPT. However, considering the narrow difference in DAPT duration, with different regimen, there is a possibility that difference in clinical outcomes between different DAPT duration may exist, which might be shown in P-scores (major bleeding: 34.4% in 3-month DAPT versus 15.6% in 6-month DAPT). Further trials are warranted to compare outcomes of different duration of DAPT. We were unable to analyze the difference in subclinical valve thrombosis rate as this was not reported in the included studies. However, observational study showed that DAPT failed to prevent subclinical valve thrombosis compared with oral anticoagulants following TAVR³⁷ and its occurrence with different antiplatelet therapies require further investigations.

Our study has several limitations. First, this analysis contains not only RCTs but also 3 observational studies. Therefore, it is subject to selection bias and

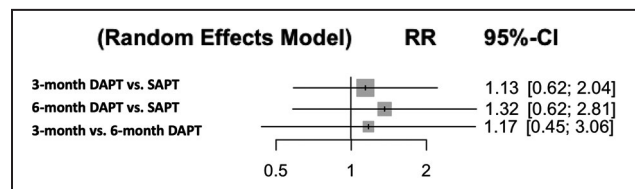


Figure 4. Antiplatelet therapy and risk of stroke (random-effects model). DAPT indicates dual antiplatelet therapy; RR, risk ratio; and SAPT, single antiplatelet therapy.

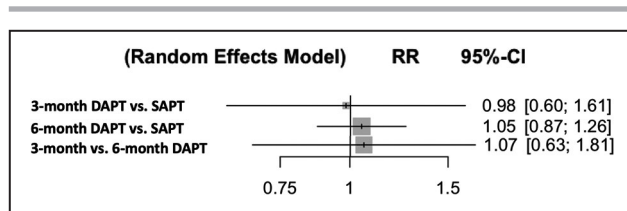


Figure 5. Antiplatelet therapy and risk of all-cause mortality (random-effects model).

DAPT indicates dual antiplatelet therapy; RR, risk ratio; and SAPT, single antiplatelet therapy.

confounders because of such study designs. However, 2 out of 3 observational studies were propensity-score matched and the other one was assessed to have low risk of bias. In addition, we did not assess the transitivity to investigate the validity of the indirect comparison. Transitivity refers to “the validity of an indirect comparison requires that the different sets of randomized trials are similar, on average, in all important factors other than the intervention comparison being made.”³⁸ Therefore, the result, especially the comparison of 3-month DAPT and 6-month DAPT, should be interpreted cautiously. Secondly, the included number of patients were relatively small since several studies did not define the duration of DAPT, which were excluded from our analysis. Third, 3 observational studies included patients who had another indication for DAPT (percutaneous coronary intervention), which could not be adjusted with propensity-score, although 4 RCTs excluded such patients from the trials. Finally, the included studies have various follow-up periods from 3 to 45 months, and studies that investigated SAPT versus 6-month DAPT have longer follow-up periods than those of SAPT versus 3-month DAPT. However, longer follow-up periods for 6-month DAPT should not have negatively affected the increased risk of bleeding since both SAPT and DAPT arms had the same antithrombotic strategies after DAPT was completed.

CONCLUSIONS

In this network meta-analysis of antiplatelet therapy following TAVR, SAPT with aspirin had lower bleeding without increasing the risk of stroke or death when compared with either 3- or 6-month DAPT.

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Supplementary Material

Tables S1–S2

Figures S1–S6

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SUPPLEMENTAL MATERIAL

Table S1. Variables used for propensity-score matching.

Author	Year	Variables used for propensity-score matching
Ichibori et al. [26]	2017	Age, sex, New York Heart Association classification, previous percutaneous coronary intervention, estimated glomerular filtration rate and aortic valve area.
D'Ascenzo et al. [27]	2017	Pre-treatment covariates.

Table S2. Quality assessment of observational studies based on NOS (range, 1-9). NOS score ≥ 8 is low risk, 6-7 is moderate risk and ≤ 5 is high risk.

Studies	Representativeness of exposed cohort	Selection of nonexposed cohort	Ascertainment of exposure	Absence of outcome at start of study	Comparability of cohorts	Outcome assessment	Length of follow-up	Adequacy of follow-up	NOS score
Poliacikova et al. [28]	1	1	1	1	1	1	1	1	8
Ichibori et al. [26]	1	1	0	1	2	0	1	1	8
D'Ascenzo et al. [27]	1	0	1	1	2	1	1	1	8

NOS=Newcastle-Ottawa Scale.

Figure S1. Search term.

EMBASE

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<input type="checkbox"/>	2	dual antiplatelet therapy/	7225	Advanced	Display Results	More ▾	
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<input type="checkbox"/>	9	TAVR.mp.	7727	Advanced	Display Results	More ▾	
<input type="checkbox"/>	10	1 or 8 or 9	24792	Advanced	Display Results	More ▾	
<input checked="" type="checkbox"/>	11	7 and 10	1192	Advanced	Display Results	More ▾	

Cochrane Central Register of Controlled Trials

91 Trials matching **(transcatheter aortic valve) AND (antiplatelet OR antithrombotic OR aspirin or clopidogrel) in Title Abstract Keyword**

[Cochrane Central Register of Controlled Trials](#)

Pubmed

(transcatheter aortic valve) and (replacement or implant or implantation) and (antiplatelet or antithrombotic or aspirin or clopidogrel)

Figure S2. Risk of bias summary according to the Cochrane Collaboration Manual.

Yellow: unclear risk; Green: low risk (A) and risk of bias graph according to the Cochrane Collaboration Manual (B).

A

	Random sequence generation (selection bias)	Allocation concealment (selection bias)	Blinding of participants and personnel (performance bias)	Blinding of outcome assessment (detection bias)	Incomplete outcome data (attrition bias)	Selective reporting (reporting bias)
2011 Ussia	?	-	+	+	+	+
2014 Stabile	?	-	+	?	+	+
2017 Rodes-Cabau	?	-	+	?	+	+
2020 Brouwer	+	-	+	?	+	+

B

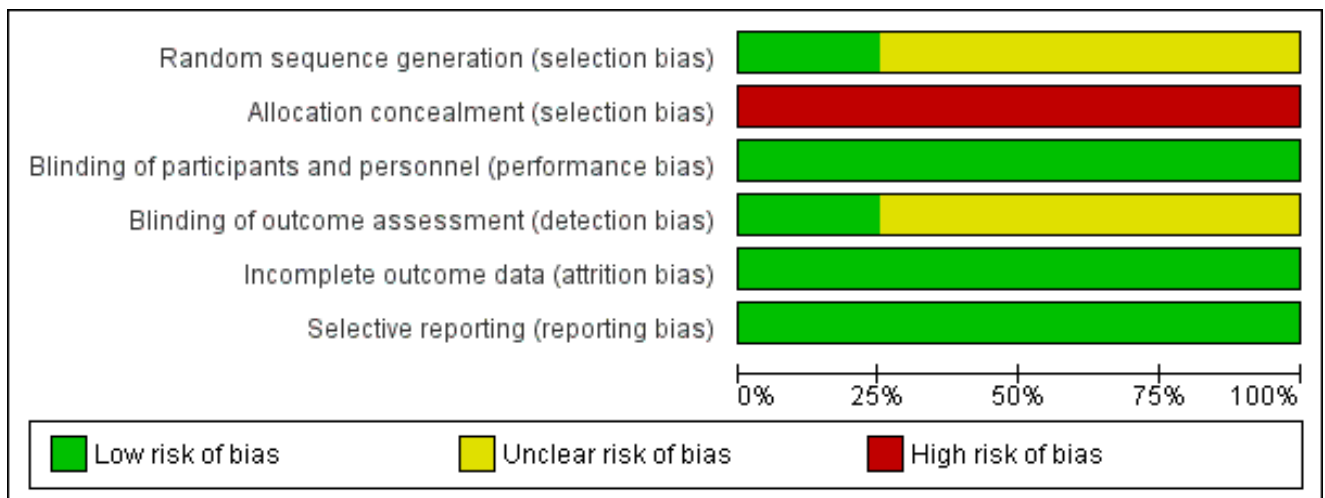
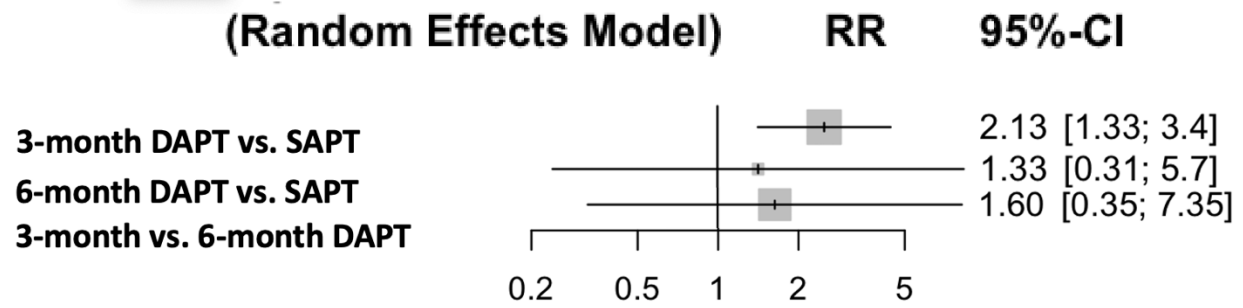
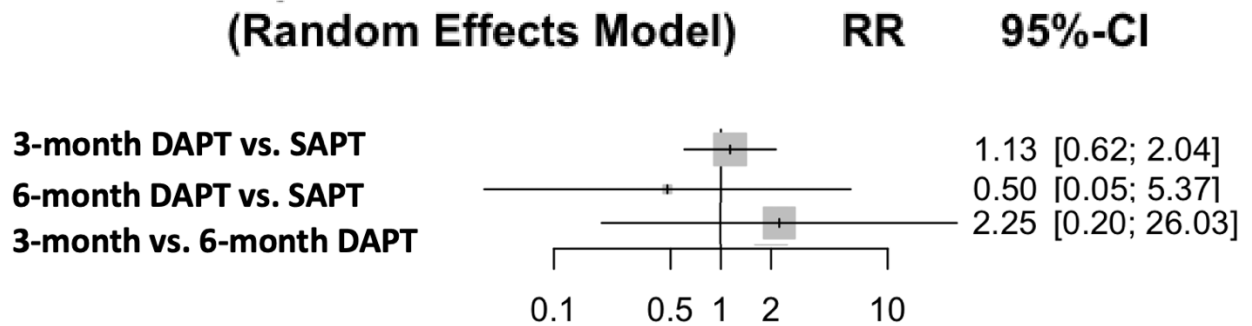


Figure S3. Antiplatelet therapy and risk of major or life-threatening bleeding (random-effects model) of sensitivity analysis including only 4 randomized controlled trials.



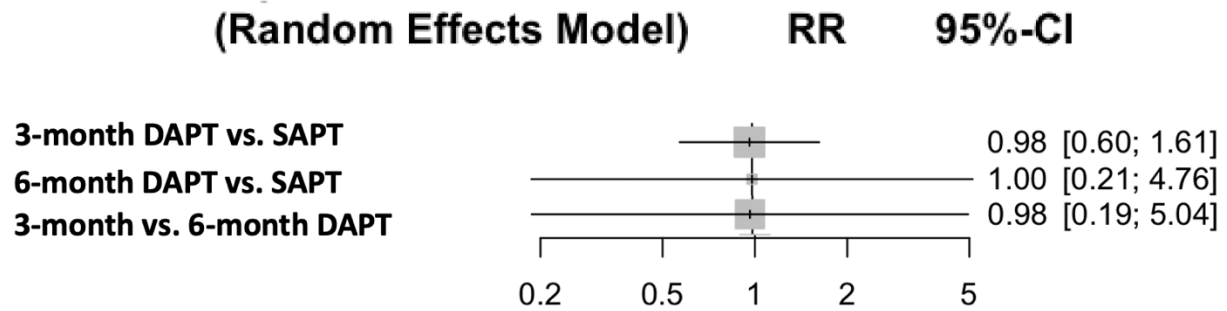
CI=confidence interval, DAPT=dual antiplatelet therapy, RR=risk ratio, SAPT=single antiplatelet therapy.

Figure S4. Antiplatelet therapy and risk of stroke (random-effects model) of sensitivity analysis including only 4 randomized controlled trials.



CI=confidence interval, DAPT=dual antiplatelet therapy, RR=risk ratio, SAPT=single antiplatelet therapy.

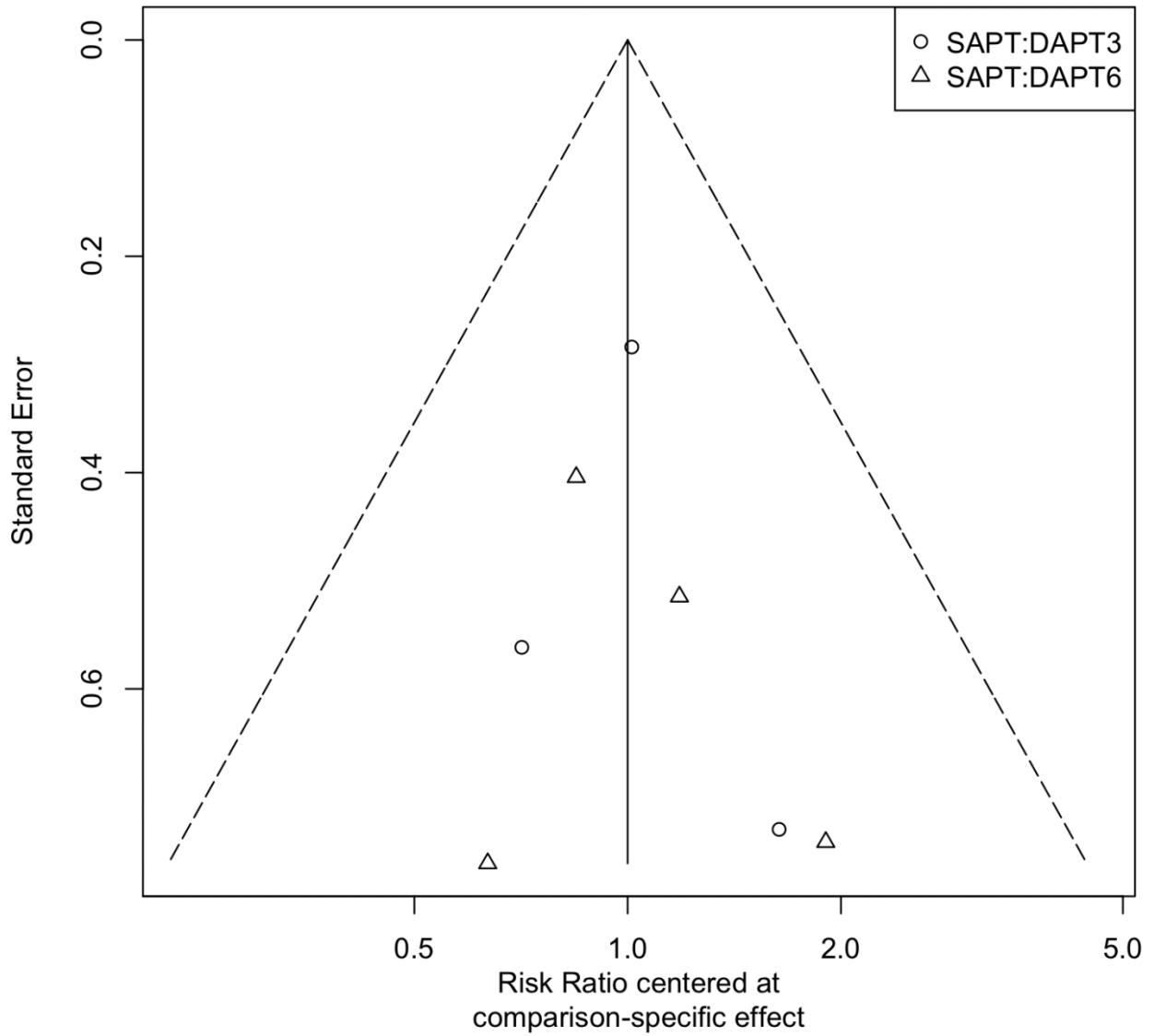
Figure S5. Antiplatelet therapy and risk of all-cause mortality (random-effects model) of sensitivity analysis including only 4 randomized controlled trials.



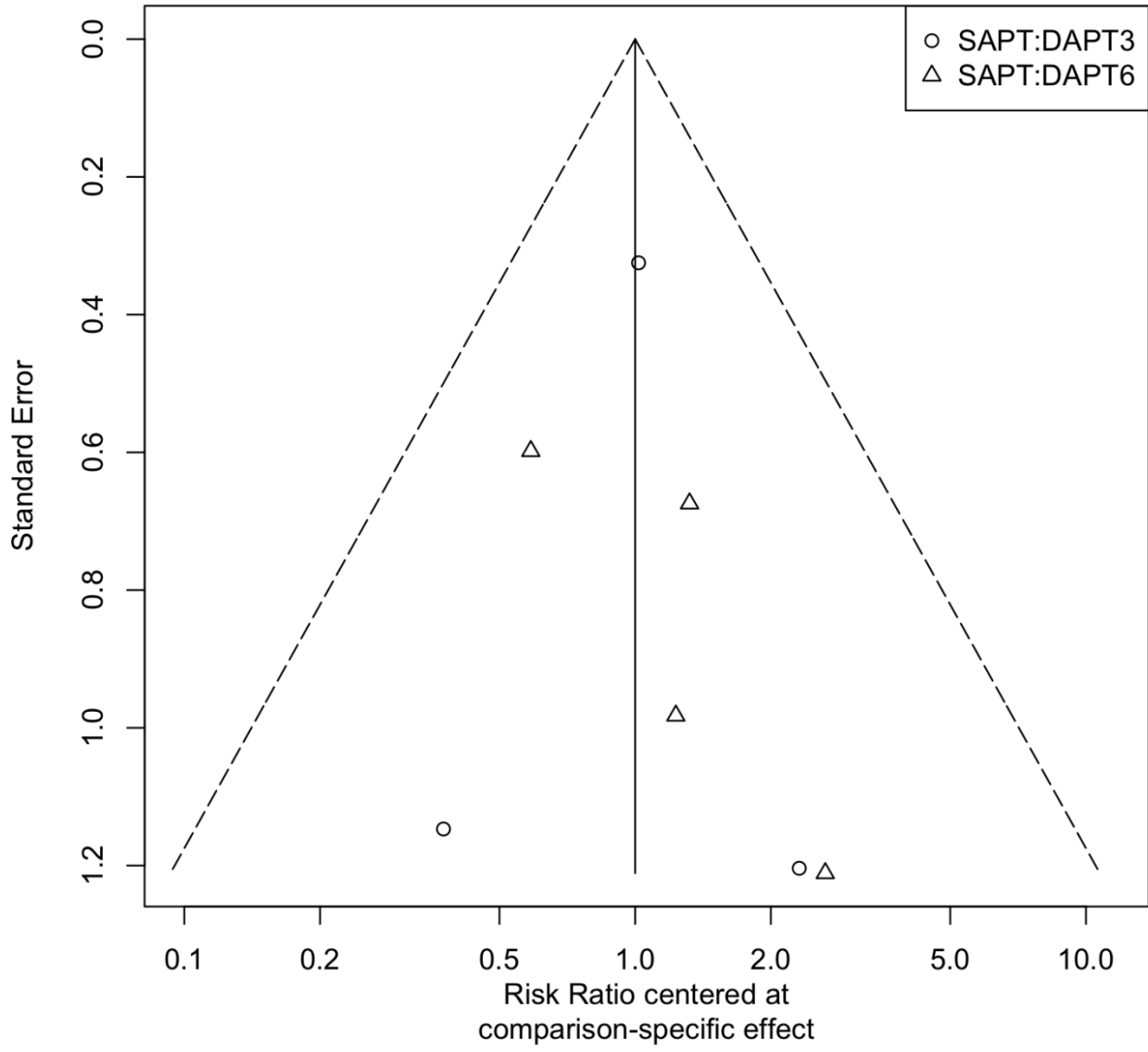
CI=confidence interval, DAPT=dual antiplatelet therapy, RR=risk ratio, SAPT=single antiplatelet therapy

Figure S6. Funnel plot for each analysis. A: Major or life-threatening bleeding; B: Stroke; C: All-cause mortality; D: Major or life-threatening bleeding (sensitivity analysis); B: Stroke (sensitivity analysis); C: All-cause mortality (sensitivity analysis).

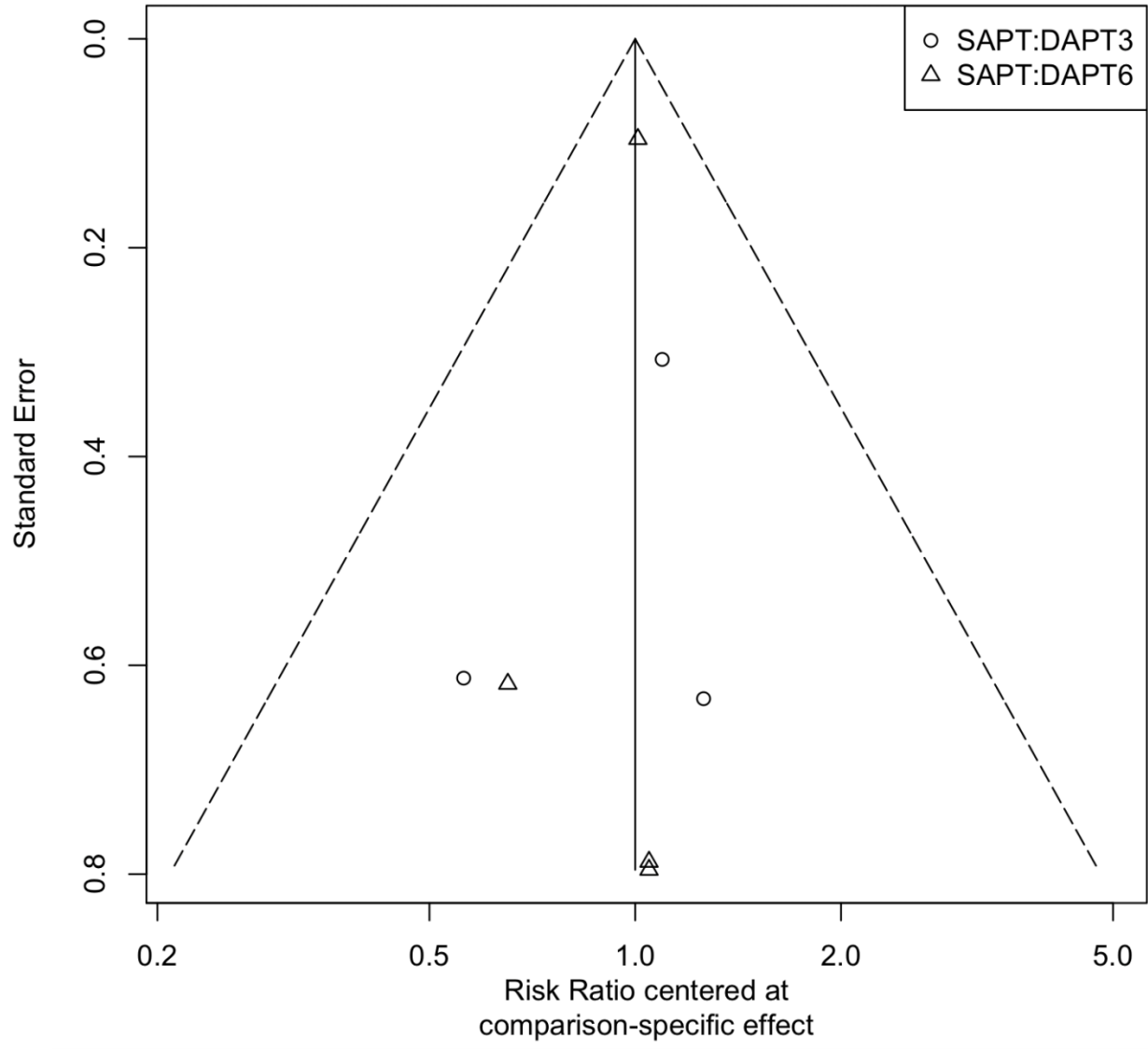
A



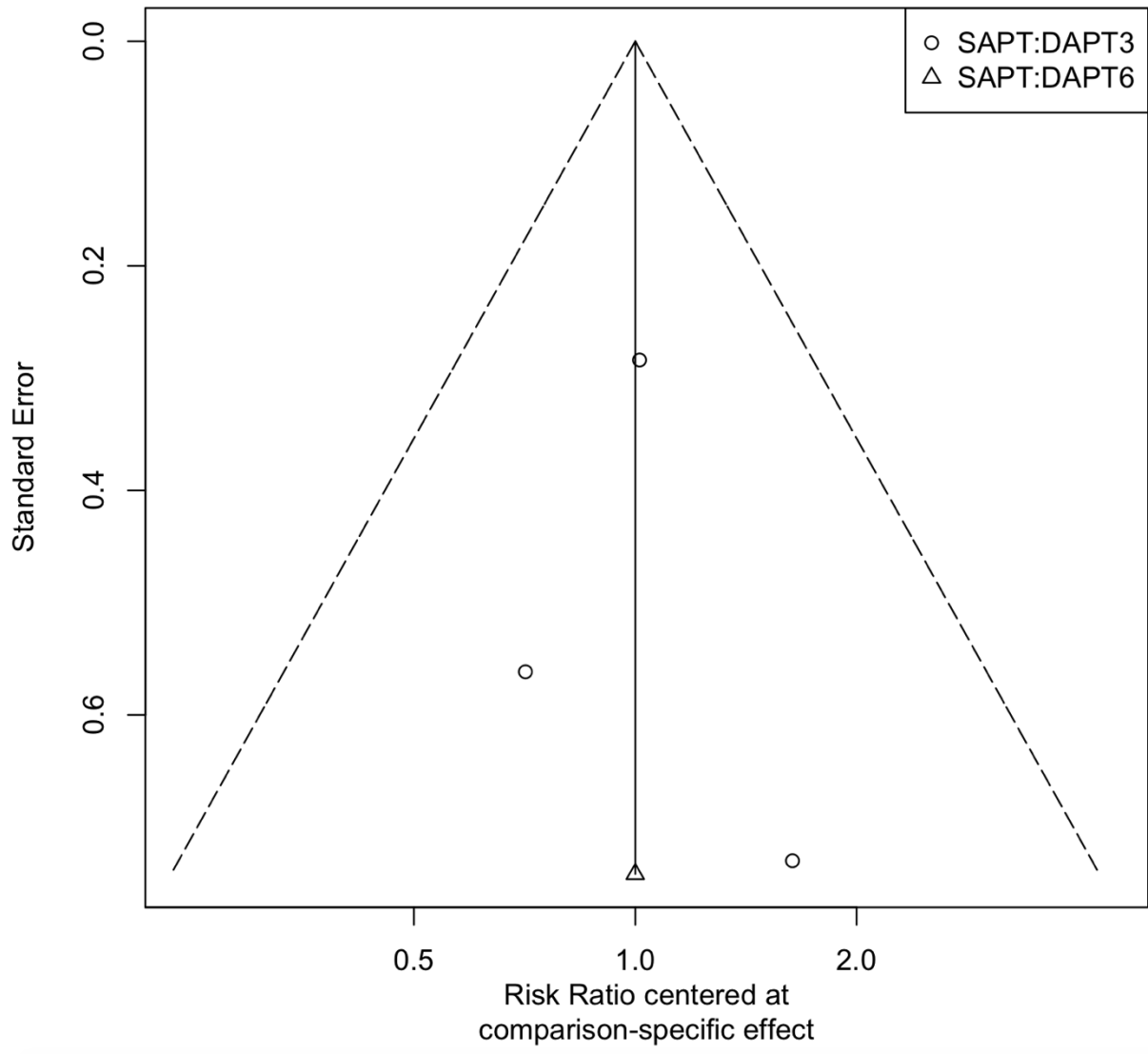
B



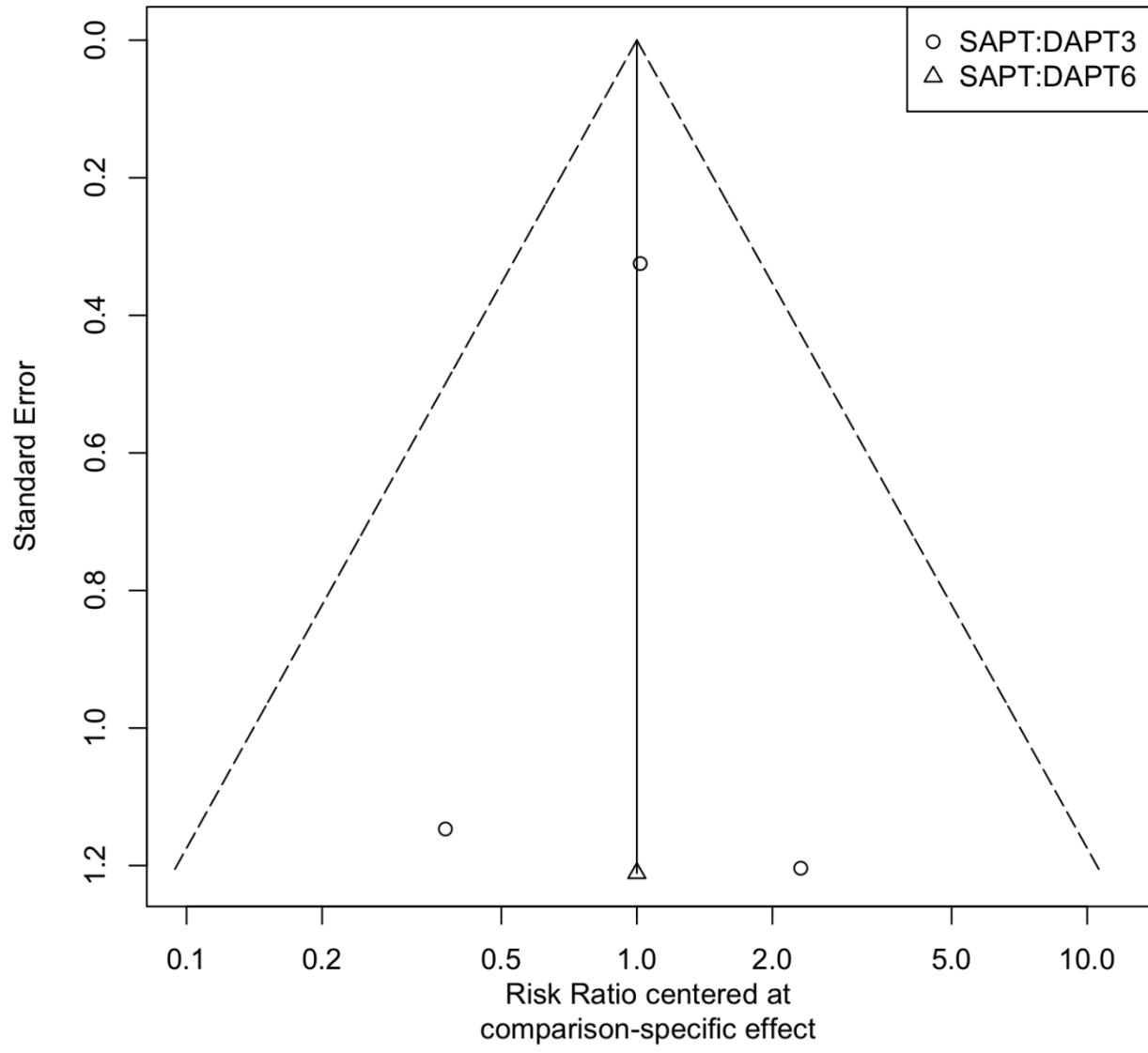
C



D



E



F

