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REVIEW

Fasting Versus Non-Fasting Before Cardiac Catheterization: A Systematic Review and Meta-Analysis of Randomized Controlled Trials

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ABSTRACT

Background: Current guidelines recommend routine fasting before cardiac catheterization under conscious sedation. However, data supporting this practice have been limited.

Aims: We aimed to compare the safety and patient well-being of a non-fasting strategy to standard fasting in patients who undergo heart catheterization procedures.

Methods: We conducted a meta-analysis of randomized studies comparing fasting versus non-fasting before cardiac catheterization. We systematically reviewed PubMed, Embase, and Cochrane databases until October 2024. We incorporated unpublished subgroup data from the previously published SCOFF Trial, exclusively on patients who underwent catheterization procedures.

Results: We included 7 RCTs comprising 3289 patients who underwent cardiac catheterization procedures. The pooled analysis demonstrated the non-inferiority of the non-fasting strategy, with no significant differences in the incidences of nausea/vomiting (RR 0.90; 95% CI 0.50−1.61; $p = 0.72$), hypoglycemia (RR 0.78; 95% CI 0.45−1.35, $p = 0.38$), acute kidney injury (RR 1.45; 95% CI 0.77−2.75, $p = 0.251$), and length of hospital stay (SMD 0.005, 95% CI −0.109 to 0.099, $p = 0.92$) compared to the fasting strategy. The non-fasting strategy was significantly associated with reduced rates of intraprocedural hypotension and showed a statistically significant improvement in overall patient satisfaction (SMD −0.749; 95% CI −1.26; −0.234, $p = 0.004$) when compared to the fasting strategy.

Conclusion: A non-fasting strategy before cardiac catheterization procedures is as safe as the standard fasting protocol and demonstrates a significant improvement of overall patient satisfaction. These findings support the consideration of non-fasting protocols as a patient-centered approach that maintains safety while enhancing the patient experience.

Abbreviations: AKI, acute kidney injury; ASA, American Society of Anesthesiologists; BMI, body mass index; CC, cardiac catheterization; PCI, percutaneous coronary intervention; RCT, randomized controlled trial(s); RR, risk-ratio.

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1 | Introduction

Individuals undergoing coronary angiography, right-heart catheterization, and percutaneous coronary interventions (PCI) have historically been required to fast in preparation for the procedure. Current guidelines for percutaneous cardiac procedures under conscious sedation have extended the long-standing recommendation of the American Society of Anesthesiologists (ASA) of 6 h of fasting for solids and 2 h for liquids before elective general and regional anesthesia [1, 2]. This practice aims to minimize the risk of intraprocedural pulmonary aspiration. The SCAI expert consensus acknowledges the ASA recommendations, although it highlights the lack of scientific evidence supporting this approach [3].

Potential harms from fasting include patient dissatisfaction, poor hydration, and irregular medication use with consequent poor glycemic and blood-pressure controls. Removing fasting requirements could increase patient well-being and overall satisfaction and minimize procedural delays and cancellations, contributing to optimal health resource allocation.

A previous systematic integrative review suggested that reducing fasting requirements before coronary angiography and angioplasty may be a safe alternative [4]. However, most of the available evidence was limited to observational studies, conference abstracts of randomized studies with limited available data, and mixed procedures, not only cardiac catheterization (CC). The most significant concerns associated with the non-fasting approach were the potential for vomiting and pulmonary aspiration [4, 5]. Recently, there has been a new body of high-quality evidence on the safety and convenience of the standard fasting approach compared to a non-fasting approach.

A recently published systematic review included a heterogeneous patient cohort comprising catheterization, transcatheter aortic valve replacement (TAVR), cardiac implantable electronic device and ablation procedures, with results that may be subjected to confounding by the invasiveness and complexity of the methods and the patient's underlying comorbidities [6]. By stratifying the study population to a more homogeneous group of coronary angiography, PCI, and right-heart catheterization, we aim to mitigate these sources of variability. This focused approach enables a more precise assessment of procedural outcomes, thereby improving the applicability of the present findings.

2 | Methods

2.1 | Eligibility Criteria

Inclusion in this meta-analysis was restricted to studies that met all the following eligibility criteria: (1) randomized controlled trials (RCT), (2) comparing preprocedural fasting to non-fasting, and (3) enrolling patients who underwent diagnostic angiography, PCI, and right-heart catheterization. We excluded (1) observational studies and those with (2) no outcomes of interest.

2.2 | Search Strategy and Data Extraction

From inception to October 2024, we systematically searched PubMed, Embase, and the Cochrane Central Register of Controlled Trials using the following main search terms: “fasting,” “non-fasting,” “npo,” “healthy diet,” “PCI,” “cardiac catheterization,” and “intervention.” We also manually searched the references from all included studies and previous systematic reviews for any additional studies. Two authors (J.M. and B.M.) independently extracted the data following predefined search criteria and quality assessment. We incorporated unpublished subgroup data from the previously published SCOFF Trial, exclusively on patients who underwent CC procedures [7]. While the primary outcomes of the study were reported, this subgroup data had not been publicly released at the time of our analysis.

2.3 | Endpoints and Sub-Analyses

Outcomes included hypoglycemia, intraprocedural hypotension, nausea, vomiting, aspiration pneumonia, acute kidney injury (AKI), length of hospital stay, and overall patient satisfaction. Patient satisfaction scores were predicted to differ across studies and were analyzed as standard mean differences. Before standardization, we corrected the scale direction to the most prevalent across studies, in which a higher score corresponds to lower levels of patient well-being. Baseline characteristics of the included studies were reported in Table 1. Available information on procedure details and sedation provision across included studies were reported in Table 2. The prespecified sub-analysis included data restricted to peer-reviewed studies.

2.4 | Quality Assessment

Quality assessment of RCTs was performed using the Cochrane Collaboration's tool for assessing risk of bias in randomized trials, in which studies are scored as high, low, or unclear risk of bias in five domains: selection, performance, detection, attrition, and reporting biases [8]. Publication bias was investigated using Egger's regression test.

2.5 | Statistical Analysis

This systematic review and meta-analysis followed the Cochrane Collaboration and the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) statement guidelines [9]. The review protocol was registered on the PROSPERO database under the number CRD42024598224. Risk ratios (RR) with 95% confidence intervals were used to compare treatment effects for categorical endpoints. Cochrane Q test and I^2 statistics were used to assess heterogeneity; p values inferior to 0.10, and $I^2 > 25\%$ were considered significant. [10] We used a random-effects model for outcomes with predicted high heterogeneity. We used a fixed-effects model with the Mantel-Haenszel method for binary outcomes with few events. We also performed a sensitivity analysis with the generic inverse variance method for outcomes with substantial heterogeneity.

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TABLE 1 | Baseline characteristics of included studies.

Study	Study design	Procedure	Patients NF/F	Male % NF/F	Age[c], year NF/F	HTN % NF/F	DM 2% NF/F	Creatinine NF/F	GI disease %, NF/F	Previous MI % NF/F	BMI[c] NF/F	FT Solid[c] NF/F	FT liquid[c] NF/F
Li et al. [11][a]	RCT	Non-urgent CC	249/266	74/80	62/63	66/69	51/42	NA	NA	NA	NA	NA	NA
Mishra et al. [12][a]	RCT	Non-urgent CC	246/274	64/53	68/67	76/80	40/40	NA	44/ 38 (GERD)	19/24	31/31	NA	NA
Boukantar et al. [13]	RCT	Elective and semi-urgent CC	376/379	75/76	68/67	72/72	30/28	84/86	NA	NA	27/27	3/15	3/15
Ferreira et al. [7]	RCT	Non-urgent CC	306/297	66/64	67/69	69/70	27/27	NA	NA	24/19	30/30	4/13	3/8
Tamborrino et al. [14]	RCT	Non-urgent CC	150/150	67/75	69/69	67/70	34/35	126/111[b]	5/10	NA	NA	4/13	NA
Woods et al. [15]	RCT	Non-urgent CC	100/97	62	63	NA	NA	NA	15/13	NA	NA	NA	NA
Mitchell et al. [16]	RCT	Elective and urgent CC	104/94	65/64	61/62	65/80	46/49	141/142	NA	NA	29/29	3/18	3/16

Abbreviations: BMI, body-mass index(kg/m^2); CC, cardiac catheterization; Creatinine, umol/L; DM, diabetes mellitus; F, fasting; FT, fasting time (hours); GI, gastrointestinal; HTN, hypertension; NA, not available, NF, non-fasting.
[a]Conference abstracts.
[b]Statistical difference between groups.
[c]Mean or median.

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TABLE 2 | Procedural characteristics of included studies.

Study	Diagnostic coronary angiography % NF/F	PCI % NF/F	Access % NF/F	Inpatient % NF/F	Sedation provision % NF/F	Procedures included/Indication
Li et al. [11][a]	50%	47/53	—	40/90[b]	7/3	Coronary angiography, coronary angiography with ad hoc PCI
Mishra et al. [12][a]	—	—	—	54/48	—	—
Boukantar et al. [13]	69/71	31/30	RA 95/94 FA 5/6	35/31	21%	Coronary angiography, PCI, left main intervention, rotational atherectomy, chronic total occlusion
Ferreira et al. [7]	63/70	27/24	RA 96/97 FA 6/6	—	88/85	Coronary angiography, PCI, physiology assessment, left main intervention, graft intervention, unplanned calcium modification
Tamborrino et al. [14]	—	44/43	RA 86/89 FA 11/13	100%	"sedatives when needed"	85% Coronary syndromes
Woods et al. [15]	57%	43%	—	100%	—	Chest pain (70%), NSTEMI (13%) unstable angina (6%), other (10%)
Mitchell et al. [16]	LHC 64/63 RHC 36/38	28/22	—	100%	80/81	Left heart catheterization, PCI, right heart catheterization

Abbreviations: BMI, body-mass index (kg/m^2); F, fasting; FA, Femoral artery; LHC, left heart catheterization; NF, non-fasting; NSTEMI, non-ST segment elevation myocardial infarction; PCI, percutaneous coronary intervention; RA, Radial artery; RHC, right heart catheterization.

[a]Conference abstracts.

[b]Statistical difference between groups.

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The software Review Manager 5.4 (Cochrane Centre, The Cochrane Collaboration, Denmark) and R (v. 4.4.1) were used for statistical analysis.

3 | Results

3.1 | Study Selection and Characteristics

As detailed in Supporting Information S1: Figure 1, the initial search yielded 1414 results. After excluding duplicate records and ineligible studies, 12 were thoroughly reviewed based on inclusion criteria. Of these, 7 RCTs were included, comprising 3289 patients who underwent CC procedures (1631 allocated in the non-fasting and 1638 in the standard fasting group) [7, 11–16]. Study characteristics are reported in Table 1. Significant study variability existed in reporting risk factors such as body mass index (BMI) and pre-existent gastrointestinal disease (Table 1). Reported sedation modalities generally followed hospital-specific routines and varied across the studies. The available information on procedure details and sedation medications in the included studies are reported in Table 2. Exclusion criteria of individual studies are reported in Supporting Information S1: Table 2.

The studies included in this analysis encompassed elective and semi-urgent procedures conducted in the catheterization laboratory, including complex and high-risk interventions. These procedures involved diagnostic coronary angiography, treatment of left main artery lesions, chronic total occlusions, high calcium burden lesions, and bifurcation lesions.

3.2 | Pooled Analysis of All Studies

In the pooled analysis, the non-fasting strategy showed no statistically significant difference in comparison to a fasting approach in terms of safety outcomes (Figure 1): hypoglycemia (RR 0.78; 95% CI 0.45−1.35, $p = 0.38$), nausea or vomiting (RR 0.90; 95% CI 0.50−1.61; $p = 0.72$), and length of hospital stay (SMD −0.005, 95% CI −0.109 to 0.099, $p = 0.92$). Rates of intraprocedural hypotension were significantly lower in the non-fasting group (Figure 2A. RR 0.62, 95% CI 0.44−0.89; $p = 0.009$), although the incidence of AKI was not significantly different between groups (Figure 2B. RR 1.45; 95% CI 0.77−2.75, $p = 0.251$). The occurrence of aspiration pneumonia was rarely reported across studies and, in the overall analysis, did not significantly differ between groups (Figure 3. RR 2.49; 95% CI 0.37−16.52, $p = 0.35$).

In the non-fasting group, there was a statistically significant improvement of patient satisfaction scores (Figure 4. SMD −0.749; 95% CI −1.26; −0.234, $p = 0.004$). Mishra et al. reported in a population of 520 individuals, there was no statistically significant difference in patient satisfaction scores (mean of 4.45 non-fasting vs. 4.39 fasting group $p = 0.438$). Information about scale direction was unavailable. However, an analysis in both directions showed little influence on the overall trend of the pooled analysis (Supporting Information S1: Figure 2). Analysis of patient satisfaction scores evidenced a high heterogeneity among studies.

Fasting times in the standard fasting group were across studies much longer than the recommendation (average 14.3 h, $n = 920$). [17]

3.3 | Sub-Analyses in Selected Populations

In a sub-analysis excluding the two conference abstracts [11, 12], there was a significant improvement in well-being scores in the non-fasting group compared to the standard fasting group (Figure 5). Rates of the safety outcomes of nausea and vomiting and hypoglycemia, did not significantly differ between groups (Figure 6). Furthermore, the rate of aspiration pneumonia in the sub-analysis was unremarkable in both groups (Central Illustration 1).

3.4 | Quality Assessment

Individual RCT appraisal is reported in Supporting Information S1: Table 1. Egger's regression test was performed and suggested no significant publication bias (Supporting Information S1: Figure 3: $p = 0.1275$ and $p = 0.1763$ for the outcomes of patient satisfaction). For the safety outcome of aspiration pneumonia, the number of studies reporting any event was too small to test for publication bias and minor study effects. To reduce the amount of non-reporting bias, we have also included unpublished results (solely available as conference abstracts), according to Cochrane Guidelines [18].

4 | Discussion

The main finding of the present meta-analysis, involving seven randomized studies, indicates that there was no statistically significant difference in safety outcomes between a non-fasting strategy and fasting before coronary angiography, PCIs, and right-heart catheterization. The safety outcomes of aspiration pneumonia, nausea and vomiting, hypoglycemia, the incidence of AKI, and length of hospital stay for both strategies were comparable. There was a trend toward better blood pressure control with lower rates of periprocedural hypotension in the non-fasting group. The non-fasting strategy was significantly associated with higher patient satisfaction and well-being rates.

Despite limited evidence supporting this practice, pre-procedural fasting remains a routine recommendation for patients undergoing cardiac interventions. Conversely, fasting can disrupt regular medication schedules, as patients may skip or delay essential medications, leading to impaired blood pressure control and glycemic management, potentially increasing the risk of perioperative complications. For individuals with diabetes, fasting often demands adjustments to insulin administration, which may result in blood glucose fluctuations.

Our pooled analysis observed a trend toward a higher frequency of hypotension episodes in patients subjected to standard fasting conditions before cardiac procedures, which may be attributed to inadequate hydration. However, no significant difference in the incidence of AKI was observed between fasting and non-fasting groups, suggesting that while fasting-related

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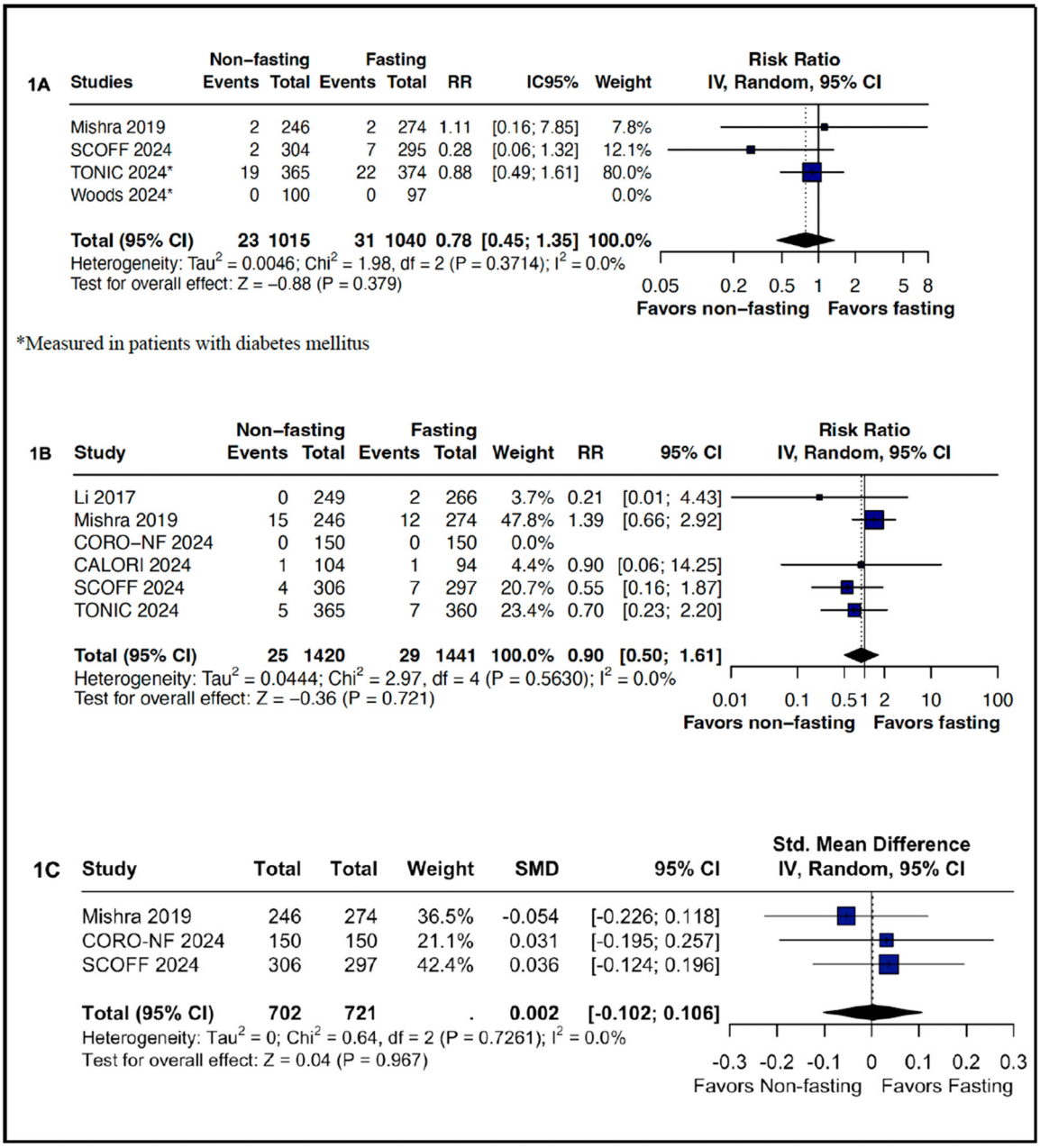

FIGURE 1 | The incidence of safety outcomes hypoglycemia (A), nausea or vomiting (B) and length of hospital stay (C) was not significantly different between the non-fasting and fasting groups. [Color figure can be viewed at wileyonlinelibrary.com]

hypotension is more common, it does not necessarily lead to pre-renal acute kidney impairment.

Our analysis showed that a shortened fasting approach was not significantly associated with higher levels of nausea and vomiting compared to the standard fasting approach. Vomiting, nausea, and allergic reactions were once common complications of angiography due to the hypertonic nature of first-generation contrast media, [19, 20] and therefore, fasting was once a relevant choice for CC procedures. However, the contrast dye used today is low-osmolality and non-ionic, which substantially decreases the reported vomiting rate.

A previous systematic review identified the most significant concern associated with the non-fasting approach was the potential for pulmonary aspiration [4]. In our analysis, the rates of aspiration or postprocedural pneumonia were unremarkable. This is consistent with previous observational data of larger cohorts. A retrospective analysis of a total of 3674 coronary procedures undertaken in a non-fasted protocol (69% of which were diagnostic coronary angiographies) showed the need for urgent intubation in three patients (0.08%) and five reported cardiac arrests, with no occurrences of post-interventional aspiration pneumonia [21]. A retrospective study of 1916 catheterization procedures due to ACS and chronic stable angina (78% of patients undergoing elective CC) without preprocedural fasting showed no requirement for emergent intraprocedural endotracheal intubation and no intra- or postprocedural aspiration pneumonia [22]. Patients were given intravenous

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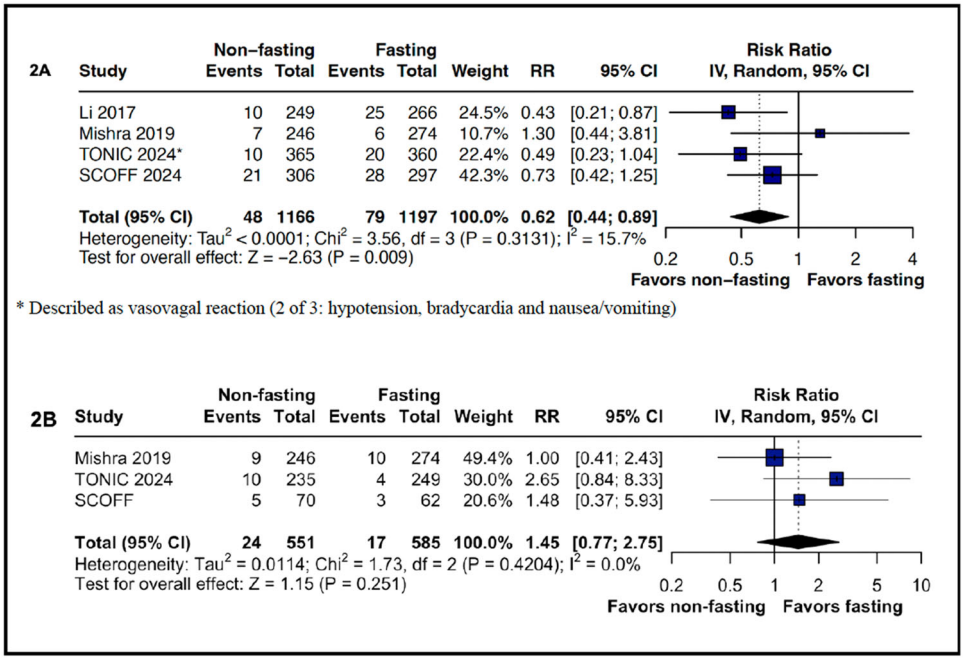

FIGURE 2 | Rates of intraprocedural hypotension (A) were significantly lower in the non-fasting group; the incidence of acute kidney injury (B) was not significantly different between groups. [Color figure can be viewed at wileyonlinelibrary.com]

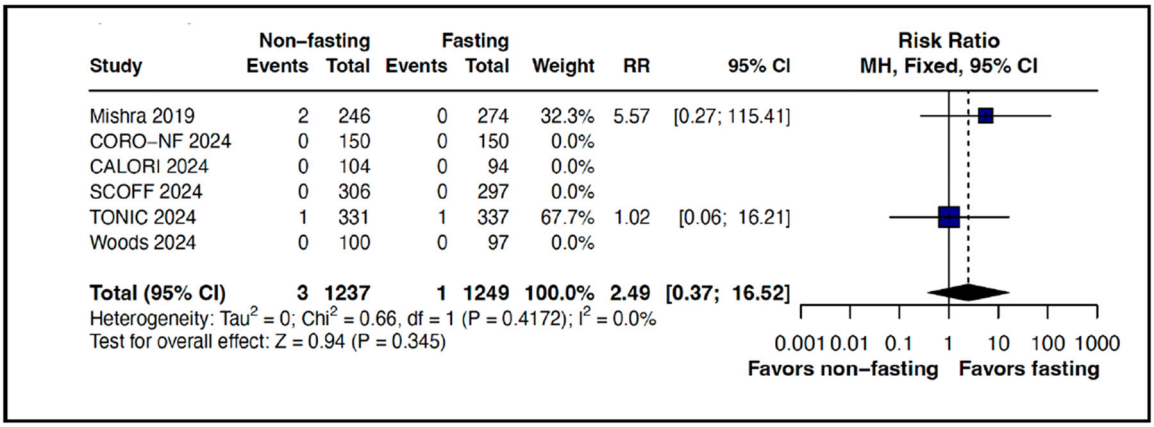

FIGURE 3 | Aspiration pneumonia was rarely reported across studies and did not significantly differ between groups. [Color figure can be viewed at wileyonlinelibrary.com]

sedation (consisting of diazepam, midazolam and/or fentanyl) as per patient request or operator choice. Chan et al. investigated retrospectively the incidence of aspiration events in 446 patients presenting with ST-elevation myocardial infarction who underwent emergent or urgent CC with moderate sedation, typically midazolam and fentanyl, with only one case of "likely aspiration" (0.2% of study patients) being identified [23].

The CORO-NF trial enrolled additionally an acute group, comprising patients undergoing emergency coronary angiography procedures, who would be considered at higher risk for food-related adverse events that showed a higher incidence of peri- or postprocedural complications [13]. However, this group did not experience a higher incidence of food-related adverse events compared with the fasting and non-fasting groups undergoing elective coronary procedures.

Significantly longer fasting times than recommended in current guidelines were evidenced across the studies in the standard fasting group. These findings are consistent with a previous large observational study in 1030 patients undergoing elective coronary angiography (69% of patients) and PCI, which showed a mean length of fasting of 11.6 ± 4.9 h, with 80% of patients fasting longer than recommended [21, 24]. This may occur due to adjustments to catheterization laboratory schedules, driven by the urgency and complexity of cases, which can contribute to procedural delays.

Our analysis found no statistically significant difference in the length of hospital stay between the fasting and non-fasting groups, suggesting that a non-fasting strategy is clinically non-inferior to standard fasting protocols regarding post-procedural recovery. These findings support the feasibility of adopting a more flexible pre-procedural approach without compromising recovery times.

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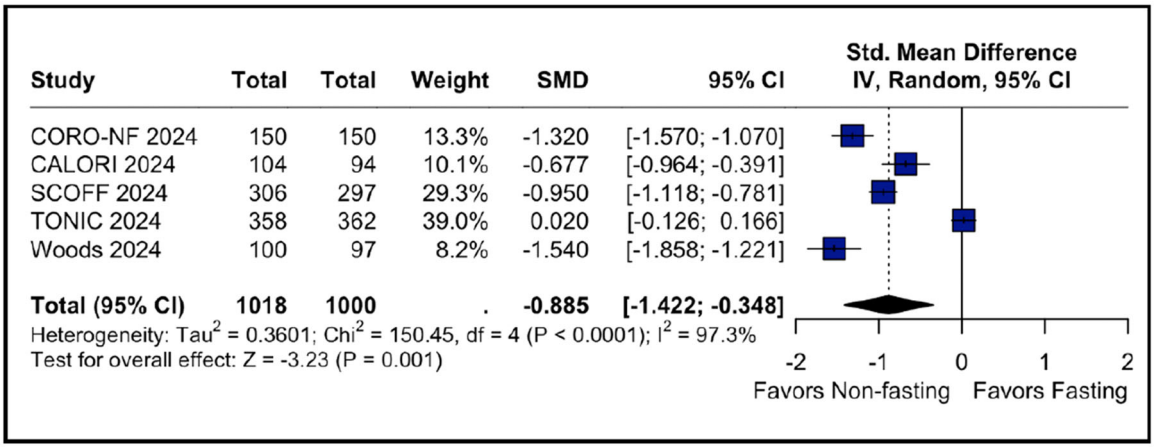

FIGURE 4 | Patient satisfaction scores were significantly improved in the non-fasting group when compared to the standard fasting group in the overall and subgroup analysis. [Color figure can be viewed at wileyonlinelibrary.com]

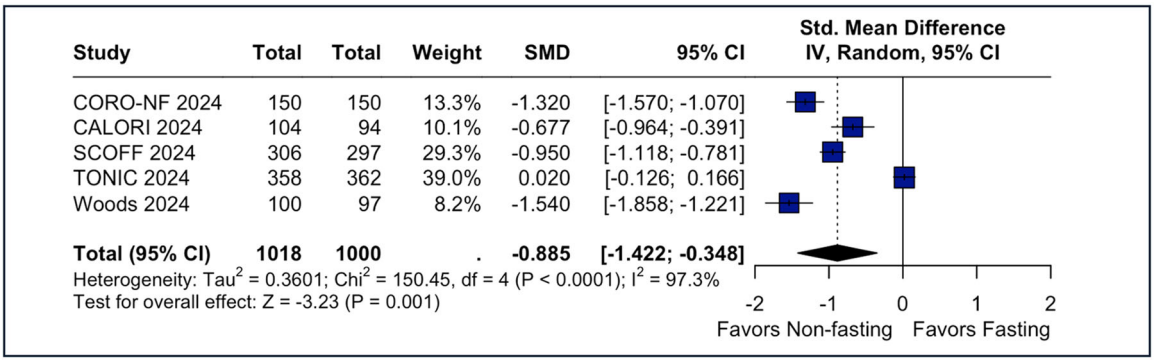

FIGURE 5 | In the subgroup analysis, there was a significant improvement in well-being scores in the non-fasting compared to the fasting group. [Color figure can be viewed at wileyonlinelibrary.com]

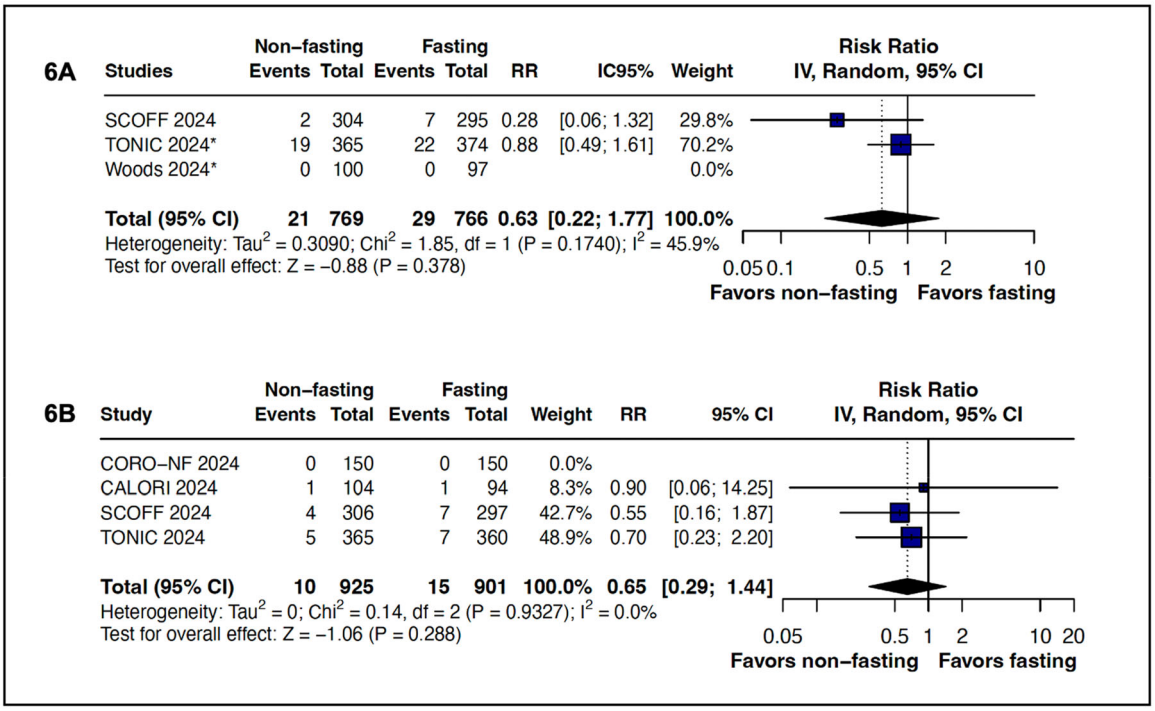

FIGURE 6 | In the subgroup analysis, rates of the safety outcomes hypoglycemia (A) and nausea/vomiting (B) did not significantly differ between groups. [Color figure can be viewed at wileyonlinelibrary.com]

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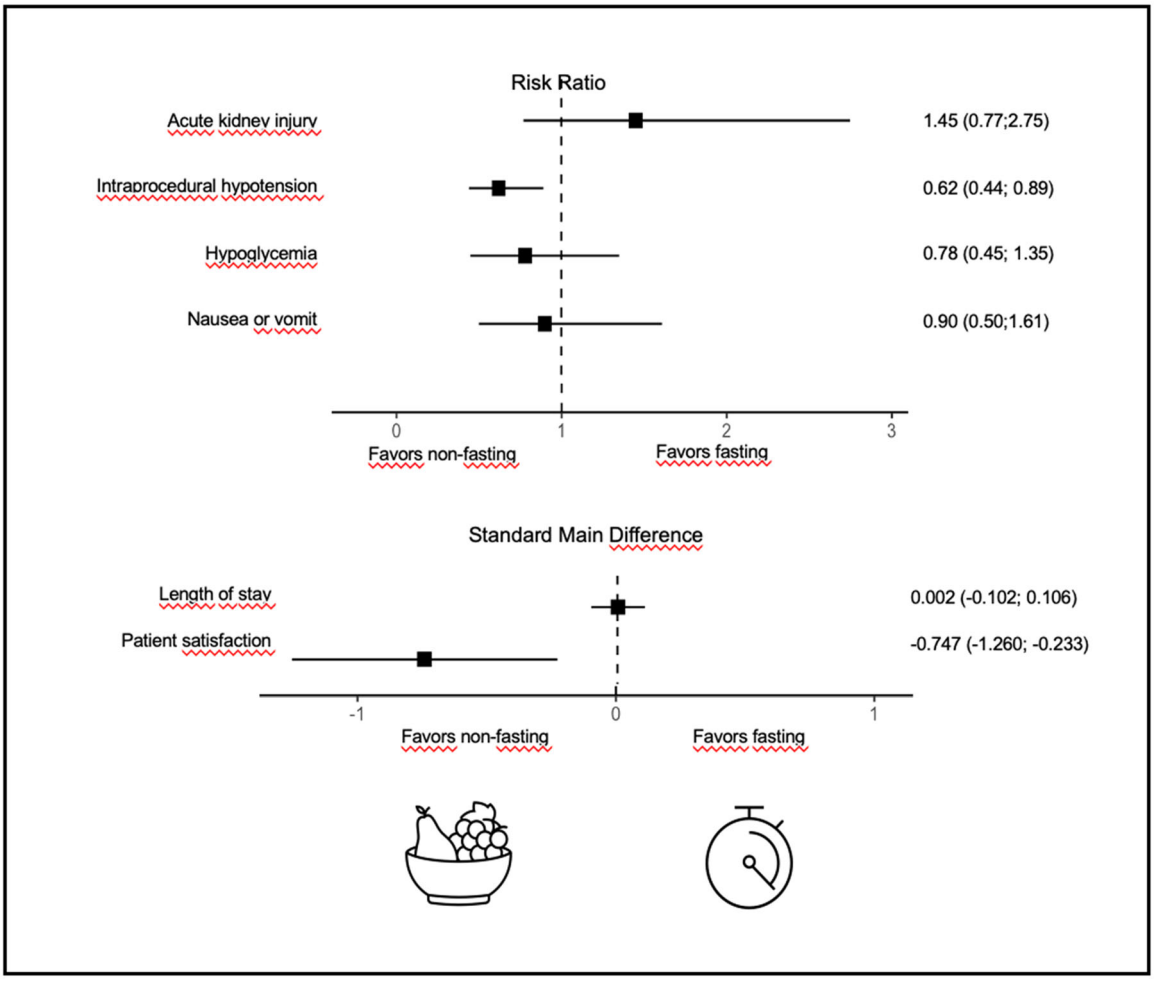

CENTRAL ILLUSTRATION 1 | A non-fasting strategy before cardiac catheterization is as safe as the standard fasting protocol and is associated with improved overall patient satisfaction. [Color figure can be viewed at wileyonlinelibrary.com]

Additionally, the non-fasting protocol allows patients to maintain their regular medication and dietary regimens, potentially reducing the risk of perioperative complications.

Patient satisfaction rates were significantly higher in the non-fasting group across studies, with lower reports of hunger, thirst, and fatigue being the primary contributors to improved well-being. However, the analysis revealed high heterogeneity among studies, which could not be resolved through sensitivity analysis (Supporting Information S1: Figure 4). Several factors may explain this variability. First, patient satisfaction is inherently subjective and influenced by contextual factors such as cultural differences, individual expectations, and personal values. Second, the timing of questionnaire administration may affect responses, as satisfaction can vary over time, complicating cross-study comparability.

4.1 | Limitations

Our study has potential limitations. First, the presence of a high risk of bias in a subset of studies could compromise the internal validity of the meta-analysis, potentially skewing pooled effect estimates. To mitigate this, we performed a sensitivity and a subgroup analysis of only peer reviewed RCTs, with consistent results. Second, the limited number of trials may lack sufficient statistical power for detecting differences in the main safety outcome of interest, such as aspiration pneumonia, which was rather infrequent. Also, to conclude whether fasting would significantly avoid aspiration would require a much larger study, which we believe is likely impractical. Therefore, we included clinically associated safety outcomes with higher reported incidence in our analysis, such as nausea and vomiting and length of hospital stay. Additionally, variability in study design, patient populations, and definitions of outcome measures across trials can lead to increased heterogeneity, as evidenced in reports of patient well-being. Finally, publication bias could potentially influence the pooled analysis, as studies with non-significant results are less likely to be published.

5 | Conclusion

This meta-analysis, which compared fasting and non-fasting strategies before CC procedures, indicates that a non-fasting approach may be a safe and effective alternative to the traditional fasting protocol. Furthermore, a non-fasting strategy enhances patient well-being and improves catheterization laboratory efficiency, warranting its consideration in future clinical practice guidelines for cardiac interventions. Although

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the number of high-quality studies on this topic has increased in recent years, further research with adequate statistical power is still needed to further assess the primary safety outcome of aspiration pneumonia definitively.

5.1 | Impact on Daily Practice

Incorporating a non-fasting strategy routinely in CC procedures enhances healthcare efficiency by reducing procedural delays and cancellations, which optimizes resource allocation in the catheterization laboratory. The non-fasting approach shows to be safe in procedures of coronary angiography with or without PCI, and right-heart catheterization and to improve patient's overall well-being, contributing to a better overall experience. This approach increases efficiency while ensuring patient safety and leads to improved patient satisfaction.

Disclosure

Dr. Ribeiro has served as a proctor for Edwards Lifesciences, Medtronic, and Boston Scientific and has received a research grant from Medtronic, Scitech Medical and Meril Lifesciences.

Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

They also take responsibility for the reliability and freedom from bias of the data presented and their discussed interpretation.

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