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Ten-year outcomes of TIPS for Budd-Chiari syndrome: systematic review and meta-analysis

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HIGHLIGHTS

- We performed a systematic review and meta-analysis of TIPS effectiveness in Budd-Chiari syndrome with 17 studies that comprised 618 subjects.
- The pooled results (95%CI) showed a 19% (25.9–12.5%) rate of portosystemic pressure reduction.
- We found a 92% (83–97%) prevalence of living subjects five years after TIPS placement.
- Our study showed a 77% frequency (68–83%) of patients alive ten years after TIPS placement.

ABSTRACT – **Background** – Budd-Chiari syndrome (BCS) results from the obstruction of the hepatic venous flow, usually at the level of the hepatic vein or inferior vena cava. When left untreated, it can progress with several complications, including liver cirrhosis. Transjugular intrahepatic portosystemic shunt (TIPS) appears to be effective in a subgroup of BCS patients. **Objective** – To perform a systematic review and meta-analysis of TIPS effectiveness in BCS treatment, considering the survival rate, reduction in portosystemic pressure, need for liver transplantation, technical failure, and shunt dysfunction for up to 10 years of follow-up. **Methods –** We evaluated 17 studies published in PubMed, Science Direct, Web of Science, and SCOPUS databases, which used TIPS as a treatment for BCS, comprising 618 subjects between 18 and 78 years old. We assessed the bias risk by the NOS, NHI, and JBI scales for cohort studies, before-after studies, and case series, respectively. We conducted the meta-analyses by extracting the number of events and the total patients evaluated to perform the proportion meta-analyses using the R software ("meta" package - version 4.9-6). **Results –** The pooled results (95%CI) showed a 19% (25.9–12.5%) rate of portosystemic pressure reduction, 6% (1–12%) rate for the need for liver transplants despite the use of TIPS, 2% (1–6%) technical failure rate, 30% (18–46%) shunt dysfunction rate, and 88% (81–93%) for the mean frequency of patients alive between 1 and 10 years after the procedure. We stratified survival rate and found an 86% (74–93%) prevalence of living subjects during less than five years, 92% (83–97%) at five years, and a 77% frequency (68–83%) of patients alive ten years after the TIPS placement. **Conclusion –** TIPS is an effective treatment for BCS, providing a high 10-year frequency of living patients and a significant decrease in portosystemic pressure. The need for liver transplants after TIPS and the technical failure rate is low.

Keywords – TIPS; Budd-Chiari syndrome; outcome; systematic review; meta-analysis

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INTRODUCTION

Budd-Chiari Syndrome (BCS) is an obstruction to the liver venous outflow due to thrombosis or phlebitis of the hepatic veins and inferior vena cava[1]. The clinical picture can vary from asymptomatic to fulminant liver failure in the most severe cases[2].

The BCS estimated prevalence varies between 1/50,000 and 1/100,000 in the world population[3]. However, its distribution is heterogeneous, with a slight predominance in middle-aged men (45 years, average) in Asia, while women have a higher frequency in the Western world, with an average age of 35 years[4].

Data have shown that the involvement of the hepatic vein related to obstruction by thrombosis is more frequent in the West than in Asia and South Africa, where the inferior vena cava-primary membranous obstruction is the more frequent BCS-etiology[5]. BCS may be classified, according to the etiology, as primary when the vein obstruction results from an endoluminal venous injury such as thrombosis, membranous, and endo phlebitis; or secondary, if the obstruction originates outside the venous system, such from a tumor, abscess, cyst, so that the lesion obstructs the flow by luminal invasion or by extrinsic compression[1]. When untreated, the condition can progress to death in up to 90% of patients within three years, mainly due to complications secondary to liver cirrhosis and clinically significant portal hypertension[5].

Often, the disease progresses, and portal system decompression intervention or liver transplantation is necessary[6] and transjugular intrahepatic portosystemic shunt (TIPS) appears to have a high efficacy rate in reducing portal hypertension, improving liver function, decreasing aminotransferase levels, and controlling ascites[7].

The indications of TIPS are patients with acute, subacute, and chronic BCS, according to the patient's clinical condition, mainly the liver function and hepatic encephalopathy status. TIPS decreases portal hypertension levels and has a primordial role as a bridging therapy to liver transplantation in cirrhotic patients, effectively treating high-risk severe variceal hemorrhage and refractory ascites[8,9]. Scientific literature presents several articles published on this topic, but there are no data analyzing the 10-year outcomes. Therefore, it is relevant to perform a new systematic review with meta-analysis to revisit and update the knowledge about the TIPS effectiveness in patients with Budd-Chiari syndrome.

METHODS

Inclusion criteria:

I. Studies published in English.

II. Patients aged 18 years or over.

III. Patients diagnosed with primary or secondary Budd-Chiari Syndrome.

IV. TIPS or modified TIPS as an intervention.

Exclusion criteria:

I. TIPS as a bridge to transplantation.

II. The combination of TIPS and another technique in the same patient.

III. Association of Budd-Chiari Syndrome with other pathologies.

IV. Studies of patients with hepatopulmonary syndrome.

Literature search

We searched the following databases: PubMed, ScienceDirect, Web of Science, and SCOPUS, and used a combination of DeCS/MeSH descriptors and specific terms. We carried out this search using elements of the PICO strategy, grouped and linked with Boolean systems OR and AND in which the terms utilized to describe the population of interest through the PICO strategy were: Budd-Chiari OR Budd's Syndrome OR Chiari's Disease OR Obstruction hepatic venous flow. On the other hand, the terms related to the intervention were: TIPS OR Transjugular intrahepatic portosystemic shunt.

At PubMed, we used ((TIPS[Title/Abstract]) OR (Transjugular intrahepatic portosystemic shunt [Title/Abstract])) AND ((Budd-Chiari[Title/Abstract]) OR (obstruction hepatic venous flow[Title/Abstract]) OR (Budd's Syndrome[Title/Abstract]) OR (Chiari's Disease[Title/Abstract])) as search strategy on May 24, 2021. This search resulted in 280 articles.

On ScienceDirect, we opted for (TIPS OR Transjugular intrahepatic portosystemic shunt) AND (Budd-Chiari OR obstruction hepatic venous flow OR

Budd's Syndrome OR Chiari's Disease), with a filter – research articles, as search strategy on July 14, 2021.

This search resulted in 598 articles.

On Web of Science, we utilized the terms (TIPS) OR (Transjugular intrahepatic portosystemic shunt)) AND ((Budd-Chiari) OR (obstruction hepatic venous flow) OR (Budd Syndrome) OR (Chiari Disease)) as search strategy on July 14, 2021. This search resulted in 462 articles.

Finally, at SCOPUS, we used (TITLE-ABS-KEY (tips OR Transjugular intrahepatic portosystemic shunt) AND TITLE-ABS-KEY (Budd-Chiari OR obstruction hepatic venous flow OR Budd's Syndrome OR Chiari's Disease) as search strategy on July 14, 2021. This search resulted in 568 articles.

Study selection and data extraction

The first evaluator performed the searches and imported those articles to the Rayyan – Intelligent Systematic Review platform, a free-to-use system sponsored by the Qatar Foundation that allows a rapid initial screening due to its several features available. Two independent evaluators performed a selection of articles to be read based on title and abstract, identifying studies that provided a complete reading, and excluding those not relevant to the present paper. If divergences had arisen, the evaluators would demand the opinion of a third evaluator. After that, the approved articles were listed in an Excel spreadsheet to collect data concerning the country of publication, number, gender, the average age of patients, the success of the intervention, restenosis rate, and the number of patients alive in 1, 5, and 10 years.

Risk of bias

We used the Newcastle-Ottawa Scale[10], JBI Critical Appraisal Checklist for Case Series[11], and NIH quality assessment tool to assess the quality of observational studies (Quality Assessment Tool for Before--After (Pre-Post) Studies With No Control Group)[12]. In addition, we developed funnel charts to evaluate the risk of bias in each publication.

Statistical analysis

We performed metanalyses extracting the number of events and patients to perform metanalyses of proportions using the R software with the "meta" package (version 4.9-6). A logistic regression model of a random intercept grouped the results and logit transformation adjusted data. For studies presenting zero events, we applied 0.5 for continuity correction. We used maximum likelihood to estimate the variance between studies (tau^2).

We assessed heterogeneity using I^2 statistics, considering I^2 <40% as low heterogeneity, ≥40% as substantial heterogeneity, and >75% as high heterogeneity. The visual inspection was adopted using a funnel plot when the funnel presented asymmetry. Publication bias was analyzed using the Egger test when analyses had ≥10 studies included[13].

We performed subgroup analysis to assess the frequency of patients alive and subdivided them by period: <5 years, five years, and 10 years.

Conflict-of-interest statement

The authors deny any conflict of interest and the use of artificial intelligence in writing this article.

RESULTS

Study selection

During the study selection process from the different databases, we identified 1908 references, and of those, we removed 657 (34.4%) due to duplicity. After reading the titles and abstracts, we excluded 1193 (63%) because they did not fulfill the inclusion criteria, leaving 58 selected reports. We could not access 15 of these references, even after trying to contact their respective authors. Finally, we performed full reading of 43 studies, and only 17 met all eligibility criteria, as shown in FIGURE 1.

Characteristics of the studies

TABLE 1 summarizes the baseline characteristics of eligible manuscripts published between 1995 and 2018. All studies were observational and retrospective. They comprised 608 participants aged between 18 and 78 years old. Regarding the subject's demographic characteristics, the metanalysis evaluated four Chinese, four American, two Spanish, and two Russian studies. It also analyzed Egyptians, Dutch, Germans, Italians, and Singaporeans (one study from each country). We considered some outcomes like

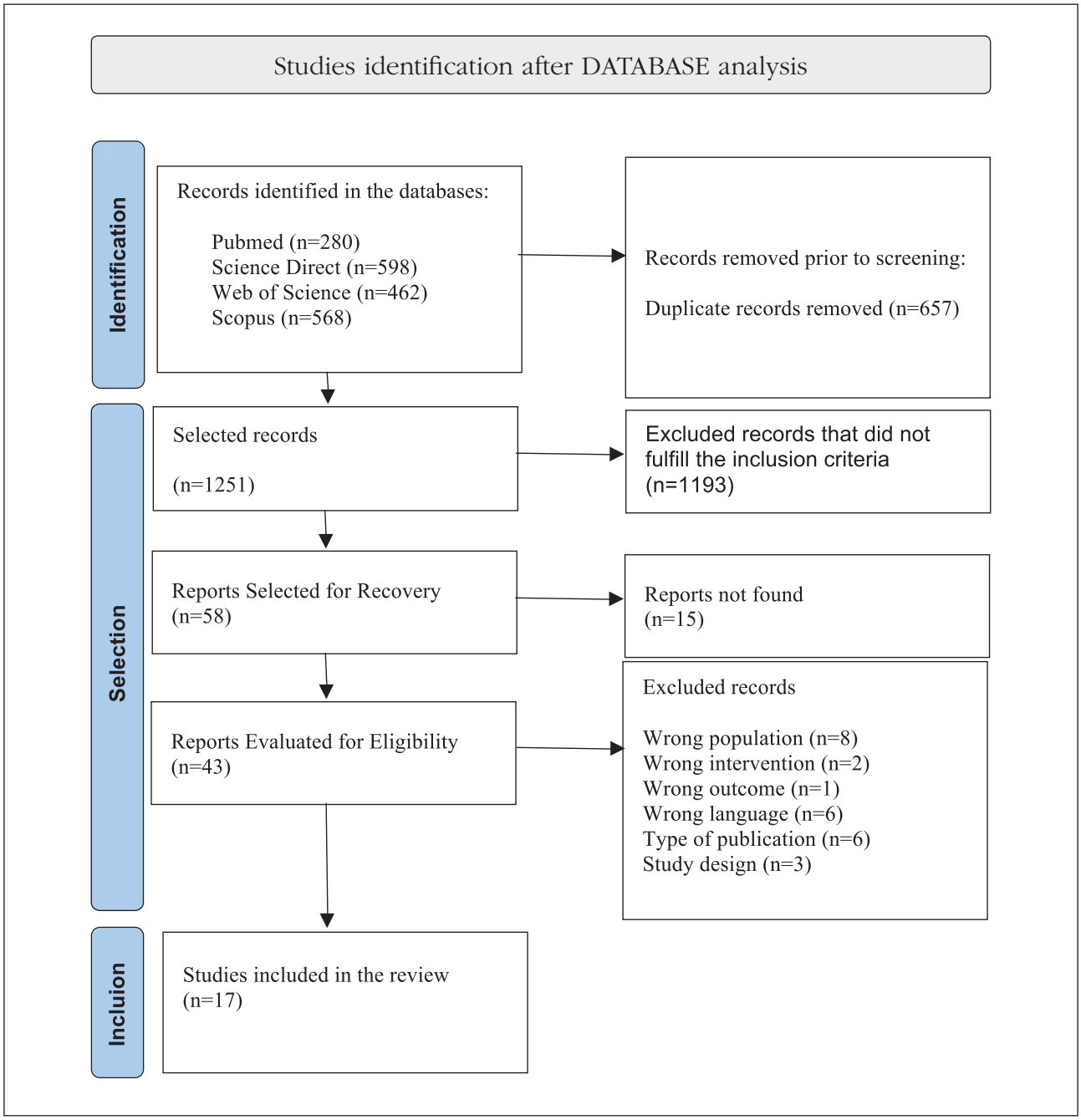

FIGURE 1. Flow Diagram – PRISMA.

the frequency of patients alive, the TIPS intervention success rate, the frequency of shunt dysfunction, the liver transplantation rate after TIPS, the hepatic vein pressure gradient measurement (before and after TIPS), and biochemical variables.

Only six studies described the baseline characteristics of patients. He et al. (2015) and (2016) investigated subjects with acute or subacute Budd-Chiari, while Parekh et al. (2017) selected individuals with acute liver failure. Perelló et al. (2002) evaluated patients with drug-refractory BCS, and Pagán et al. (2008) analyzed patients with BCS and refractory ascites.

The symptoms most frequently described in study samples were hepatic encephalopathy, ascites, variceal bleeding, and jaundice. The etiologies identified were myeloproliferative diseases, antiphospholipid syndrome, paroxysmal nocturnal hemoglobinuria, and polycythemia vera, respectively.

TABLE 1. Characteristics of the studies included.

Author (year)	Study design	Country	Sample N (age)	Follow-up	Outcomes	
					Primary	Secondary
Blum et al. (1995)[23]	Before and after	DEU	GT: 12 GC: 0 (52 [31–71])	3 years	S1: 75%	SD: 41.7% IS: 100% T: 8.3%
Perelló et al. (2002)[22]	Cohort	ESP	GT: 13 GC: 8 (38±13)	4±3 years	S1: 92%	SD: 61.5% IS: 92.35% T: 7.7%
Mancuso et al. (2003)[24]	Before and after	ITA	GT: 15 GC: 0 (39.5 [20–73])	3.7 years	S1: 73.3%	SD: 26.7% IS: 93.3% T: 0%
Molmenti et al. (2005)[25]	Before and after	USA	GT: 11 GC: 0 (53±20)	10 years	S1: nr S5: 91%	SD: 18% IS: 91% T: 9%
Eapen et al. (2006) [26]	Cohort	GBR	GT: 26 GC: 35 (44 [21–67])	5 years	S1: 84.6% S5: 80.8%	SD: 11.64% IS: 100% T: 3.85%
Lee et al. (2006)[27]	Case series	USA	GT: 2 GC: 17 (45 [28–68])	4 years	S1: 100%	SD: nr IS: 100% T: 0%
Murad et al. (2008)[28]	Cohort	NLD	GT: 16 GC: 0 (31 [19–50])	3 years	S1: 80% S3: 72%	SD: 62.5% IS: 93.75% T: 6.25%
Pagán et al. (2008)[29]	Case series	ESP	GT: 133 GC: 29 (38 [35–40])	5 years	S1: 88% S5: 78%	SD: 41% IS: 93.3% T: 6.5%
Zhang et al. (2013)[30]	Cohort	CHN	GT: 3 GC: 15 (36±9)	5 years	S1:nr	SD: 100% IS: 100% T: 0%
Tripathi et al. (2014)[31]	Cohort	GBR	GT: 67 GC: 0 (39.9±14.2)	10 years	S1: 92% S5: 80% S10: 72%	SD: 45% IS: 98.5% T: 3%
Pavri et al. (2014)[32]	Cohort	USA	GT: 19 GC: 21 (33.3 [29.7–45.8])	5 years	S1: 83.3%	SD: 52.6% IS: nr T: 26.3%
He et al. (2015)[33]	Before and after	CHN	GT: 21 GC: 16 (39.67±2.74)	1.5 years	S1: 100%	SD: 0% IS: 100% T: nr
Fan et al. (2016)[34]	Before and after	CHN	GT: 33 GC: 27 (38.82±11.45)	10 years	S1: nr	SD: nr IS: 94% T: 0%
He et al. (2016)[35]	Cohort	CHN	GT: 91 GC: 9 (28±10.5)	5 years	S1: nr S5: 93.41%	SD: 10.98% IS: 100% T: nr
Parekh et al. (2017)[8]	Case series	USA	GT: 7 GC: 12 (38 [19–59])	2 years	S1: 42.8%	SD: nr IS: nr T: 0%
Sakr et al. (2017)[36]	Cohort	EGY	GT: 107 GC: 87 (28.79±8.94)	1 year	S1: 89.7%	SD: 19.8% IS: nr T: nr
Sonavane et al. (2018)[37]	Before and after	SGP	GT: 42 GC: 0 (40.52±14.26)	10 years	S1: 86% S5: 81% S10:76%	SD: 7.14% IS: 100% T: 4.76%

CHN: China; DEU: Germany; EGY: Egypt; ESP: Spain; GBR: United Kingdom; ITA: Italy; NLD: Netherlands; SGP: Singapore; USA: United States; GT: TIPS group; GC: comparison or control group; S1: survival 1 year; S3: survival 3 years; S5: survival 5 years; S10: survival 10 years; SD: shunt dysfunction; IS: intervention success; T: liver transplant.

Risk of bias rating

The assessment of the risks of bias in the included studies, under the different scales, including NOS[10], JBI[11], and NIH[12], used to qualify the cohort studies, case series, and before and after, respectively, are shown in TABLE 2.

Of the eight cohort studies evaluated by the NOS scale, only two reached the maximum score for the selected domain, obtaining four[4] stars. In the comparison domain, five studies did not score. All papers had three stars in the outcome domain. The overall score of the studies ranged from five to eight stars.

TABLE 2. Risk of bias assessment of studies included.

Author (year)	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Score
Tool:	NIH: Assessment of studies before and after inclusion												
Blum et al. (1995)	Y	Y	Y	Y	Y	Y	Y	N	Y	N	N	NA	8
Mancuso et al. (2003)	Y	U	Y	Y	Y	Y	Y	N	Y	N	N	NA	7
Molmenti et al. (2005)	Y	U	Y	Y	Y	Y	Y	N	Y	N	N	NA	7
He et al. (2015)	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	N	NA	9
Fan et al. (2016)	Y	U	Y	Y	Y	Y	Y	N	Y	N	N	NA	7
Sonavane et al. (2018)	Y	Y	Y	Y	Y	Y	Y	N	N	N	N	NA	7
Tool:	JBI to assess case series studies included												
Lee et al. (2006)	N	Y	Y	Y	Y	Y	N	Y	Y	U	-	-	7
Pagán et al. (2008)	Y	N	Y	Y	N	Y	Y	Y	Y	Y	-	-	8
Parekh et al. (2017)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	-	-	10
Tool:	Newcastle-Ottawa Scale (NOS)												
Author (year)	**Selection**					**Comparison**				**Outcome**			**Score**
Perelló et al. (2002)	★★									★★★			5
Eapen et al. (2006)	★★									★★★			5
Murad et al. (2008)	★★★★									★★★			7
Zhang et al. (2013)	★★★									★★★			6
Tripathi et al. (2014)	★★★									★★★			6
Pavri et al. (2014)	★★★★					★				★★★			8
He et al. (2016)	★★					★				★★★			6
Sakr et al. (2017)	★★★					★★				★★★			8

Y= yes; N = no; U = unclear;
Questions (NIH/JBI):
Q1 – Was the study hypothesis or objective clearly stated? / Were there clear criteria to include studies in the case series?
Q2 – Were the eligibility/selection criteria for the study population pre-specified and clearly stated? / Was the condition measured in a standardized and reliable manner for every participant included in the case series?
Q3 – Were the study participants representative of those eligible for test/service/intervention in the general population or clinic of interest? / Were the methods used capable of identifying the condition for every participant included in the case series?
Q4 – Were all eligible participants who met the pre-specified inclusion criteria enrolled? / Did the case series have consecutive inclusion of participants?
Q5 – Was the sample size large enough to make the study findings reliable? / Did the case series have full inclusion of participants? / Did the case series have full inclusion of participants?
Q6 – Was the test/service/intervention clearly described and performed in a consistent manner for the entire study population? / Was there a clear report of demographic data of study participants?
Q7 – Were the result measurements pre-specified, clearly defined, valid, reliable and evaluated in a consistent manner for every study participant? / Was there a clear report of participants' clinical information? / Were the results or case follow-up results clearly reported?
Q8 – Were the people responsible for result assessments blinded for exposures/interventions of participants? / Were the results or case follow-up results clearly reported?
Q9 – Was the loss to follow-up rate after baseline 20% or lower? Were losses to follow-up considered in the analysis? / Was there a clear report of demographic data of sites/clinics presented?
Q10 – Did the statistical methods evaluate changes in result measurements before and after the intervention? Were statistical tests performed to provide p values for pre- and post-changes? / Was the statistical analysis appropriate?
Q11 – Were the main result measurements performed several times before and after the intervention (that is, the studies used an interrupted time series design)?
Q12 – If the intervention was carried on at a group level (for example, an entire hospital, a community etc.), did the statistical analysis consider the use of data at an individual level in order to determine the effects at a group level?

For case series studies, only Parekh et al. (2008) achieved the maximum score on the JBI scale. The study by Lee et al. (2006) did not score questions 1 and 7, which refer respectively to the inclusion criteria and the clear presentation of results, nor question 10, as it clarified the statistical analysis method used to analyze the results.

In the evaluated studies classified as before and after, none carried out the intervention at the group level. Furthermore, none of the six studies used an interrupted time series design, taking measurements only once. In three of the studies, the eligibility/selection criteria of the population under analysis were not pre-specified and clearly described.

Portosystemic pressure

We included nine studies to analyze the portosystemic pressure (PP) reduction outcome. All demonstrated a PP reduction, resulting in a pooled effect size of -3.80 (95%CI -5.12 to -2.49), equivalent to a 19 mmHg or mmH2O reduction (95%CI 25 .9 to 12.5), as shown in FIGURE 2. However, high heterogeneity was reported (I^2=94%).

By exploring heterogeneity by sensitivity analysis, the Baujat plot demonstrated that He et al. (b) partially influenced the overall results and heterogeneity (FIGURE 3). Then, applying leave-one-out analysis and excluding this study (FIGURE 4), 11% of heterogeneity was explained (from 94% to 83%).

Liver transplant

We analyzed the frequency of liver transplants after TIPS failure, and the pooled data resulted in 6% (95%CI 1–12%; *P*=0.10) (FIGURE 5), showing moderate heterogeneity (I^2=43%). After assessing heterogeneity by sensitivity analysis, the Baujat plot (FIGURE 6) showed that the study of Pavari et al. (2014) significantly influenced heterogeneity and the clustered result. Applying the leave-one-out method to access the study influence (FIGURE 7), we found a decrease in the liver transplant rate from 6% to 4%, dropping heterogeneity to 0%.

Technique failure

The frequency of TIPS technical failure was 2% (CI95% 1–6%; *P*=1.00, I^2=0%) (FIGURE 8). Visually observing the funnel plot (FIGURE 9), we found a positive asymmetry but no publication bias by the Egger test (*P*=0.348).

Shunt dysfunction

The pooled effect of shunt dysfunction was 30% (CI95% 18–46%; *P*<0.01), showing high heterogeneity (I^2=79%) (FIGURE 10). For the investigation of suspected publication bias, the funnel plot (FIGURE 11) did not show asymmetry. The heterogeneity analysis by sensitivity method and the Baujat plot (FIGURE 12) showed that the Pagán et al. 2008 study influenced the heterogeneity and the pooled result. After

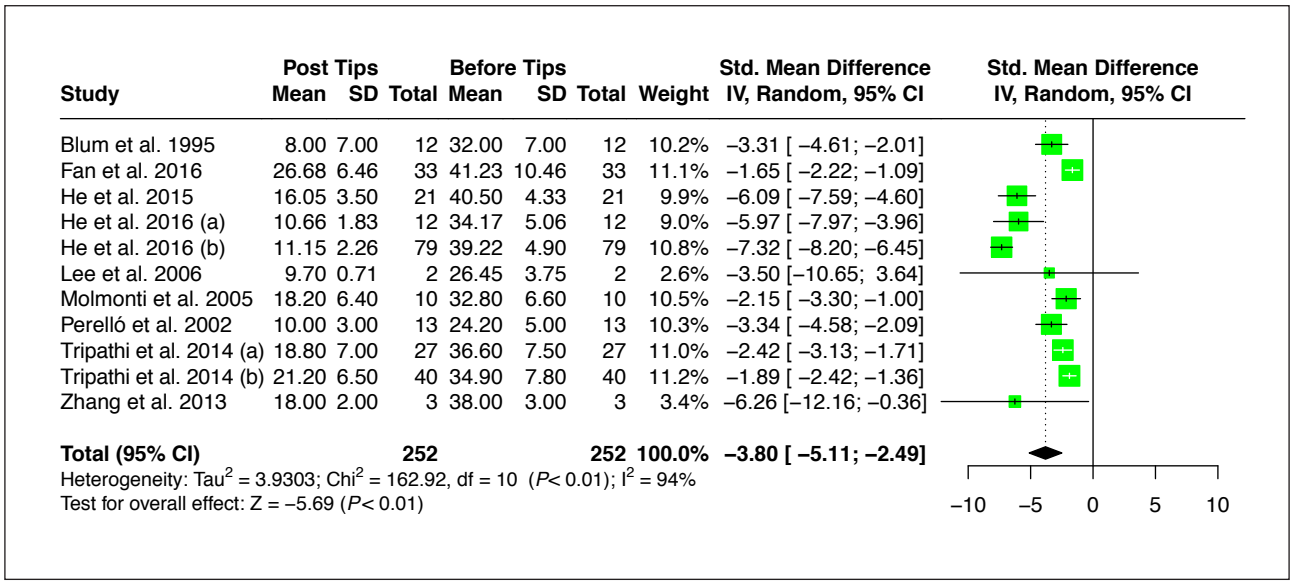

FIGURE 2. Forest graph - Portosystemic pressure.

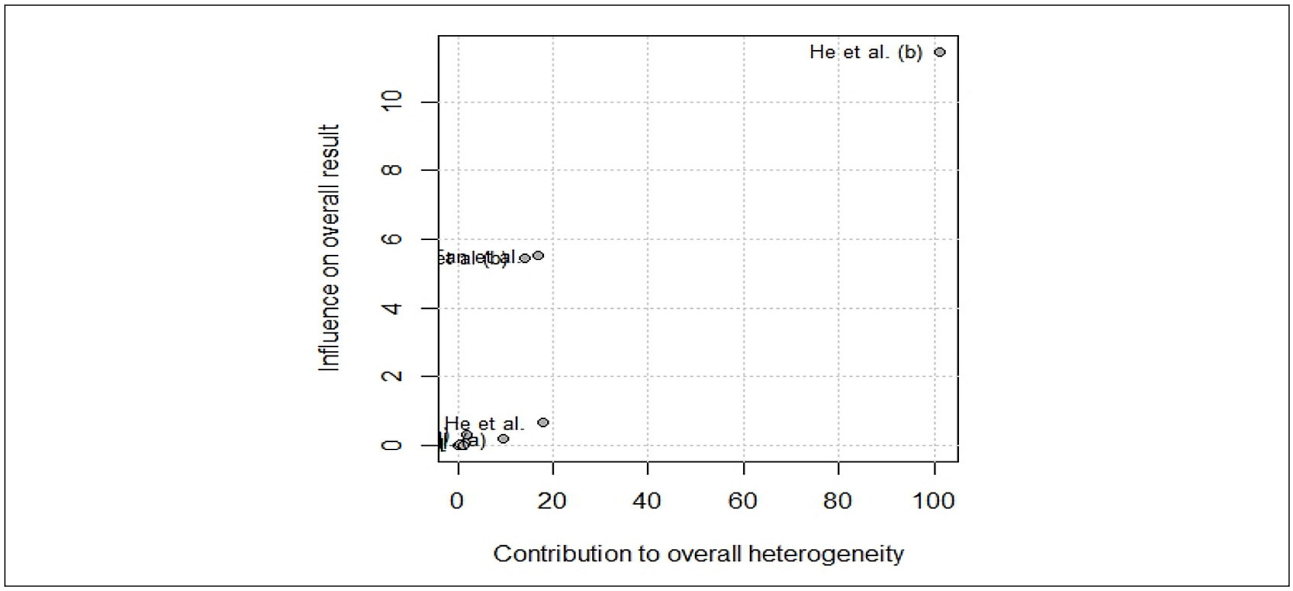

FIGURE 3. Baujat graph – Portosystemic pressure.

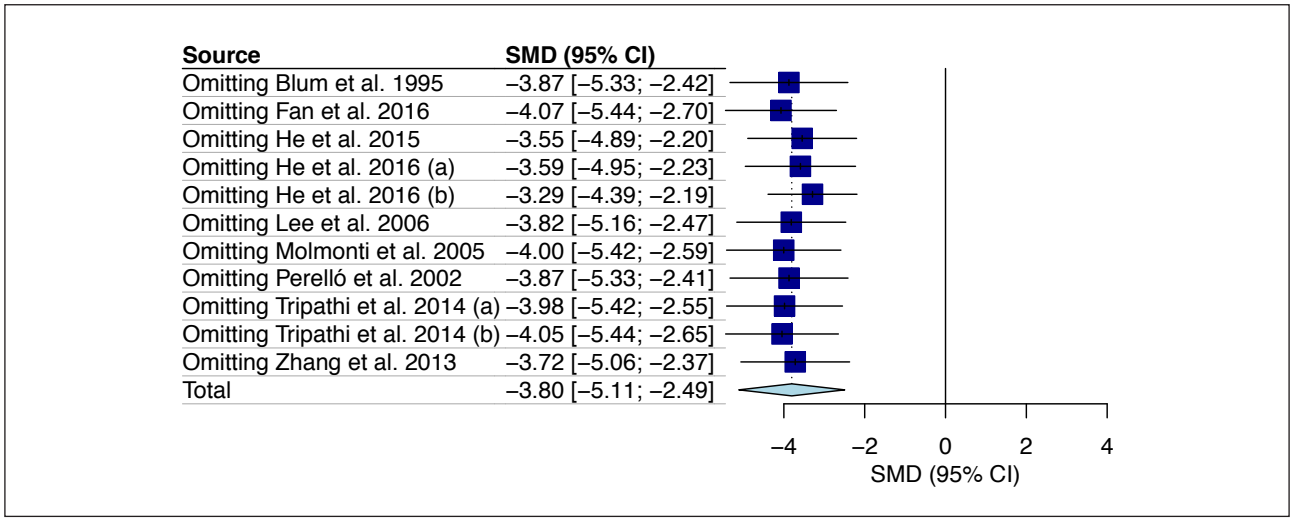

FIGURE 4. Forest graph excluding one study – portosystemic pressure.

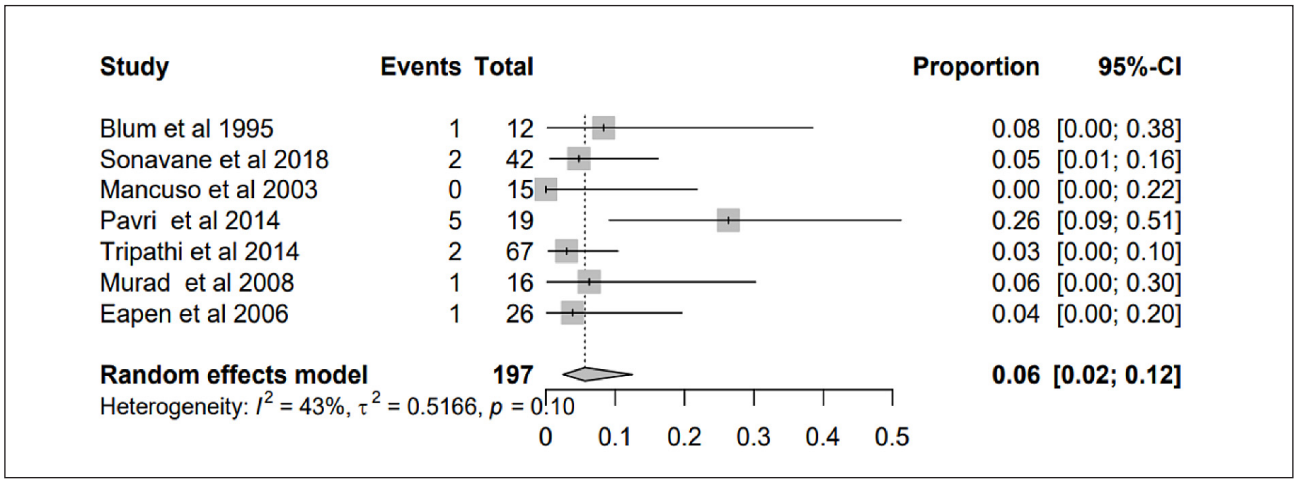

FIGURE 5. Forest chart – Liver transplantation.

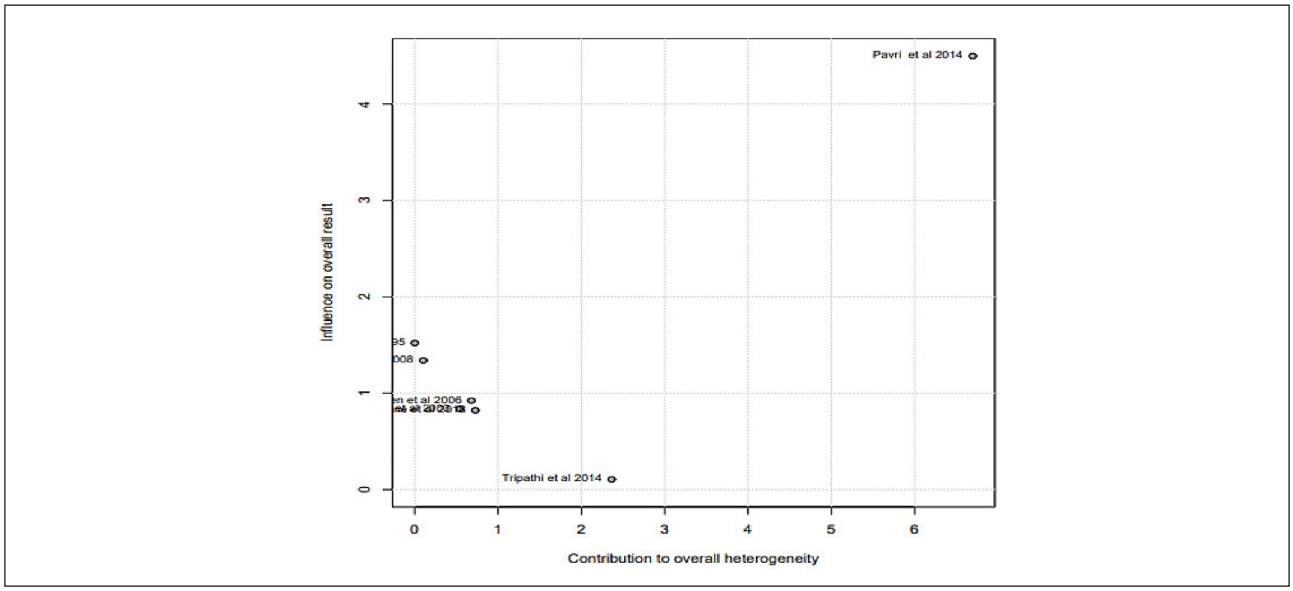

FIGURE 6. Baujat chart – liver transplantation.

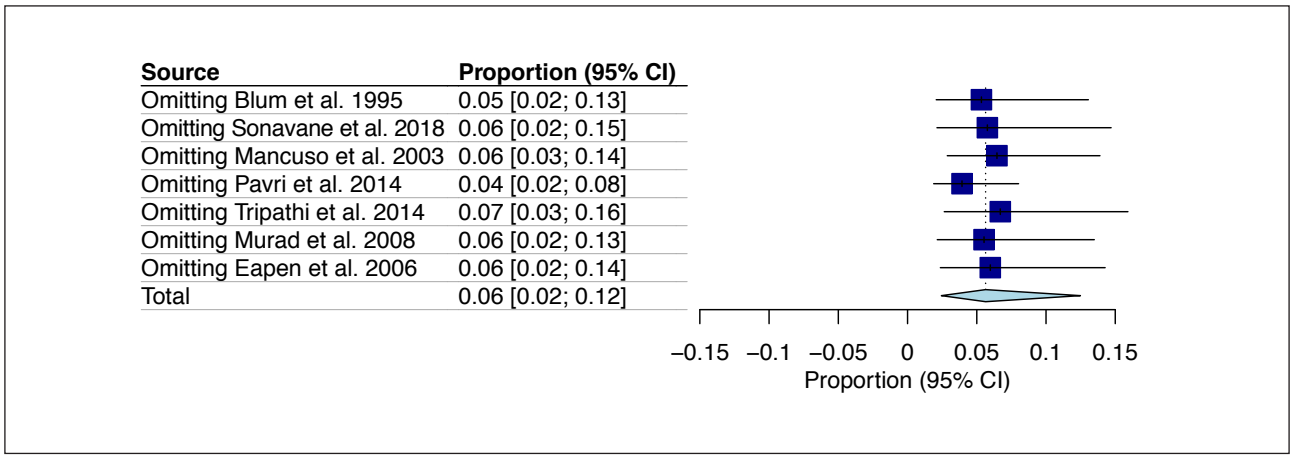

FIGURE 7. Forest graph excluding one study – liver transplantation.

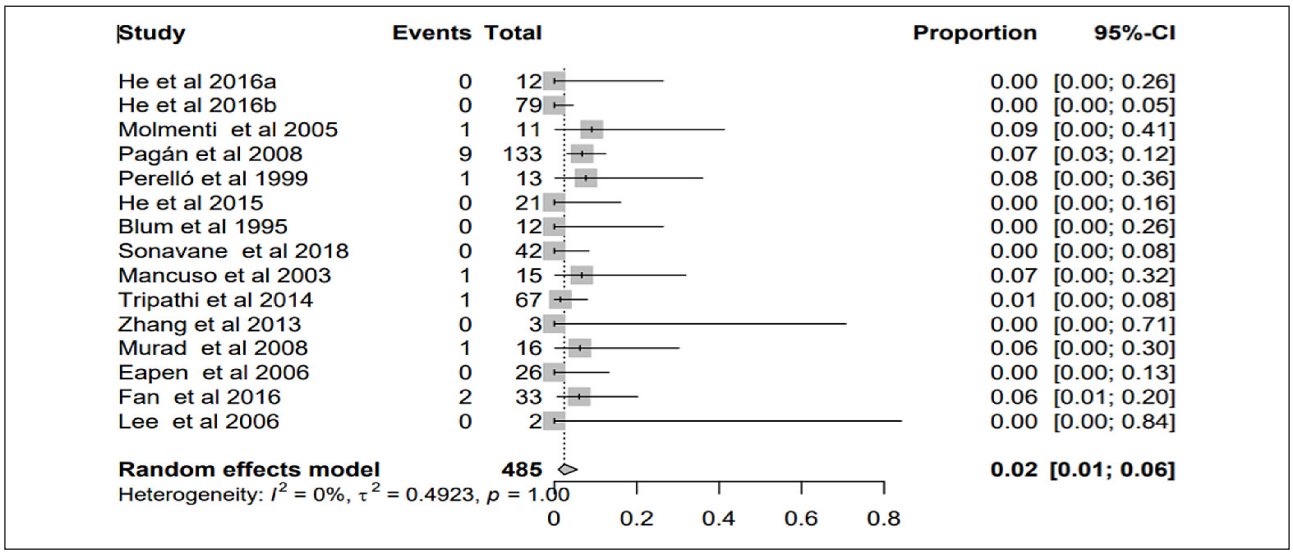

FIGURE 8. Forest chart – technique failure.

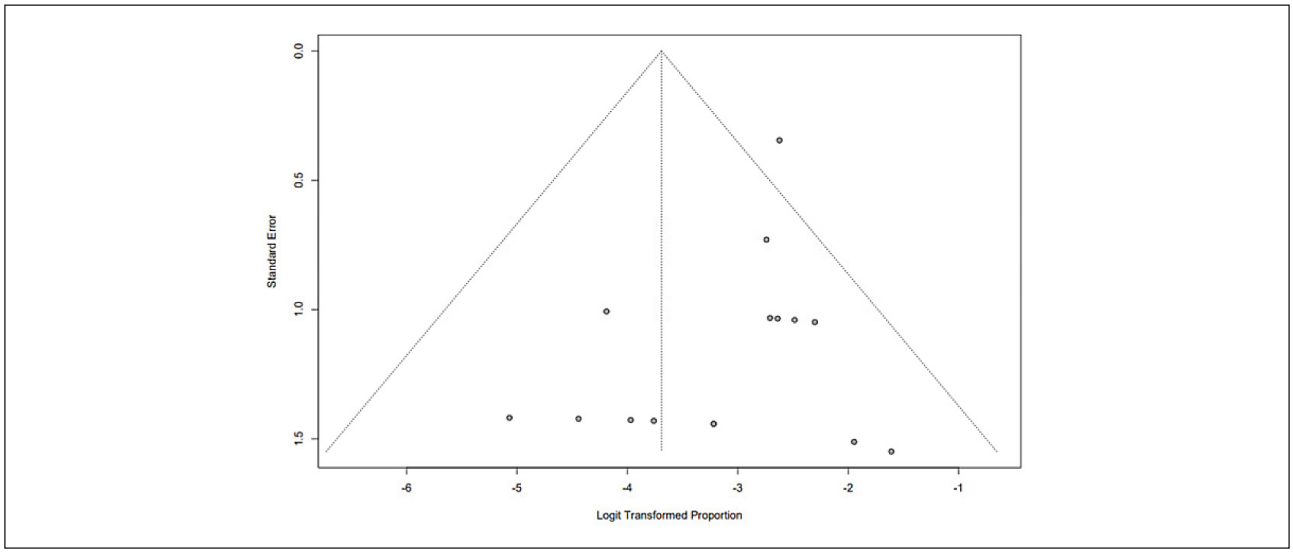

FIGURE 9. Funnel chart - technique failure.

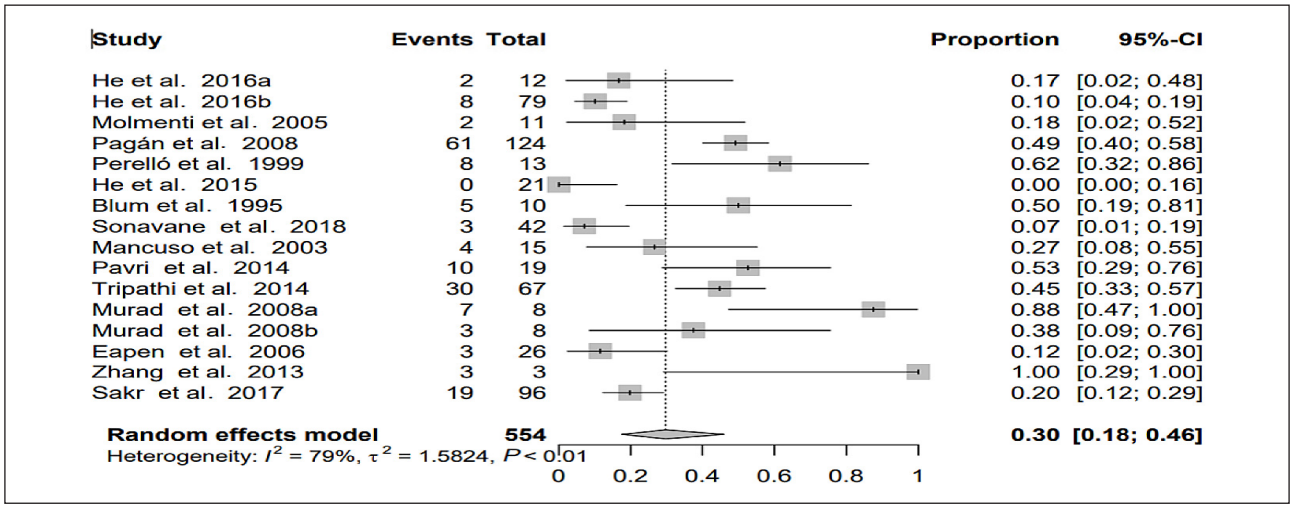

FIGURE 10. Forest graph – shunt dysfunction.

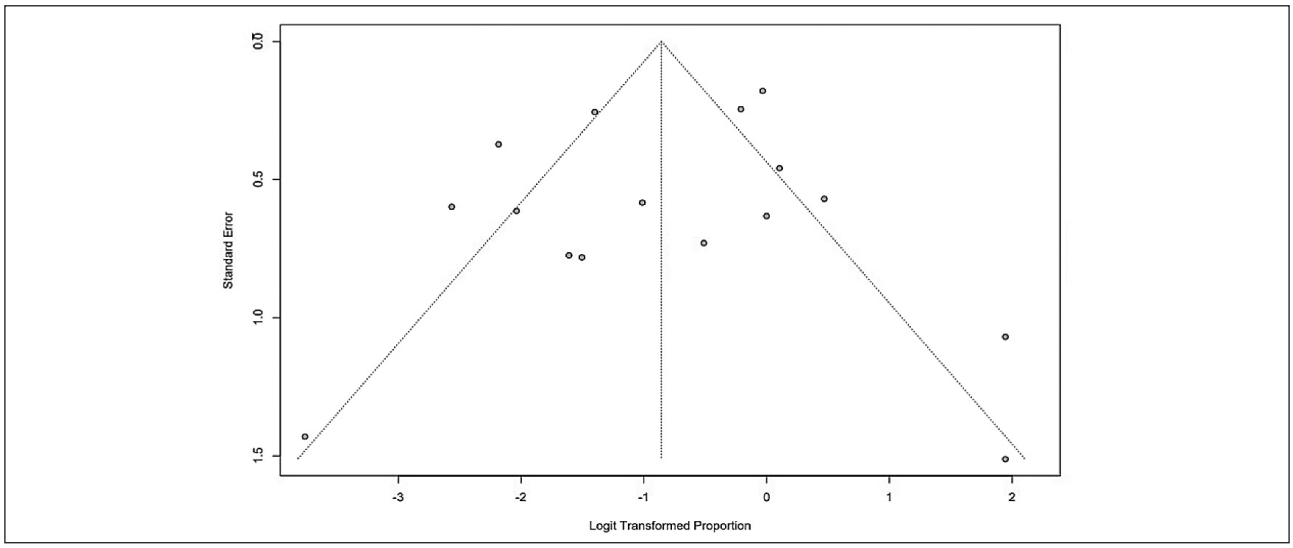

FIGURE 11. Funnel chart – shunt dysfunction.

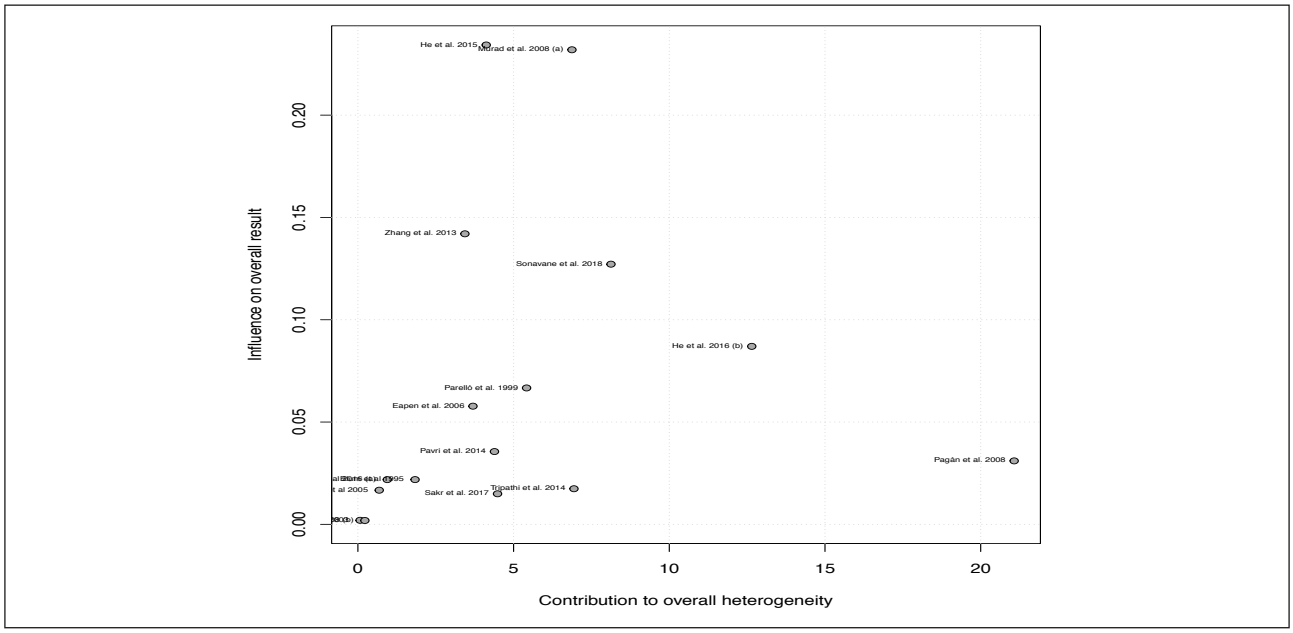

FIGURE 12. Baujat chart – shunt dysfunction.

its exclusion by leave-one-out analysis (FIGURE 13), it was possible to demonstrate a slight reduction in pooled outcome (from 30% to 28%) and heterogeneity (I^2=79% to 75%).

Survival rate

The pooled data resulted in 88% of live patients after TIPS therapy (CI95% 81–93%; *P*<0.01), with moderate heterogeneity (I^2=59%). Before five years, there was a mean frequency of 86% live people after TIPS (CI95% 74–93%; *P*=0.14), with moderate heterogeneity (I^2=36%). In 5-year post-TIPS, the live people's mean frequency was 92% (CI95% 83–97%; *P*=0.01), with moderate heterogeneity (I^2=68%). In 10-year post-TIPS, a mean frequency of 77% live people was found (CI95% 68–83%; *P*=1) with a low heterogeneity (I^2=0%). There is an expected difference between the subgroups (*P*=0.03) due to the variations in the time point evaluation (FIGURE 14).

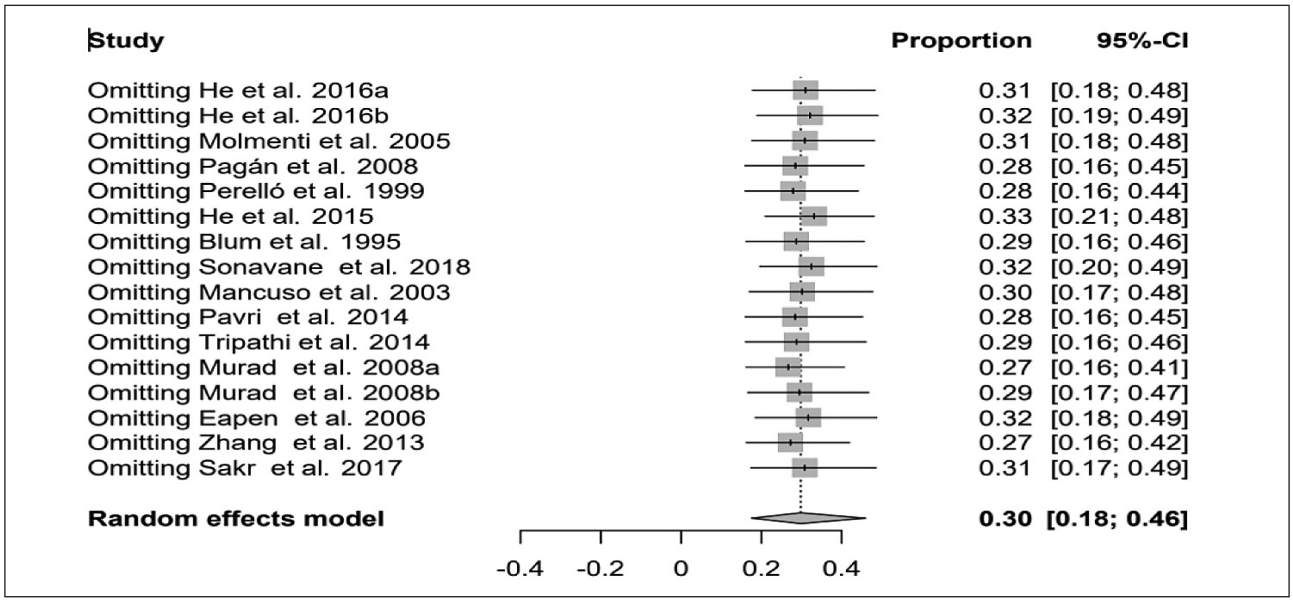

FIGURE 13. Forest graph excluding one study – shunt dysfunction.

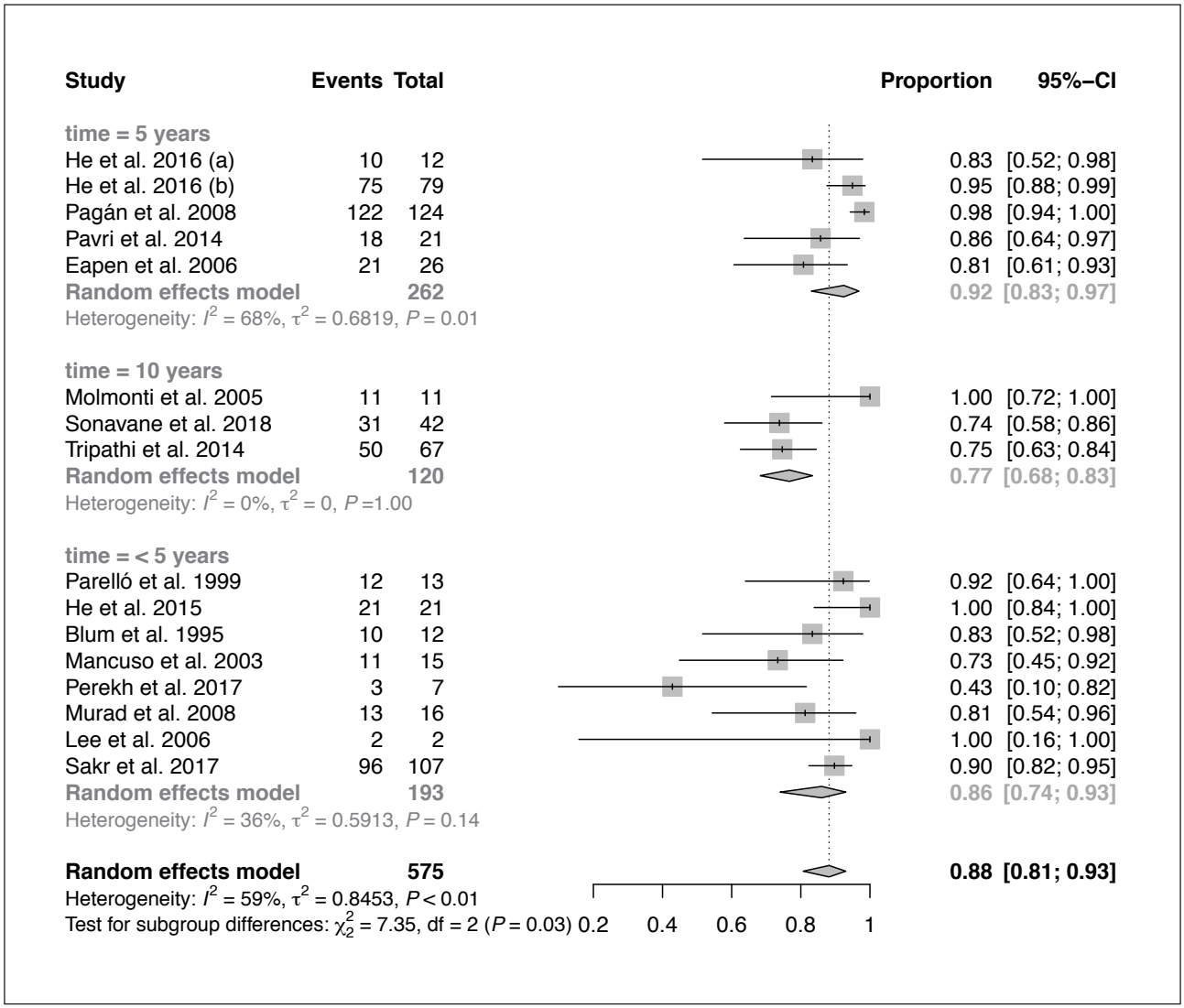

FIGURE 14. Frequency Graph – living patients.

DISCUSSION

This systematic review and meta-analysis included 17 studies and 618 patients and evaluated the effect of TIPS insertion in patients with Budd-Chiari concerning survival, the reduction of portosystemic pressure, shunt dysfunction, technical failure, and rate of liver transplantation. To our knowledge, this is the first meta-analysis that analyzed up to 10-year TIPS outcomes.

The overall survival rate from 1 to 10 years after the intervention was 88%. In the period ranging from 1 to 5 years, we detected an average rate of 86%, while in the exact 5-year period, we found that 92% of the patients were alive. This minor difference may be due to an underestimation of the analysis of the studies with low sample power[8] In the period of exactly 10 years post-TIPS, there were 77% of patients alive[8]. Our findings agree with the ones from the systematic review of Qi et al. (2015), who found a median 1-, 5- and 10-year survival rate of 93%, 83%, and 73% after interventional radiological treatment[14].

Among Budd-Chiari patients who underwent TIPS, we found that approximately 6% of the subjects required liver transplants due to TIPS failure. It probably occurred due to the advanced stage of the liver disease of these subjects, who progressed to end-stage liver failure in spite of the TIPS placement.

Our study found a 98% success rate (estimated technical failure of only 2%) for TIPS insertion and is consistent with the meta-analysis of Zhang et al. in 2014[15], which detected a 93.7% success rate for TIPS intervention.

On the other hand, the results regarding the rate of shunt dysfunction differed from another meta-analysis. Our results detected an estimated value of 30%, while Zhang et al.[16] showed an approximate rate of 12% for vascular restenosis one year after the initial procedure. This variation is probably due to 2 factors: follow-up time and type of stent. We evaluated the follow-up time according to each study, ranging from 1 to 10 years, while Zhang et al. only analyzed 6 months after the intervention[15]. Also, there was a high prevalence of uncovered stent application compared to covered stents in our paper.

Our study found a portosystemic pressure mean reduction of 19 mmHg[15]. When TIPS insertion is successful, it may not only lead to a decrease in the portosystemic pressure gradient but also increases the portal vein (PV) flow velocity and blood flow in patients with BCS[17], This hemodynamic improvement is due to the decompression of this system after TIPS.

Two previous published meta-analyses corroborated the results presented in our paper. Suprabhat et. al. found an average rate of 98.6% for the success of the technique, 40.1% for TIPS dysfunction, 4.5% for the need for liver transplantation, and 94.6% for survival at one year[18] Mukhiya et al. showed an average success rate of 98.9% for the technique, and the survival rates at 1 and 5 years after the initial intervention procedure were 98.9% and 94.9%, respectively[19]. Both studies did not evaluate the 10-year outcomes.

Many treatments for Budd-Chiari Syndrome are available depending on the patient, etiology, and liver failure status, including thrombolysis, angioplasty, TIPS, and liver transplantation; among them, the insertion of TIPS has stood out for its effectiveness in reducing mortality over the years[8].

TIPS may be the first choice for subacute BCS, with progressive clinical and (or) biochemical worsening that does not respond to drug therapy[20]. Individuals with BCS and acute liver failure, Rotterdam class III, prior implantation of a hepatic venous stent, or diffuse hepatic venous thrombosis are also candidates for TIPS placement[17,21].

TIPS insertion appears to improve liver function and ascites and reduce aminotransferase levels. Perelló et al. (2002)[22] demonstrated that BCS patients' clinical status improved after the TIPS. The authors evaluated 12 patients who underwent TIPS insertion and one who underwent portocaval shunt (SSPCS). They compared hemodynamic, clinical, and biochemical parameters before and two months after the intervention. Twelve of the 13 patients had ascites. After TIPS placement, only one continued with ascites. There was a significant reduction in the Child-Pugh score, from 9 to 6, showing the potential benefits and better prognosis with the insertion of TIPS.

CONCLUSION

TIPS is an effective treatment for Budd-Chiari syndrome, providing a high 10-year survival and a significant decrease in portosystemic pressure. The need for liver transplant after TIPS and the technical failure rate is low.

Authors' contribution

Moreno MOA aquisition of data, analysis, and drafting of the article; Paz CLSL drafting of the article and statistical analysis; Dezan MGF critical revision; Cavalcante LN critical revision; Lyra AC interpretation of data, drafting the article, conception, and design of the study, critical revision, final approval.

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RESUMO – Contexto – A síndrome de Budd-Chiari (SBC) é resultante da obstrução do fluxo venoso hepático, usualmente no nível da veia hepática ou da veia cava inferior. Quando não tratada, pode evoluir com complicações, incluindo a cirrose hepática. O tratamento com TIPS parece ser eficaz em um subgrupo de pacientes. **Objetivo –** Realizar uma revisão sistemática e meta-análise da eficácia do TIPS no tratamento da síndrome de Budd-Chiari, considerando sobrevida, redução de pressão portossistêmica, necessidade de transplante hepático, falha técnica e disfunção no shunt em 10 anos de seguimento. **Métodos –** Foram avaliados 17 estudos publicados nas bases de dados PubMed, Science direct, Web of Science e SCOPUS, que utilizaram TIPS como tratamento da SBC, correspondendo a um total de 618 pacientes, entre 18 e 78 anos. O risco de viés foi avaliado pelas escalas de NOS, NHI e JBI, para estudos de coorte, antes e depois e séries de casos, respectivamente. As meta-análises foram conduzidas, extraindo o número de eventos e o total de pacientes avaliados para realizar as meta-análises de proporções usando o software R, com o pacote "meta" (versão 4.9-6). **Resultados –** Os resultados agrupados (IC de 95%) foram de 19% (25,9–12,5%) para a taxa de redução da pressão portossistêmica, 6% (1–12%) para a taxa de necessidade de transplantes hepáticos a despeito do uso do TIPS, 2% (1–6%) para a taxa de falha técnica, 30% (18–46%) para a taxa de disfunção do shunt e 88% (81–93%) para a sobrevida entre 1 e 10 anos depois do procedimento. Estratificando essa sobrevida, foi detectada 86% (74–93%) no período menor do que 5 anos, 92% (83–97%) com 5 anos, e 77% (68–83%) de frequência de pacientes vivos 10 anos após a realização do TIPS. **Conclusão –** O TIPS é um tratamento eficaz para a SBC, proporcionando elevada sobrevida em 10 anos e uma diminuição significativa da pressão portossistêmica. A necessidade de transplantes de fígado após TIPS e a taxa de falha técnica são baixas.

Palavras-chave – Síndrome de Budd-Chiari; resultado; revisão sistemática; meta-análise.

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