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REVIEW

Non-operative Management of Type A Acute Aortic Syndromes: A Systematic Review and Meta-Analysis

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WHAT THIS PAPER ADDS

This review assembles and analyses contemporary evidence regarding the medical management of patients with type A acute aortic syndrome. For patients with type A aortic dissection, surgery remains superior to medical intervention. However, there may be a role for medical therapy of type A intramural haematoma. This warrants further investigation and research.

Objective: For type A acute aortic syndrome (TAAAS), the only alternative for patients who are contraindicated for open surgery or endovascular interventions is medical therapy. The objective of this study was to assess the impact of conservative treatment in patients suffering TAAAS.

Methods: This systematic review and meta-analysis was performed according to the PRISMA guidelines. A systematic search was conducted on MEDLINE, Embase, and the Cochrane Library for relevant studies. Pairwise meta-analysis was conducted to compare surgical with medical intervention. Included studies were subjected to risk of bias assessment using the Newcastle—Ottawa scale.

Results: Twenty-nine studies comprising 6894 patients were included. For patients with type A aortic dissection (TAAD), the pooled proportions of all cause in hospital mortality and all cause 30 day mortality were 39.1% (95% confidence interval [CI] 29.8—48.9%; $I^2 = 90.1\%$), and 31.1% (95% CI 8.8—59.1%; $I^2 = 95.9\%$), respectively. There was a significant proportion of patients who converted from medical to surgical treatment (20.7%, 95% CI 0.0—61.7%; $I^2 = 93.4\%$). In patients with type A intramural haematoma (IMH), the pooled proportions of all cause in hospital mortality and all cause 30 day mortality were 7.2% (95% CI 2.6—13.4%; $I^2 = 76.5\%$) and 15.3% (95% CI 1.1—37.9%; $I^2 = 64.1\%$). A significant proportion of patients converted from medical to surgical treatment (26.3%, 95% CI 12.1—43.4%; $I^2 = 90.5\%$).

Conclusion: Mortality remains high for conservatively treated patients with TAAD. For patients with IMH, heterogeneity in the types of conservative treatment prohibit any firm conclusion regarding its safety and efficacy.

Keywords: Medical therapy, Surgery, Type A aortic dissection, Type A acute aortic syndrome, Type A intramural haematoma
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INTRODUCTION

Type A acute aortic syndrome (TAAAS) is a potentially calamitous spectrum of pathology encompassing intramural haematoma (IMH), penetrating aortic ulcer (PAU), and type A aortic dissection (TAAD).[1] IMH and TAAD may present with overlapping clinical symptoms but are idiosyncratic in their mechanisms. Patients often present with a constellation of signs pathognomonic for TAAAS, including hypertension; sudden onset of severe thoracic pain; and variation in pulse or blood pressure in the upper extremities.[1,2] The triggering event for IMH is rupture of the vasa vasorum, resulting in bleeding into the tunica media.[2] The deleterious sequelae can include progression to acute aortic dissection, when the intimal layer is being compromised and ruptures, termed the "entry tear".[1—4]

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TAAD is universally reported to be the most common type of thoracic aortic dissection, and epidemiological trends suggest that incidence is rising.[5–8] The aortic catastrophe confers poor prognosis if left unmanaged. Mortality is dismal, with a rate of 1% per hour, and up to 50% of patients die within a week as a consequence of progressive extension of dissection, stroke visceral ischaemia, pericardial tamponade, or rupture.[9–12] Expeditious surgical management remains the cornerstone of treatment for TAAD, with post-operative survival rates of 96% and 91% after one and three years, respectively, reported in the International Registry of Acute Aortic Dissection (IRAD).[13] However, surgery remains a challenge for patients with comorbidities or beyond a certain age; contemporary alternatives include the hybrid or endovascular approaches.[10] Although 32–50% of patients are anatomically fit candidates for endovascular treatment,[14,15] it remains unappealing as standard management.[16] Despite the paucity of endovascular literature, the most robust evidence to date was reported by a retrospective study,[17] wherein the 30 day mortality rate was 6.7% and overall mortality was 11% after a mean follow up of 35.5 months.

There is encouraging evidence supporting the use of medical management for TAAAS, particularly the IMH variant.[4,18,19] It is an integral component to achieve initial stabilisation of patients, blunting propagation of the aortic insult.

Patients contraindicated for both surgical and endovascular interventions can only be managed conservatively. By appraising the assemblage of real world evidence, it is the aim of this systematic review to assess the survival outcomes of non-operative management of patients with TAAAS. Acknowledging that only the worst risk candidates receive conservative management, this study does not aim to make any comparison between conservative and surgical approaches.

METHODS

This study was prospectively registered with PROSPERO (CRD42018104218). The systematic review and meta-analysis was performed in accordance to the Preferred Reporting Items for Systematic Reviews and Meta-analysis (PRISMA) standards.[20] A systematic search was conducted on MEDLINE, Embase, and the Cochrane library from date of inception until 27 November 2017. The following terms were combined using Boolean operators and searched on Medline: (aortic dissection OR aorta AND dissection) AND (type A OR Stanford type A OR Debakey type I OR Debakey type II) AND (non operative OR non surgical OR medical therapy OR medical treatment); (type A OR debakey type I OR debakey type II) AND (intramural hematoma OR aortic intramural hematoma OR penetrating aortic ulcer) AND (non operative OR non surgical OR medical therapy OR medical treatment OR medical management). The full search strategy can be obtained from the corresponding author upon request. Manual searches were undertaken to review the references of relevant review articles. To minimise publication bias, conference abstracts and other types of unpublished data were considered for inclusion and analysis if sufficient data were reported.

Inclusion and exclusion criteria

Any non-randomised study reporting medical management of patients with TAAAS, which includes dissections, IMH, and PAU. Studies must have reported on at least one of the following outcomes: in hospital overall mortality; 30 day overall mortality; rates of conversion to open surgery. Papers with the following characteristics were excluded: non-English language; animal and laboratory studies; included only other aortic syndrome subtypes (e.g., Stanford type B); case reports/series; conference abstracts with no extractable data; letters to editors and commentaries; systematic reviews and meta-analysis; studies with no extractable data.

Study selection

Two reviewers (I.W., R.S.V.) independently screened and assessed the studies for potential inclusion, first by their titles and abstracts, followed by the full text for review if the relevance could not be confirmed from the first step. Disagreements were resolved by consensus, or by appeal to a third author (A.M.C.).

Risk of bias assessment

Included studies were subjected to a risk of bias assessment using the Newcastle–Ottawa scale (NOS), which is a tool for assessing the quality of nonrandomised studies. The scale encompasses the following domains: selection bias (representativeness of exposed cohort; selection of non-exposed cohort; ascertainment of exposure; demonstration that outcome was absent at start of study); comparability (comparability of cohorts); outcome (assessment of outcome; length of follow up; adequacy of follow up). Publication bias was assessed only if there were more than 10 studies reporting a similar outcome.

Data abstraction and outcomes of interest

By using a standardised pro forma, two authors (I.W., R.S.V.) independently abstracted details of study population (title, authors, source, study design, year of publication, mean age, sex, comorbidities, diagnosis), interventions (medical management, surgical management), and outcomes of interest (in hospital overall mortality; 30 day overall mortality; conversion rates to open surgery). While aortic related mortality was studied, it was found that this was actually duplicating 30 day mortality as all deaths examined were directly related to aortic rupture or aortic complications. Conflicts were resolved by consensus or by appeal to a third author, if necessary. The primary authors of included studies were contacted for missing data.

Statistical analyses

All meta-analyses were carried out using random effects models to account for statistical variability across studies. Pooled proportions were obtained by computing the

Clopper—Pearson exact confidence intervals (CIs) for each study and applying the Freeman—Tukey double arcsine variance stabilisation to achieve approximate normality, prior to inverse variance weighting. The CIs for the pooled proportions were then estimated with the Wald method using the metaprop command in Stata 13.0 (StataCorp, College Station, TX, USA).

RESULTS

A total of 518 unique studies were screened, of which 56 remained after duplicate removal, title, and abstract screening. All 56 articles were reviewed in their entirety, and 27 were excluded leaving 29 studies. This comprised 17 studies[19,21—36] evaluating TAAD with a total of 6894 patients, with a mean age ranging from 48.9 - 84.9 years, and a male proportion of 44.2%. The remaining 14 studies[18,19,25,37—47] evaluating IMH (Fig. 1) included a total of 693 patients, with a mean age ranging from 56 - 70.5 years, and a male proportion of 42.7%. For patients with TAAD, the mean age across studies ranged from 48.9 - 84.9 years. Characteristics of the included studies can be found in Tables 1 and 2.

Prevalence of mortality in patients with TAAD who were treated conservatively

In 16 of 17 studies, the reasons for conservative management included advanced age, extensive comorbidities, debated or misdiagnosis, and refusal of operation. Only one study cited lack of facilities, resources, and surgical staff necessary to perform surgery.[21] The pooled proportion of all cause in hospital mortality in medically treated patients was 39.1% (95% CI 29.8—48.9%, $I^2 = 90\%$ [$n = 15$ studies]) (Fig. 2), whereas the pooled proportion of all cause 30 day mortality was 31.1% (8.8—59.1%, $I^2 = 95.9\%$ [$n =$ six studies]) (Fig. 3). There was a significant proportion of patients who converted from medical to surgical treatment (20.7%, 95% CI 0.0—61.7%; $I^2 = 93.4\%$ [$n = 3$ studies]) (Fig. S1; see Supplementary Material).

Prevalence of mortality in patients with IMH who were treated conservatively

Next, the mortality in patients with type A IMH was examined. The pooled proportion of all cause in hospital mortality in medically treated patients was 7.2% (95% CI

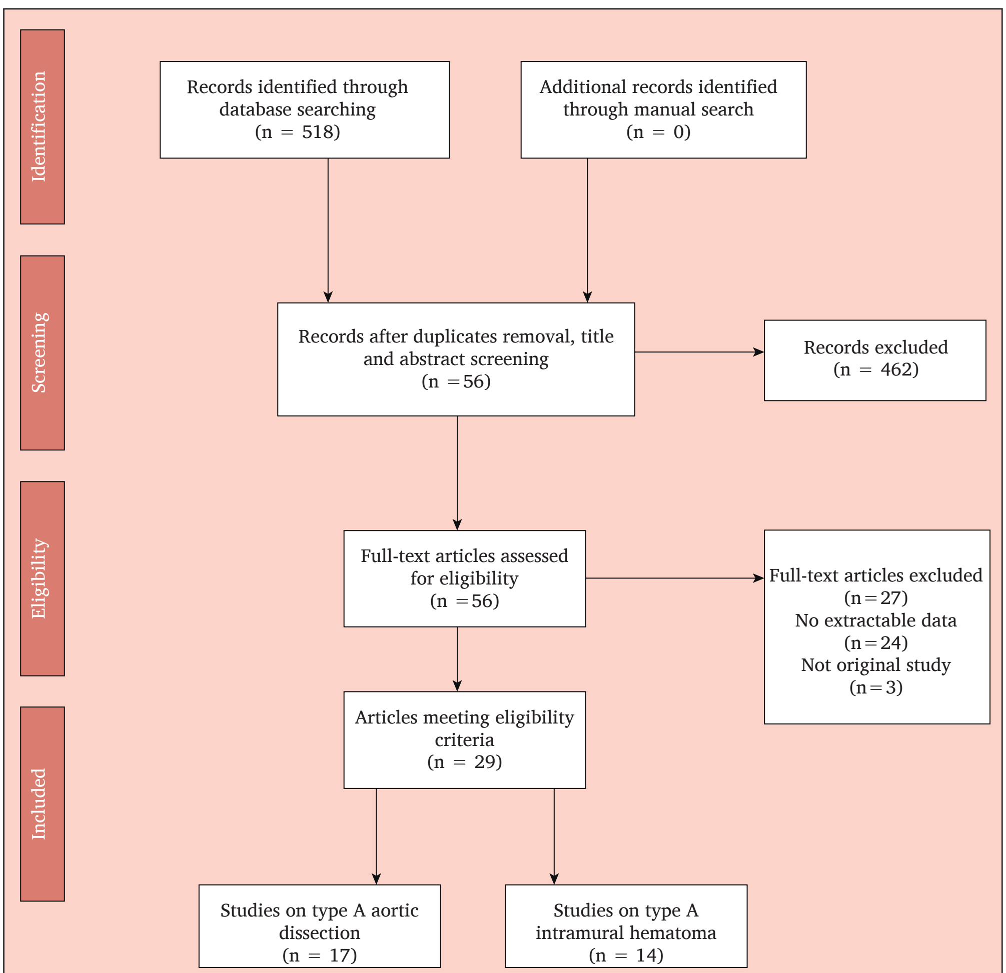

Figure 1. Preferred Reporting Items for Systematic Reviews and Meta-analysis (PRISMA) flow diagram.

Table 1. Baseline characteristics of 17 included studies for patients with type A aortic dissection (TAAD)

First author, year	Study type	Reason for conservative treatment (% whenever reported)	Definition of conservative treatment	*n* (medical/ non-medical)	Mean age ± SD, years	No. of males	Comorbidities				
							Cardiovascular	Respiratory	Endocrine	Renal	Others
Masuda, 1991[21]		Lacked facilities, resources, and surgical staff	Treated medically and converted in case of complication/ progression	112 (60/ 52)	57 ± 13	72/ 112	Hypertension (HTN; 81/112)	–	Hypercholesterolaemia (7/112), diabetes mellitus (DM; 9/112)	–	Marfan syndrome (9/ 112)
Tanaka, 1991[22]	RA	Elderly, extensive comorbidities (HTN)	Treated medically and converted in case of complication or progression	53 (22/ 31)	–	–	–	–	–	–	–
Scholl, 1999[23]	RA	Extensive comorbidities (26.5%), refused operation (23.5%), misdiagnosis (50.0%)	Treated medically and converted in case of complication/ progression	75 (34/ 41)	–	49/75	Congestive heart failure (3/ 34), aortic regurgitation (15/34), pericardial effusion (PE) (5/34), coronary artery disease (CAD; 6/34)	Chronic obstructive pulmonary disease (COPD; 5/ 34)	–	Acute renal failure (1/34)	–
Kozai, 2001[24]	RA	High surgical risk (majority), stable state (majority), elderly, refused operation	Treated medically and converted in case of complication/ progression	87	65	51/87	–	–	–	–	Shock (36/87)
Song, 2009[39]	RA	Multi-organ failure (31.3%), stroke (18.7%), refused operation (31.3%), died before operation (18.7%)	Medical treatment with purposefully delayed operation	256 (32/ 224)	56 ± 14	139/ 117	HTN (134/ 256); cardiac tamponade (CT; 24/256); PE (122/256)	Pleural effusion (61/256)	DM (7/256)	–	–
Ho, 2011[25]	RA	Elderly, multi-organ failure, extensive comorbidities, refused operation	Treated medically and converted in case of complication or progression	56 (15/ 41)	60.5 ± 16.2	38/56	HTN (33/56); IHD (3/56); CT (7/56); PE (13/ 56)	–	DM (2/56)	–	Stroke (12/56)
Hu, 2011[26]	RA	Multi-organ failure, refused operation	Treated medically and converted in case of complication or progression	105 (67/ 35/3- others)	48.9 ± 11.4	88/ 105	HTN (49/105); atherosclerosis (AS; 19/105)	–	DM (5/105)	–	–
Yanagisawa, 2011[27]	RA	Elderly, extensive comorbidities, high surgical risk	Treated medically and converted in case of complication or progression	82 (48/ 34)	69 ± 14	41/82	HTN (67/82); CAD (7/82);	COPD (4/ 82)	DM (4/82); hyperlipidaemia (HL; 11/82)	Haemodialysis (2/82)	Dementia (8/ 82); cirrhosis (1/ 82)
Okina, 2013[28]	RA	–	Treated medically and converted in case of complication or progression	71	–	36/71	–	–	–	–	–
Uzuka, 2013[29]	RA	High surgical risk (cardiac tamponade, aortic rupture)	Treated medically and converted in case of complication or progression	34 (16/ 18)	74.8 ± 9.9	12/34	HTN (29/34); CAD (2/34)	–	DM (4/34); HL (4/34)	–	–

Table 1-*continued*

First author, year	Study type	Reason for conservative treatment (% whenever reported)	Definition of conservative treatment	*n* (medical/ non-medical)	Mean age ± SD, years	No. of males	Comorbidities				
							Cardiovascular	Respiratory	Endocrine	Renal	Others
Wang, 2014[30]	RA	–	Treated medically and converted in case of complication or progression	430 (153/ 226/51-others)	50.5 ± 11.2	328/ 430	HTN (221/ 430); AS (132/ 430); cardiac surgery (7/430)	–	DM (8/430)	–	–
Tanaka, 2015[31]	RA	Refused operation (37.1%), delayed diagnosis (4.8%), extensive comorbidities (12.9%), thrombosis of false lumen (40.3%), others (4.8%)	Treated medically and converted in case of complication or progression	62	73 ± 13	29/33	–	–	–	–	–
Bossone, 2016[32]	RA	Elderly, extensive comorbidities, refused operation	Treated medically and converted in case of complication or progression	2704 (308/ 2343/53 - others)	61.4 ± 14.5	1828/ 2704	HTN (1938/ 2704); AS (586/2704)	–	DM (190/2704)	–	–
Dumfarth, 2017[33]	RA	Extensive comorbidities	Treated medically and converted in case of complication or progression	90 (23/ 67)	84.9 ± 3.7	43/90	HTN (73/90); CAD (28/90); PVD (9/90); PE (41/90)	COPD (15/ 90)	DM (17/90); HL (36/ 90)	–	Cerebrovascular disease (10/90)
Kitamura, 2017[34]	RA	Refused surgery, died pre-operatively	Treated medically and converted in case of complication or progression (only three patients had staged repair)	195 (58/ 137)	70	111/ 195	–	–	–	–	–
Hanna, 2013[36]	(RA)	Elderly, extensive comorbidities, refused operation	NR	2454 (310/ 2144)	70.4 ± 14.6	166/ 144	–	–	–	–	–
Shingu, 2003[35]	RA	Thrombosed false lumen (100%)	Treated medically and converted in case of complication or progression	28	69.9 ± 11.4	14/28	–	–	–	–	–

AS = atherosclerosis; CAD = coronary artery disease; CT = cardiac tamponade; COPD = chronic obstructive pulmonary disease; DM = diabetes mellitus; HTN = hypertension; HL = hyperlipidaemia; PE = pericardial effusion; RA = original research article; PVD = peripheral vascular disease; IHD = ischaemic heart disease; NR = not recorded; SD = standard deviation.

2.6–13.4%; $I^2 = 76.5\%$ [$n = 12$ studies]) (Fig. 4); however, the pooled proportion of all cause 30 day mortality was increased to 15.3% (1.1–37.9%; $I^2 = 84.1\%$ [$n = 5$ studies]) (Fig. 5). There was a significant proportion of patients who converted from medical to surgical treatment (26.3%, 95% CI 12.1–43.4; $I^2 = 90.5\%$ [$n = 8$ studies]) (Fig. S2; see Supplementary Material).

Risk of bias in included studies

The NOS was employed to assess the risk of bias of included studies. For studies on type A aortic dissection, only two out of 12 studies scored <7/9 points,[22,30] whereas the rest were deemed to be robust in their methodology. Four studies were not comparative and one was a conference abstract;[24,28,31,35] hence, the NOS tool was not applicable (Table S1; see Supplementary Material). For studies on type A IMH, all seven studies scored >7/9 points, and were deemed to be robust in their methodology. Three studies were not comparative,[39,40,42] and two were conference abstracts;[41] hence, the NOS tool was not applicable (Table S2; see Supplementary Material).

Table 2. Baseline characteristics of included studies for patients with type A intramural haematoma

First author, year	Study design	Definition of conservative management	*n* (conservative/ surgical)	Mean age ± SD, years	No. of males	Comorbidities				
						Cardiovascular	Respiratory	Endocrine	Renal	Others
Nienaber, 1995[37]	RA	Treated medically only	12 (5/7)	56 ± 13	–	Hypertension (HTN; 9/12)	–	Diabetes mellitus (DM; 2/12)	–	Marfan syndrome (3/12)
Motoyoshi, 2003[38]	RA	Treated medically and converted in case of complication or progression	36 (26/10)	68 ± 9	20	HTN (30/36)	–	Hyperlipidaemia (HL; 54/59)	–	–
Song, 2003[39]	RA	Treated medically and converted in case of complication or progression	31 (25/6)	67	6	–	–	–	–	–
Kitai, 2009[18]	RA	Treated medically and converted in case of complication or progression	66 (50/16)	67 ± 11	25/66	HTN (57/66)	–	DM (12/66); HL (14/66)	Haemodialysis (3/50; 0/16)	–
Song, 2009[19]	RA	Medical treatment with purposefully delayed operation	101 (85/16)	65 ± 10	30/101	HTN (68/101); cardiac tamponade (CT; 21/101); pericardial effusion (PE; 69/101)	Pleural effusion (49/101)	DM (5/101)	–	–
Sawaki, 2010[40]	RA	Treated medically and converted in case of complication or progression	24	67 ± 13.6	13/24	HTN (17/24); PE (7/24)	–	DM (3/24)	–	–
Ho, 2011[25]	RA	Treated medically and converted in case of complication or progression	34 (25/9)	69.7 ± 12.4	18/34	HTN (22/34); IHD (3/34); CT (8/34); PE (22/34)	–	DM (3/34)	–	Stroke (0/34)
Kent, 2011[41]	RA	NR	10 (5/5)	–	–	–	–	–	–	–
Watanabe, 2013[42]	RA	Treated medically and converted in case of complication or progression	59	70.5 ± 10.6	27/59	HTN (59/59); CT (4/59); PE (11/59)	–	HL (54/59)	–	Cerebrovascular disease (CVD; 2/59)
Hata, 2014[43]	RA	Treated medically and converted in case of complication or progression	171 (105/66)	69.5	91/171	–	–	DM (23/171)	Chronic renal failure (3/105; 3/66)	Stroke (5/105; 2/66)
Choi, 2014[44]	RA	Treated medically and converted in case of complication or progression	61 (47/14)	68 ± 10	23/61	HTN (37/61)	–	DM (4/61); HL (16/61)	–	Smoking (20/61)
Estrera, 2009[45]	RA	Medical treatment with purposefully delayed operation	36 (29/7)	63 ± 13.5	24/36	CT (2/36)	–	–	–	Stroke (2/36); paraplegia (1/36)
Moizumi, 2002[46]	RA	Treated medically and converted in case of complication or progression	33 (24/9)	64.2 ± 7.0	19/33	HTN (30/33)	Lung disease (2/33)	DM (1/33); HL (2/33)	Renal dysfunction (5/33)	Liver disease (7/33); CVD (7/33)
Zhang, 2011[47]	RA	Treated medically and converted in case of complication or progression	19 (13/6)	–	–	–	–	–	–	–

CVD = cerebrovascular disease; CT = cardiac tamponade; DM = diabetes mellitus; RA = original research article; HTN = hypertension; HL = hyperlipidaemia; PE = pericardial effusion; IHD = ischaemic heart disease; NR = not recorded; SD = standard deviation.

DISCUSSION

This study attempted to assess the impact of non-operative management of TAAAS, including both (TAAD) and type A IMH. A meta-analysis of 17 studies on TAAD demonstrated a high in hospital and 30 day mortality in conservatively treated patients, as compared with the pooled analysis of 12 studies on type A IMH. However, these findings are limited by the significant heterogeneity in types of conservative management across studies. For instance, three studies implemented a purposely delayed operation for patients who received initial conservative therapy,[19,34,45] whereas the remaining studies first treated patients conservatively and operated only if there were complications or disease progression.

These findings for TAAD are in agreement with the 2014 European Society of Cardiology (ESC) guidelines, which strongly recommend that all patients with TAAD are sent for surgery.[48] Similarly, investigators from the IRAD reported a reduction in mortality rate in patients with TAAD who underwent surgery.[5,49] In line with the ESC guidelines,[48] the present findings suggest that initial surgical treatment may be a sensible option.

Acute TAADs may present with a slew of lethal complications, such as intra-pericardial rupture, acute aortic valve insufficiency, coronary ischaemia, and branch vessel

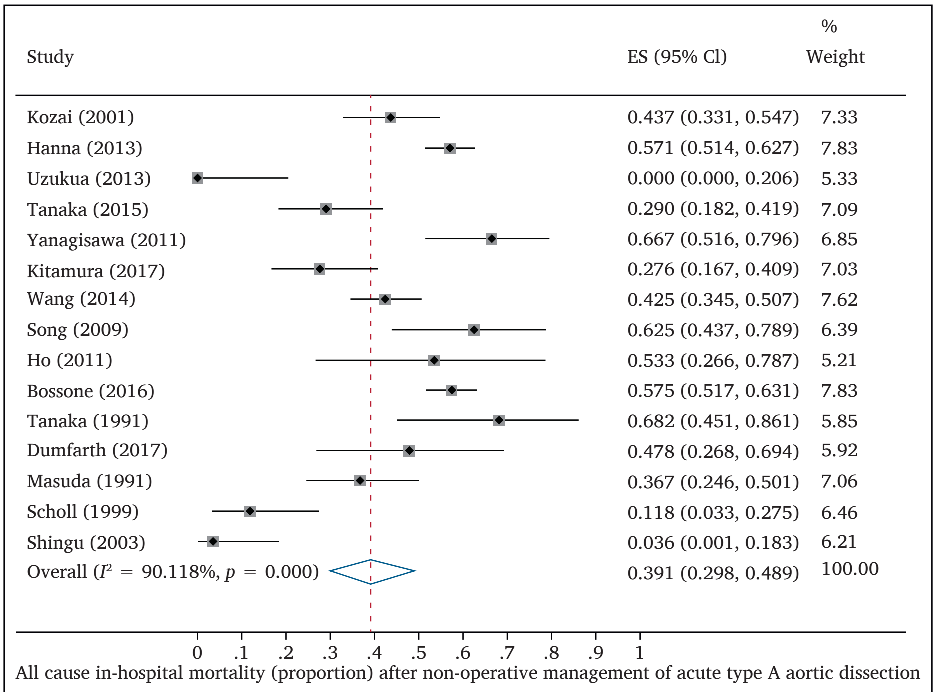

Figure 2. All cause in-hospital mortality after non-operative management of acute type A aortic dissection across 15 analysed studies. The pooled in hospital mortality rate was 39%. CI = confidence interval; ES = effect size; I^2 = percentage of variation.

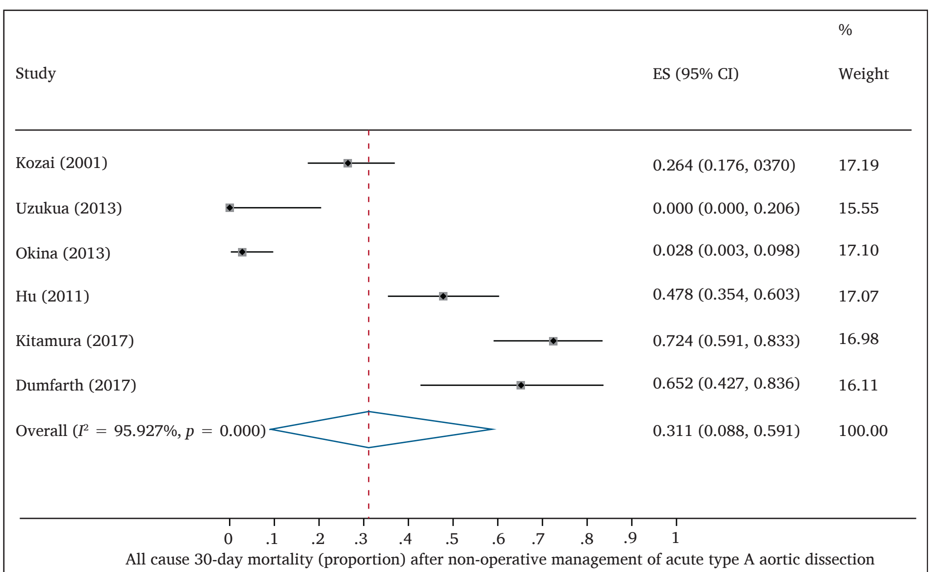

Figure 3. All cause mortality at 30 days after non-operative management of acute type A aortic dissection across 6 analysed studies. The pooled 30 day mortality rate was 31%. CI = confidence interval; ES = effect size; I^2 = percentage of variation.

occlusion, necessitating urgent surgical intervention.[23] Hence, this review was not purposed to refute the conventional wisdom that surgery is warranted for TAAD. Rather, it was intended to assess the mortality rate of medical intervention associated with two distinct groups of patients: (i) those who are contraindicated for surgery owing to comorbidity and advanced age; (ii) those who were diagnosed many days after the onset of acute TAAD and survived long enough to be referred to hospital. Hence, there is a high risk of selection bias, as patients included in this review, who have received medical intervention only, could represent a subset of the entire population with TAAD. Scholl *et al*. have suggested that the critical phase of an aortic dissection is the first 48 h, and anything thereafter

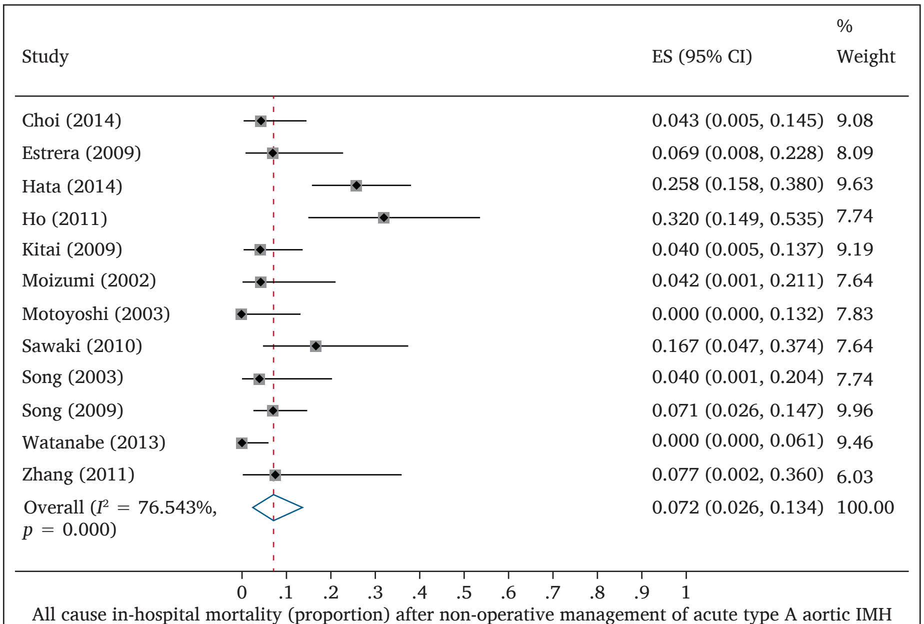

Figure 4. All cause in-hospital mortality after non-operative management of acute type A aortic intramural hematoma (IMH) across 12 analysed studies. The pooled in-hospital mortality rate was 7%. CI = confidence interval; ES = effect size.

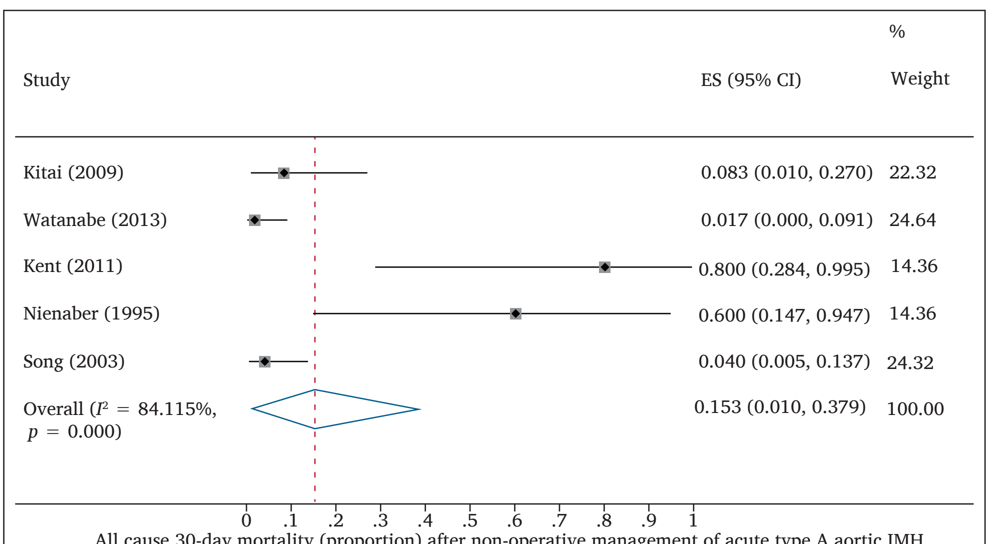

Figure 5. All cause mortality at 30 days after non-operative management of acute type A aortic intramural hematoma (IMH) across 5 analysed studies. The pooled 30 day mortality rate was 15%. CI = confidence interval; ES = effect size; I^2 = percentage of variation.

could potentially be managed aggressively with medical therapy and/or operated on semi-electively;[23] hence, patients who have survived past this critical period without operation tend to be more stable. However, the present study has shown that the mortality rate for patients contraindicated for surgery, as per the reasons stated above, remains high, despite best medical therapy. Nevertheless, improvements in surgical technique, as well as implementation of multidisciplinary programmes,[50] have led to improved mortality outcomes in acute TAAD surgery, even in low volume centres, and even among the elderly, who may be at increased risk of surgery.[51,52]

Hitherto, the role of surgical intervention for patients with type A IMH remains controversial. Some investigators have demonstrated that aggressive medical treatment led to complete resorption of the thrombosed false lumen, with a low mortality risk,[46,53] whereas others have reported poorer outcomes associated with medical treatment alone,[37,54] which corroborates findings of a previous meta-analysis of 143 patients.[55] The findings from the present study suggest a relatively low in hospital mortality rate in comparison to the 30 day mortality rate in patients treated medically. Despite the encouraging findings, the 95% CI in these two outcomes (2.6—13.4% and 1.1—37.9%, respectively) implies that the in hospital and 30 day mortality risk may be as high as 13.4% and 38%, respectively, significant figures that should not be overlooked. The difference between the in hospital and 30 day mortality rates could be attributed to the risk of disease progression post-discharge; hence patient mortality risk remains high post-discharge, even after effective medical therapy during the in hospital stay. Therefore, vigilance during the short-term follow up period is essential for clinicians to identify patients who might be at risk of progression, and to intervene as necessary.

Despite that, it is the present authors' opinion that the decision to treat medically type A IMH should be made judiciously on a case by case basis. Surgical candidates for type A IMH tend to be those with, or at risk of progressing to overt type A dissections, with the accompanying risk of cardiac tamponade or impending rupture.[46] However, Moizumi *et al*. showed that aggressive antihypertensive therapy was effective in preventing these adverse consequences.[46] To better select surgical candidates for type A IMH, surgeons should incorporate predictive factors in the clinical decision making process. Several investigators have recommended the use of maximum aortic wall thickness and diameter parameters (<50 mm), as obtained from computed tomography scans, to predict progression of IMH.[46,56,57]

The findings of this review must be interpreted in the context of known limitations. Firstly, there were no randomised trials included, understandably, given that it is ethically and practically inappropriate to randomise patients with such fatal conditions that may warrant emergency intervention. Secondly, there is a high risk of selection bias in the included studies, given that the profile of medically and surgically treated patients are very different, the former of which tend to be more stable without significant complications or pathological progression. Lastly, there is significant statistical heterogeneity in the findings ($I^2 > 50\%$), indicating inconsistency in the proportion of mortality reported across studies. This could arise from qualitative heterogeneity, including differences in patient characteristics, and type of conservative treatment being employed. Future research should consider comparing treatment strategies between groups with similar clinical profiles.

CONCLUSION

While patients with TAAD should still be prioritised for surgical intervention, the inherent limitations of this review prohibit any firm recommendations regarding the safety and efficacy of conservative management for type A IMH.

CONFLICT OF INTEREST

None.

FUNDING

None.

APPENDIX A. SUPPLEMENTARY DATA

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ejvs.2018.10.015.

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COUP D'OEIL

Stent Induced Veno-colic Fistula

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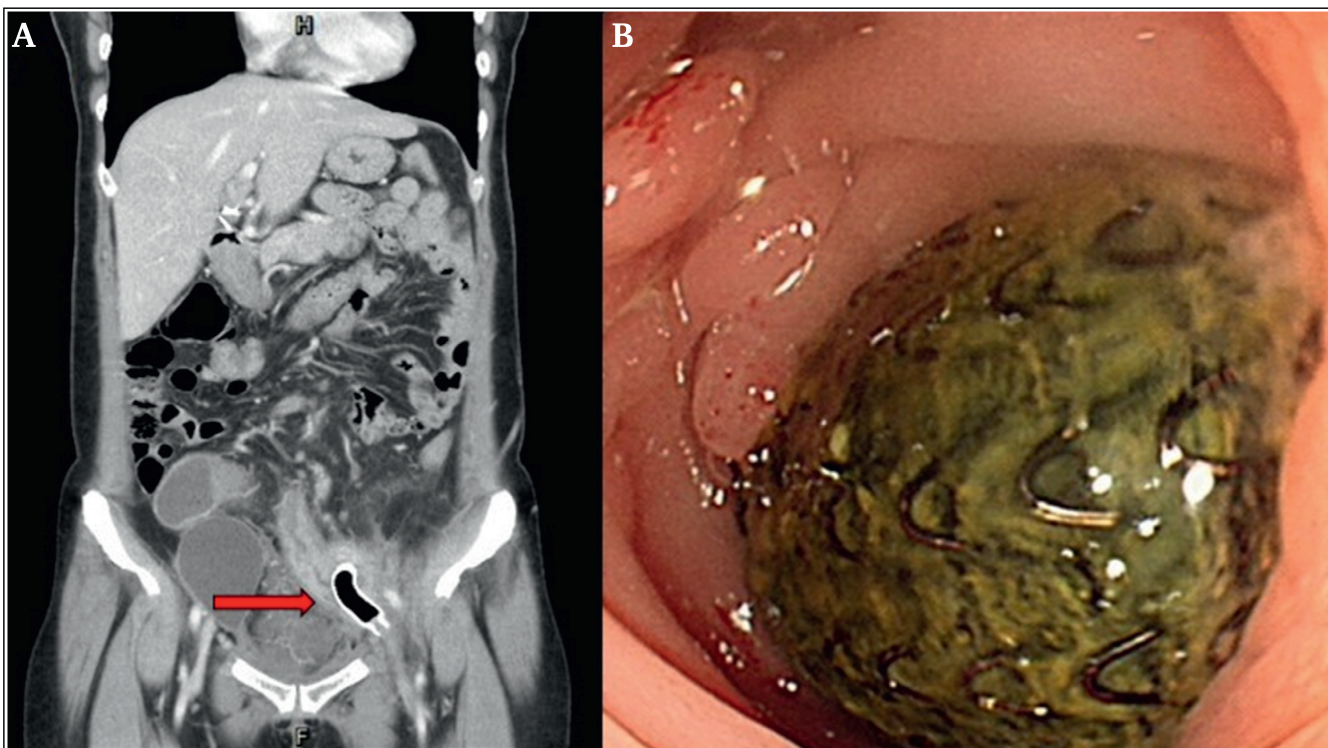

A 49 year old female developed left leg swelling after salpingo-oophorectomy 18 months previously; venography showed stenosis of the entire left external iliac vein and one 16 × 90 mm WALLSTENT® Endoprosthesis (Boston Scientific, Natick, MA, USA) was implanted. Ten months later she presented again with severe bloody stools. Computed tomographic venography showed free air around the stent (A). Free air around the left external iliac vein where the stent was implanted is shown by arrow in panel (A). Colonoscopy revealed a fistula between the sigmoid colon and the left external iliac vein with venous stent exposure (B). Sequential necrosis of both walls caused the veno-colonic fistula. Removal of stent and colostomy were performed. One year later, the patient is well.

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