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Systematic Review

Neurologic Complications Rate Following Aortic Manipulation after Off-Pump Coronary Artery Bypass Grafting: A Meta-Analysis

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Abstract

Background: Neurologic complications after coronary artery bypass grafting continue to be among the most devastating complications. The goal of coronary artery bypass grafting, which is performed utilizing off-pump techniques on a beating heart, was to reduce this risk. The purpose of the study was to assess the neurologic complications rate following aortic manipulation after off-pump coronary artery bypass grafting. **Methods**: Dichotomous random or fixed effect models generated the odds ratio (OR) and mean difference (MD) with 95% confidence intervals (CIs) based on the study of the meta-analysis data. 28 papers, with a total of 823,972 patients, were available between 2002 and 2021 and were comprised in this meta-analysis. **Results**: Aortic manipulation was much less likely to cause a stroke in people with off-pump coronary artery bypass grafting (OR, 0.58; 95% CI, 0.44–0.77; $p < 0.001$) than non-aortic manipulation. However, no significant difference was found between aortic manipulation and non-aortic manipulation in all-cause mortality (OR, 0.84; 95% CI, 0.69–1.02, $p = 0.08$), acute renal failure (OR, 0.86; 95% CI, 0.69–1.08, $p = 0.20$), atrial fibrillation (OR, 0.67; 95% CI, 0.21–2.15, $p = 0.50$), myocardial infarction (OR, 0.75; 95% CI, 0.56–1.01, $p = 0.06$), respiratory complications (OR, 0.64; 95% CI, 0.40–1.03, $p = 0.07$), reoperation for bleeding (OR, 0.89; 95% CI, 0.57–1.38, $p = 0.59$), and mediastinitis (OR, 0.77; 95% CI, 0.46–1.28, $p = 0.31$) in subjects with off-pump coronary artery bypass grafting. **Conclusions**: The present evaluation showed that using aortic manipulation resulted in a significantly lower rate of stroke occurence; however, no significant difference was found in all-cause mortality, acute renal failure, atrial fibrillation, myocardial infarction, respiratory complications, reoperation for bleeding, and mediastinitis compared to non-aortic manipulation in subjects with off-pump coronary artery bypass grafting. However, given that some comparisons comprised a small number of studies, attention ought to be given to their values.

Keywords

off-pump coronary artery bypass grafting; stroke; all-cause mortality; acute renal failure; aortic manipulation; neurologic complications

Introduction

Neurological issues are still among the most severe side effects following coronary artery bypass grafting. This danger was intended to be decreased by coronary artery bypass grafting, which is done on a beating heart using off-pump procedures. However, a new meta-analysis that compared on-pump coronary artery bypass grafting to beating heart with off-pump techniques did not find a statistically significant lower risk of stroke in patients who underwent beating heart with off-pump techniques [1]. Alternatively, this is sometimes called beating heart surgery. Off-pump coronary artery bypass grafting is a procedure surgeons use to restore blood flow to the coronary arteries. The surgeon takes an artery or a vein from another place in the body and then uses the vessel to bypass the blocked part of the vessel and restore normal blood flow to the heart. The healthcare provider may plan the surgery in advance or the patient might need it in an emergency if a vessel suddenly becomes blocked. This discovery aligns with an American Heart Association scientific statement stating that no conclusive answer is available about the optimal surgical method in terms of neurologic prognosis [2]. The risk of neurologic problems can be decreased using anaortic (or no-touch) procedure to beat the heart using off-pump techniques, leaving the ascending aorta unaltered [3]. The project's goal was to find and collect information about neurologic complications that happened after heart surgery using off-pump techniques to find out what the baseline risk is and whether anaortic heart surgery using off-pump techniques lowers that risk even more. This article attempts to provide a comprehensive review of papers that have evaluated aortic manipulation during off-pump coronary artery bypass grafting evaluation.

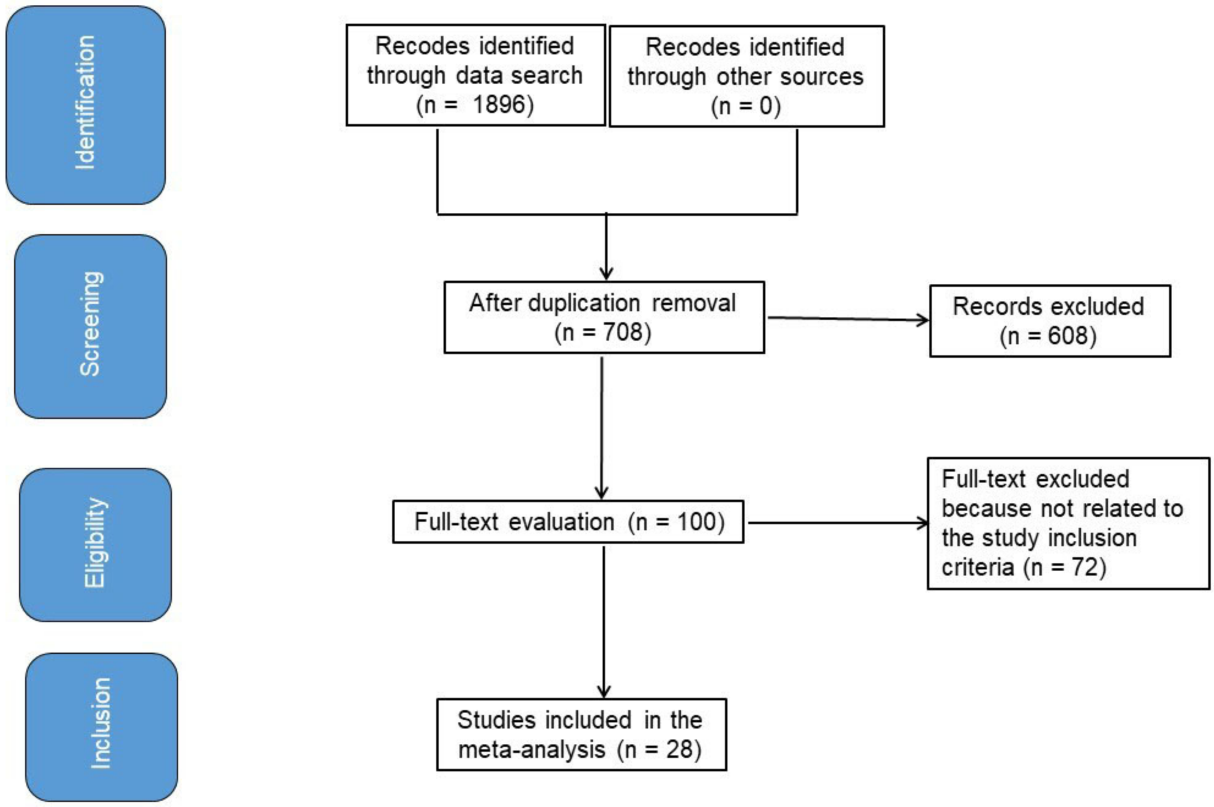

Fig. 1. Flow diagram showing the study selection process.

Methods

Literature Search Strategy

The meta-analyses were estimated and combined with the epidemiological statement using a predefined procedure. Several databases, including Cochrane Library, PubMed, OVID, Google Scholar, and Embase, were accessed to gather and analyze the data. These datasets were used to compare the rate of neurological complications after aortic manipulation following coronary artery bypass grafting.

In this research, the main consequence of the inclusion parameter was analyzed. Language obstacles were not considered during the inclusion of research or the screening process for potential participants. There were no restrictions on the quantity of patients that could be found for the research. Since letters, reviews, and editorials do not present a position in the meta-analysis, we did not include these. Fig. 1 illustrates the complete inspection identification process.

Eligibility Criteria

The neurologic complications rate following aortic manipulation after off-pump coronary artery bypass grafting was studied. Only studies that reported how interventions influenced the incidence of different clinical results were included in the sensitivity analysis. Associating the numerous subtypes with the interference groups enabled the implementation of subclass and sensitivity analyses.

Fig. 1 is a representation of the overall study design. When the inclusion criteria were satisfied, the literature was incorporated into the study:

(1) The research was retrospective and prospective.

(2) Subjects with off-pump coronary artery bypass grafting were the investigated selected subjects.

(3) The interference incorporated aortic manipulation.

(4) The study reported neurologic complication rates following aortic manipulation after off-pump coronary artery bypass grafting.

Non-comparative study designs were excluded.

Data Extraction

A protocol of search algorithms was established and specified by the PICOS principle [4] which states: P (population): Subjects with off-pump coronary artery bypass

Study or Subgroup	With aortic manipulation Events	Total	Without aortic manipulation Events	Total	Weight	Odds Ratio M-H, Random, 95% CI	Year
Calafiore, 2002	3	1533	5	460	2.9%	0.18 [0.04, 0.75]	2002
Kim, 2002	0	222	1	123	0.7%	0.18 [0.01, 4.54]	2002
Patel, 2002	3	597	2	520	2.1%	1.31 [0.22, 7.86]	2002
Bucerius, 2003	17	1077	19	765	6.9%	0.63 [0.33, 1.22]	2003
Leacche, 2003	0	84	5	556	0.9%	0.59 [0.03, 10.83]	2003
Kapetanakis, 2004	4	476	40	2527	4.5%	0.53 [0.19, 1.48]	2004
Lev-Ran, 2005	1	429	6	271	1.6%	0.10 [0.01, 0.86]	2005
Vallely, 2008	1	1201	3	557	1.4%	0.15 [0.02, 1.48]	2008
Manabe, 2009	1	241	1	185	1.0%	0.77 [0.05, 12.34]	2009
Misfeld, 2010	1	1346	3	600	1.4%	0.15 [0.02, 1.43]	2010
Emmert, 2011	24	2203	51	2111	8.3%	0.44 [0.27, 0.73]	2011
Pawlaczyk, 2011	4	499	1	133	1.5%	1.07 [0.12, 9.62]	2011
Diegeler, 2013	41	1179	52	1191	8.9%	0.79 [0.52, 1.20]	2013
Matsuura, 2013	1	72	1	264	1.0%	3.70 [0.23, 59.96]	2013
Arrigoni, 2015	5	398	18	903	4.7%	0.63 [0.23, 1.70]	2015
Moss, 2015	51	2529	86	6449	9.4%	1.52 [1.07, 2.16]	2015
Lamy, 2016	55	2375	66	2377	9.3%	0.83 [0.58, 1.19]	2016
Albert, 2018	22	4485	115	8794	8.5%	0.37 [0.24, 0.59]	2018
Formica, 2018	4	282	9	363	3.8%	0.57 [0.17, 1.86]	2018
Dominici, 2019	4	119	29	295	4.3%	0.32 [0.11, 0.93]	2019
Lorusso, 2019	18	4131	50	4131	7.9%	0.36 [0.21, 0.61]	2019
Saito, 2021	44	5012	53	5012	9.0%	0.83 [0.55, 1.24]	2021
Total (95% CI)		**30490**		**38587**	**100.0%**	**0.58 [0.44, 0.77]**	
Total events	304		616				

Heterogeneity: Tau² = 0.20; Chi² = 53.22, df = 21 (P = 0.0001); I² = 61%
Test for overall effect: Z = 3.70 (P = 0.0002)

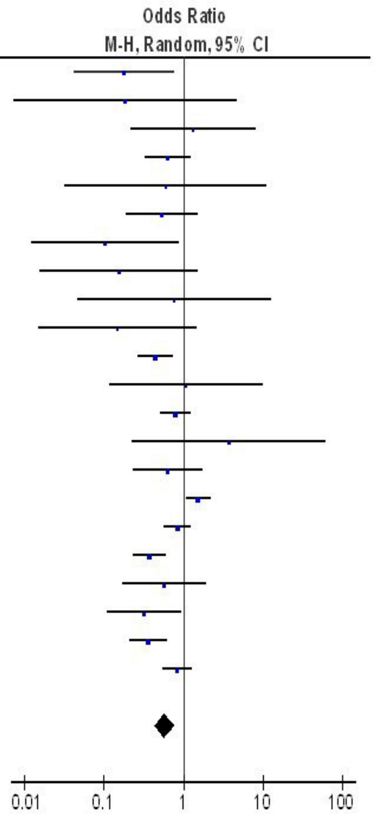

Fig. 2. A forest plot showing the effect of aortic manipulation compared to non-aortic manipulation on stroke in subjects with off-pump coronary artery bypass grafting.

Study or Subgroup	With aortic manipulation Events	Total	Without aortic manipulation Events	Total	Weight	Odds Ratio M-H, Random, 95% CI	Year
Kim, 2002	2	222	3	123	1.1%	0.36 [0.06, 2.21]	2002
Boova, 2006	2	137	2	60	0.9%	0.43 [0.06, 3.12]	2006
Manabe, 2009	2	241	3	185	1.1%	0.51 [0.08, 3.07]	2009
Misfeld, 2010	13	1346	6	600	3.0%	0.97 [0.37, 2.55]	2010
Emmert, 2011	35	2203	51	2111	7.1%	0.65 [0.42, 1.01]	2011
Chawla, 2012	1970	158561	7849	584348	10.6%	0.92 [0.88, 0.97]	2012
Diegeler, 2013	83	1179	95	1191	8.6%	0.87 [0.64, 1.19]	2013
Kim, 2014	370	2333	811	2870	10.2%	0.48 [0.42, 0.55]	2014
Moss, 2015	46	2529	62	6449	7.7%	1.91 [1.30, 2.80]	2015
Arrigoni, 2015	31	398	78	903	7.1%	0.89 [0.58, 1.38]	2015
Hussain, 2016	1	150	2	150	0.6%	0.50 [0.04, 5.54]	2016
Lamy, 2016	346	2375	322	2377	10.0%	1.09 [0.92, 1.28]	2016
Bassano, 2016	3	223	5	143	1.6%	0.38 [0.09, 1.60]	2016
Formica, 2018	9	282	6	363	2.7%	1.96 [0.69, 5.58]	2018
Albert, 2018	55	4485	143	8794	8.5%	0.75 [0.55, 1.03]	2018
Dominici, 2019	3	119	7	295	1.8%	1.06 [0.27, 4.19]	2019
Lorusso, 2019	80	4131	120	4131	8.8%	0.66 [0.50, 0.88]	2019
Kowalewski, 2020	214	0	238	0		Not estimable	2020
Saito, 2021	75	5012	87	5012	8.5%	0.86 [0.63, 1.17]	2021
Total (95% CI)		**185926**		**620105**	**100.0%**	**0.84 [0.69, 1.02]**	
Total events	3340		9890				

Heterogeneity: Tau² = 0.10; Chi² = 113.19, df = 17 (P < 0.00001); I² = 85%
Test for overall effect: Z = 1.74 (P = 0.08)

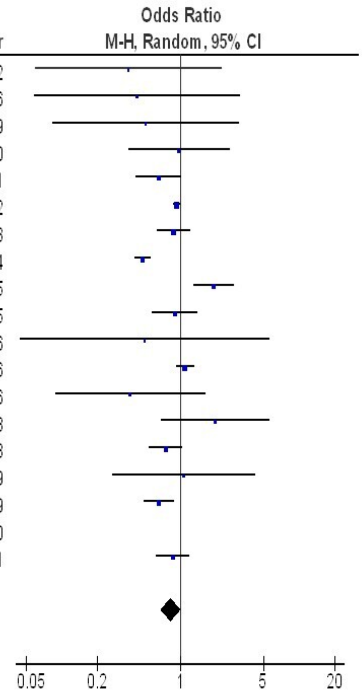

Fig. 3. A forest plot showing the effect of aortic manipulation compared to non-aortic manipulation on all-cause mortality in subjects with off-pump coronary artery bypass grafting.

Table 1. Database Search Strategy for inclusion of studies.

Database	Search strategy
Google Scholar	#1 "off-pump coronary artery bypass grafting" OR "stroke" #2 "acute renal failure" OR "aortic manipulation" OR "all-cause mortality" OR "neurologic complications" #3 #1 AND #2
Embase	#1 "off-pump coronary artery bypass grafting"/exp OR "stroke"/exp OR "all-cause mortality" #2 "acute renal failure"/exp OR "aortic manipulation"/exp OR "neurologic complications" #3 #1 AND #2
Cochrane Library	#1 (off-pump coronary artery bypass grafting):ti,ab,kw OR (stroke):ti,ab,kw OR (all-cause mortality):ti,ab,kw (Word variations have been searched) #2 (acute renal failure): ti,ab,kw OR (aortic manipulation):ti,ab,kw OR (neurologic complications):ti,ab,kw (Word variations have been searched) #3 #1 AND #2
PubMed	#1 "off-pump coronary artery bypass grafting" [MeSH] OR "stroke" [MeSH] OR "all-cause mortality" [All Fields] #2 "acute renal failure" [MeSH Terms] OR "aortic manipulation" [MeSH] OR "neurologic complications" [All Fields] #3 #1 AND #2
OVID	#1 "off-pump coronary artery bypass grafting" [All Fields] OR "stroke" [All Fields] OR "all-cause mortality" [All Fields] #2 "acute renal failure" [All fields] OR "aortic manipulation" [All Fields] or "neurologic complications" [All Fields] #3 #1 AND #2

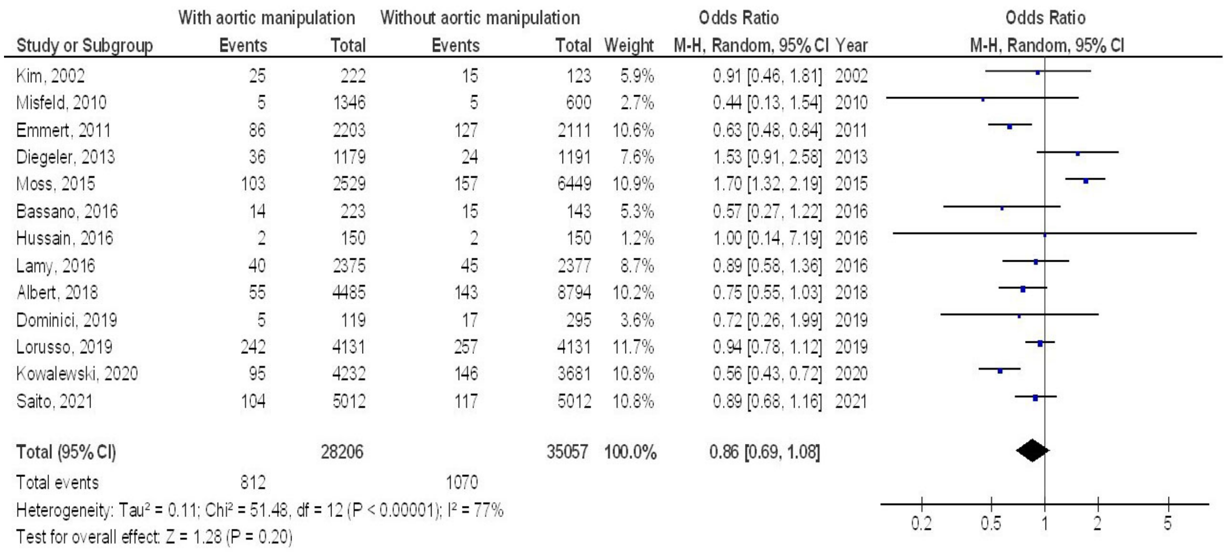

Fig. 4. A forest plot showing the effect of aortic manipulation compared to non-aortic manipulation on acute renal failure in subjects with off-pump coronary artery bypass grafting.

grafting; aortic manipulation was the "interference" or "exposure"; C (comparison): the comparison among aortic manipulation and non-aortic manipulation. O (outcome): different clinical results; S (study design): the planned evaluation was unlimited [5]. Using the keywords in Table 1, we led a thorough exploration of the applicable databases through to August 2024. Assessments were conducted on all the articles which contained the relevant details to be included in a reference management program, comprising the author, titles, and abstracts. Moreover, two authors assessed publications to detect appropriate tests [6].

Study or Subgroup	With aortic manipulation Events	Total	Without aortic manipulation Events	Total	Weight	Odds Ratio M-H, Random, 95% CI	Year
Kim, 2002	2	222	3	123	9.9%	0.36 [0.06, 2.21]	2002
Emmert, 2011	123	2203	82	2111	12.9%	1.46 [1.10, 1.95]	2011
Matsuura, 2013	27	72	91	264	12.6%	1.14 [0.66, 1.96]	2013
Moss, 2015	510	2529	1150	6449	13.0%	1.16 [1.04, 1.31]	2015
Formica, 2018	70	282	101	363	12.8%	0.86 [0.60, 1.22]	2018
Lorusso, 2019	634	4131	3142	4131	13.0%	0.06 [0.05, 0.06]	2019
Dominici, 2019	36	119	98	295	12.7%	0.87 [0.55, 1.38]	2019
Saito, 2021	594	5012	515	5012	13.0%	1.17 [1.04, 1.33]	2021
Total (95% CI)		**14570**		**18748**	**100.0%**	**0.67 [0.21, 2.15]**	
Total events	1996		5182				

Heterogeneity: Tau² = 2.74; Chi² = 1920.46, df = 7 (P < 0.00001); I² = 100%
Test for overall effect: Z = 0.68 (P = 0.50)

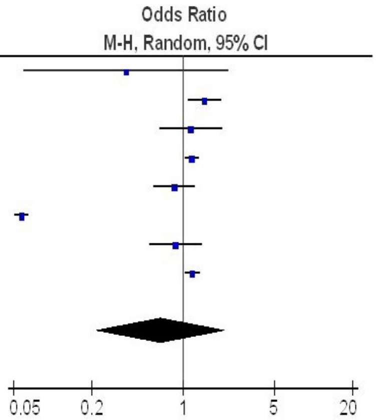

Fig. 5. A forest plot showing the effect of aortic manipulation compared to non-aortic manipulation on atrial fibrillation in subjects with off-pump coronary artery bypass grafting.

Study or Subgroup	With aortic manipulation Events	Total	Without aortic manipulation Events	Total	Weight	Odds Ratio M-H, Random, 95% CI	Year
Kim, 2002	3	222	7	123	3.8%	0.23 [0.06, 0.89]	2002
Emmert, 2011	24	2203	46	2111	13.5%	0.49 [0.30, 0.81]	2011
Diegeler, 2013	25	1179	28	1191	12.5%	0.90 [0.52, 1.55]	2013
Matsuura, 2013	27	72	91	264	12.6%	1.14 [0.66, 1.96]	2013
Moss, 2015	17	2529	29	6449	11.5%	1.50 [0.82, 2.73]	2015
Arrigoni, 2015	13	398	64	903	11.3%	0.44 [0.24, 0.81]	2015
Lamy, 2016	178	2375	194	2377	19.6%	0.91 [0.74, 1.13]	2016
Kowalewski, 2020	37	4232	53	3681	15.1%	0.60 [0.40, 0.92]	2020
Total (95% CI)		**13210**		**17099**	**100.0%**	**0.75 [0.56, 1.01]**	
Total events	324		512				

Heterogeneity: Tau² = 0.10; Chi² = 19.69, df = 7 (P = 0.006); I² = 64%
Test for overall effect: Z = 1.91 (P = 0.06)

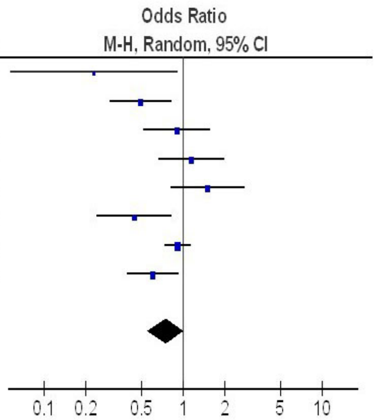

Fig. 6. A forest plot showing the effect of aortic manipulation compared to non-aortic manipulation on myocardial infarction in subjects with off-pump coronary artery bypass grafting.

Study or Subgroup	With aortic manipulation Events	Total	Without aortic manipulation Events	Total	Weight	Odds Ratio M-H, Random, 95% CI	Year
Kim, 2002	4	222	1	123	4.2%	2.24 [0.25, 20.25]	2002
Emmert, 2011	35	2203	82	2111	32.0%	0.40 [0.27, 0.60]	2011
Bassano, 2016	8	223	7	143	14.1%	0.72 [0.26, 2.04]	2016
Hussain, 2016	4	150	7	150	10.8%	0.56 [0.16, 1.95]	2016
Kowalewski, 2020	243	4232	255	3681	38.9%	0.82 [0.68, 0.98]	2020
Total (95% CI)		**7030**		**6208**	**100.0%**	**0.64 [0.40, 1.03]**	
Total events	294		352				

Heterogeneity: Tau² = 0.14; Chi² = 11.41, df = 4 (P = 0.02); I² = 65%
Test for overall effect: Z = 1.82 (P = 0.07)

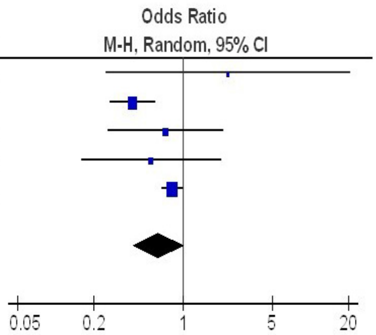

Fig. 7. A forest plot showing the effect of aortic manipulation compared to non-aortic manipulation on respiratory complication in subjects with off-pump coronary artery bypass grafting.

Critical Appraisal

The investigation was given in a regular format, along with each of its component features. The first author's last name, the study's date, the country in which the study was taking place, femininity, type of population that was employed for meta-analysis, total number of subjects, clinical and treatment characteristics, demographic information, and qualitative and quantitative evaluation methods were

Table 2. Characteristics of studies.

Study	Country	Total	With aortic manipulation	Without aortic manipulation	Study type
Calafiore, 2002 [12]	Italy	1993	1533	460	Retrospective
Kim, 2002 [13]	South Korea	345	222	123	Retrospective
Patel, 2002 [14]	UK	1117	597	520	Prospective
Bucerius, 2003 [15]	Germany	1842	1077	765	Retrospective
Leacche, 2003 [16]	Canada	640	84	556	Prospective
Kapetanakis, 2004 [17]	USA	3003	476	2527	Prospective
Lev-Ran, 2005 [18]	Palestine	700	429	271	Retrospective
Boova, 2006 [19]	USA	197	137	60	Prospective
Vallely, 2008 [20]	Australia	1758	1201	557	Prospective
Manabe, 2009 [21]	Japan	426	241	185	Retrospective
Misfeld, 2010 [22]	Australia	1946	1346	600	Prospective
Emmert, 2011 [23]	Switzerland	4314	2203	2111	Retrospective
Pawlaczyk, 2011 [24]	Poland	632	499	133	Prospective
Chawla, 2012 [25]	USA	742,909	158,561	584,348	Retrospective
Diegeler, 2013 [26]	Germany	2370	1179	1191	Prospective
Matsuura, 2013 [27]	Japan	336	72	264	Retrospective
Kim, 2014 [28]	South Korea	5203	2333	2870	Prospective
Arrigoni, 2015 [29]	Netherlands	1301	398	903	Prospective
Moss, 2015 [30]	USA	8978	2529	6449	Retrospective
Lamy, 2016 [31]	Canada	4752	2375	2377	Prospective
Hussain, 2016 [32]	Pakistan	300	150	150	Retrospective
Bassano, 2016 [33]	Italy	366	223	143	Prospective
Albert, 2018 [34]	Germany	13,279	4485	8794	Retrospective
Formica, 2018 [35]	Italy	645	282	363	Prospective
Dominici, 2019 [36]	UK	414	119	295	Retrospective
Lorusso, 2019 [37]	Italy	8262	4131	4131	Retrospective
Kowalewski, 2020 [38]	Muti-centers	7913	4232	3681	Retrospective
Saito, 2021 [39]	Japan	10,024	5012	5012	Retrospective
	Total	823,972	194,593	629,379	

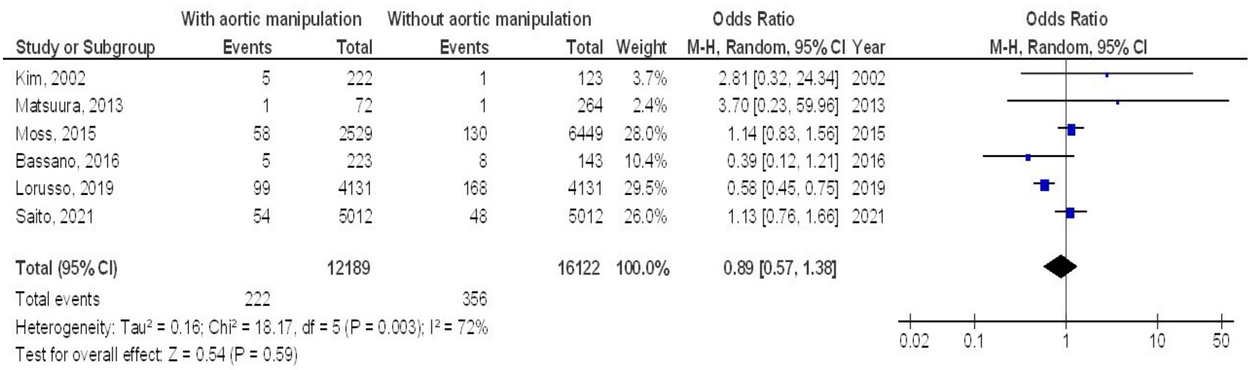

Fig. 8. A forest plot showing the effect of aortic manipulation compared to non-aortic manipulation on reoperation for bleeding in subjects with off-pump coronary artery bypass grafting.

some criteria applied to decrease the data [7]. Two authors looked into the opportunity for bias in the studies and the standard of approaches utilized in papers selected for supplementary analysis. The two authors conducted unbiased reviews of techniques used for each test [8].

Statistical Analysis

In this meta-analysis, the odds ratio (OR), and mean difference (MD) with a 95% confidence interval (CI) were estimated utilizing dichotomous random- or fixed-effect models [4]. The calculated I^2 index has a range of 0 to 100 and is expressed as a percentage [7]. Higher I^2 values sig-

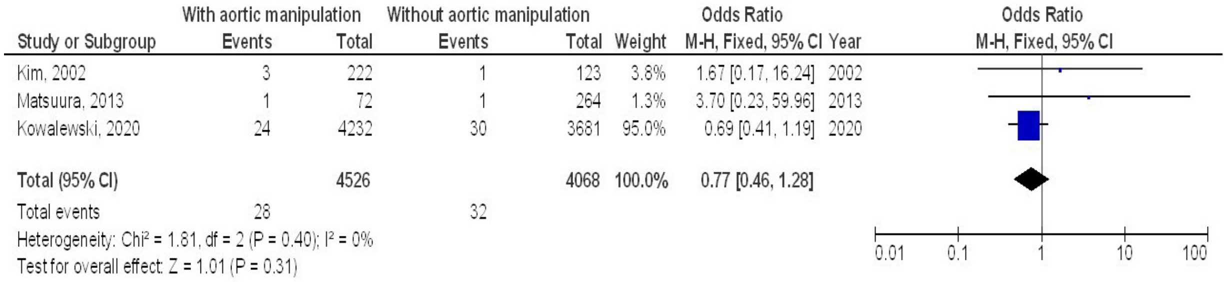

Fig. 9. A forest plot showing the effect of aortic manipulation compared to non-aortic manipulation on mediastinitis in subjects with off-pump coronary artery bypass grafting.

nify increased heterogeneity, whilst lower I^2 values signify decreased heterogeneity. If I^2 was 50% or above, the random effect was selected; otherwise, a fixed effect was chosen [9]. The first study's consequences were classified as a component of the subcategory analysis. Bias was measured using Egger's tests utilized for quantitative analysis, and it was considered to exist if $p > 0.05$ [10,11]. p-values were calculated by a two-tailed approach. With Review Manager 5.4 (The Nordic Cochrane Centre, the Cochrane Collaboration, Copenhagen, Denmark), graphs and statistical analyses were created.

Results

After examining 1896 relevant publications, 28 research papers published between 2002 and 2021 that met the eligibility criteria were included in this systematic review [12–39].

Table 2 (Ref. [12–39]) summarises the findings of these studies. 823,972 patients were included.

Aortic manipulation had significantly lower stroke risk (OR, 0.58; 95% CI, 0.44–0.77, $p < 0.001$) with moderate heterogeneity (I^2 = 61%) compared to non-aortic manipulation in subjects with off-pump coronary artery bypass grafting, as shown in Fig. 2.

However, no significant difference was found between aortic manipulation and non-aortic manipulation in all-cause mortality (OR, 0.84; 95% CI, 0.69–1.02, $p = 0.08$) with high heterogeneity (I^2 = 85%), acute renal failure (OR, 0.86; 95% CI, 0.69–1.08, $p = 0.20$) with high heterogeneity (I^2 = 77%), atrial fibrillation (OR, 0.67; 95% CI, 0.21–2.15, $p = 0.50$) with high heterogeneity (I^2 = 100%), myocardial infarction (OR, 0.75; 95% CI, 0.56–1.01, $p = 0.06$) with moderate heterogeneity (I^2 = 64%), respiratory complications (OR, 0.64; 95% CI, 0.40–1.03, $p = 0.07$) with moderate heterogeneity (I^2 = 65%), reoperation for bleeding (OR, 0.89; 95% CI, 0.57–1.38, $p = 0.59$) with moderate heterogeneity (I^2 = 72%), and mediastinitis (OR, 0.77; 95% CI, 0.46–1.28, $p = 0.31$) with no heterogeneity (I^2 = 0%) in subjects with off-pump coronary artery bypass grafting, as shown in Figs. 3,4,5,6,7,8,9.

The quantitative Egger regression test and the visual interpretation of the forest plot showing the effect of aortic manipulation revealed no indication of investigation bias (p = 0.88). It was shown that the mainstream pertinent exams had poor practical quality and were biased in their selective reporting.

Discussion

After coronary artery bypass grafting, neurologic problems are still a major concern. They may be linked to higher rates of death and morbidity, which would lengthen hospital stays and raise expenses [40–51]. Novel approaches to lower this risk include surgical or interventional methods including off-pump methods. When compared to on-pump coronary artery bypass grafting techniques, off-pump approaches have not demonstrated a discernible advantage in terms of reduced neurologic sequelae [52–54]. Furthermore, patients receiving conventional coronary artery bypass grafting appear to have a higher incidence of stroke than patients undergoing percutaneous coronary procedures [55,56]. The coronary artery bypass grafting group had a 1.6% higher incidence of stroke than the percutaneous coronary intervention group, according to data from the historic SYNTAX trial report [57]. While the SYNTAX trial's follow-up period (up to a year) was greater than that of any other research in our meta-analysis, our analysis included two studies with over a thousand cases of anaortic off-pump procedures. A stroke rate of less than 0.3% was reported by them [12,20] This implies that the stroke rate could be reduced with an anaortic off-pump approach to that of the Syntax trial's percutaneous coronary intervention group; however, longer-term follow-up is required in further trials to test this theory. Since atherosclerosis of the ascending aorta is the single greatest risk factor for stroke, it is well established that aortic manipulation during coronary artery bypass grafting raises the risk of neurologic problems [58]. To address this issue, novel approaches to surgical revascularization methods might be required. Avoiding aortic procedures (cannulation, cross-lamping, declamping, and partial clamping) that are known to induce embolism, anaortic or no-touch techniques, when performed without aortic manipulation, may considerably enhance neurologic prognosis [59]. The aorta is impacted by the shift in heart position to some extent, which could be the reason for some of the neurological issues. Reducing aortic manipulation alone may not prevent neurologic problems, as the cause of strokes in 3% of individuals after coronary artery bypass grafting is known to be multifactorial [51]. Nonetheless, aortic manipulation is a major factor in the pathogenic process of postoperative stroke. It also has to be investigated if there is a connection between a subsequent stroke and the kind or extent of aortic manipulation used during off-pump method operations. Theoretically, proximal anastomotic devices that eliminate the requirement for anaortic cannulation or side clamps may be less stressful and thus result in fewer emboli than side or cross clamp usage. This is significant because, in certain cases of hemodynamic instability, the proximal bypass graft anastomosis may need to be performed on-pump while the patient's heart is still beating, thereby avoiding the necessity of a side clamp. Furthermore, we think that a prospective, multicenter, randomized research study should be conducted to examine the effects of anaortic manipulation and anaortic off-pump procedures on neurologic and cognitive function [60,61].

Limitations

Given that several of the research studies selected for the meta-analysis were not included, assortment bias may have occurred. However, the excluded studies did not meet the necessary standards to be incorporated into the meta-analysis. Moreover, we lacked the information necessary to conclude if certain features e.g., race, gender, and age had an impact on the values. The poor quality of included studies, heterogeneity, and publication bias are parts of the limitations of this meta-analysis. Bias may have been increased as a result of incomplete or erroneous data from earlier studies being included. Age, gender, race, and nutritional status of the subjects were likely sources of bias. Unintentionally skewed values could be the result of incomplete data and unpublished research.

This meta-analysis assesses the neurologic complications rate following aortic manipulation after off-pump coronary artery bypass grafting. More investigation is still needed to clarify these probable associates of the results under discussion. More homogeneous and larger samples are obligatory for this investigation. This was emphasized in a previous work that employed a related meta-analysis technique and initiated similar advantageous outcomes for aortic manipulation. Because the present meta-analysis was unable to define whether differences in age and ethnicity are connected to the outcomes, well-led randomised controlled trials are required to assess these factors and the mixture of variable ethnicities, genders, ages, and other variants of patients.

Conclusions

The data that was evaluated showed that using aortic manipulation had a significantly lower stroke risk, however, no significant difference was found in terms of all-cause mortality, acute renal failure, atrial fibrillation, myocardial infarction, respiratory complication, reoperation for bleeding, and mediastinitis compared to non-aortic-manipulation in subjects with off-pump coronary artery bypass grafting.

Availability of Data and Materials

On request, the corresponding author is required to provide access to the meta-analysis database.

Author Contributions

LL, JY and RL designed the research study. GL, XW and SF performed the research. HG analyzed the data. All authors contributed to editorial changes in the manuscript. All authors read and approved the final manuscript. All authors have participated sufficiently in the work and agreed to be accountable for all aspects of the work.

Ethics Approval and Consent to Participate

Not applicable.

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Conflict of Interest

The authors declare no conflict of interest.

Supplementary Material

Supplementary material associated with this article can be found, in the online version, at https://doi.org/10.59958/hsf.8131.

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