J Renal Inj Prev. 2026; 15(1): e38399.

https://journalrip.com doi: 10.34172/jrip.2025.38399

Journal of Renal Injury Prevention

# C-reactive protein to albumin ratio as a predictor of contrast-induced nephropathy; a systematic review and meta-analysis

**Sam Mirfendereski[1], Mahdieh Ahmadnia[2], Ali Hasanpour Dehkordi[3*]**

[1]Department of Radiology, Isfahan University of Medical Sciences, Isfahan, Iran
[2]General Medicine Register, Redland Hospital, Brisbane, Queensland, Australia
[3]Community-Oriented Nursing Midwifery Research Center, Nursing and Midwifery School, Shahrekord University of Medical Sciences, Shahrekord, Iran

**ARTICLE INFO**

***Article Type:***
Meta-analysis

***Article History:***
Received: 16 Sep. 2025
Revised: 25 Oct. 2025
Accepted: 10 Dec. 2025
Published online: 18 Dec. 2025

***Keywords:***
Contrast-induced nephropathy, C-reactive protein, High sensitivity C-reactive protein, hsCRP, Albumin, Contrast-induced acute kidney injury

**ABSTRACT**

**Introduction:** The C-reactive protein-to-albumin ratio (CAR) is a marker of inflammation that has been found to be more informative in assessing inflammation conditions in cardiovascular patients than the C-reactive protein (CRP) or albumin (ALB) levels only. Since inflammation has been identified as a factor causing contrast-induced nephropathy (CIN), this research seeks to establish the correlation between the CAR and the risk of CIN.

**Materials and Methods:** This systematic review and meta-analysis was conducted according to the PRISMA protocol. The Cochrane, PubMed, ProQuest, and Web of Science databases, as well as the Google Scholar search engine, were searched with no time limit up to August 8, 2024. Data were analyzed using STATA 14 software at a significance level of $P < 0.05$ for all tests.

**Results**: The findings of five reviewed studies with a total number of 1,442 participants showed a statistically significant positive correlation between CAR (OR: 2.11, 95% CI: 1.41, 3.14) and CRP (OR: 1.11, 95% CI: 1.02, 1.20), with an increase in the risk of CIN. However, no statistically significant associations were found between the patient age (OR: 1.02, 95% CI: 0.96, 1.09), albumin level (OR: 0.64, 95% CI: 0.14, 2.90), hypertension (OR: 2.12, 95% CI: 0.86, 5.21), and diabetes mellitus (OR: 0.80, 95% CI: 0.28, 2.29) variables and the risk of CIN.

**Conclusion:** Elevated CAR and CRP are CIN risk factors that can be evaluated to provide a good prognosis of this condition. Nevertheless, albumin levels were not significantly related to the development of CIN.

**Registration:** This study has been compiled based on the PRISMA checklist, and its protocol was registered on the PROSPERO (ID: CRD42024580053) and Research Registry (UIN: reviewregistry1874) websites.

*Implication for health policy/practice/research/medical education:*
In this meta-analysis we found that C-reactive protein-to-albumin ratio (CAR) and C-reactive protein (CRP) are proteins that raise contrast-induced nephropathy (CIN risk), therefore, their value can be conducted to diagnose the condition. However, the correlation between the albumin levels and the incidence of CIN was not statistically significant. Consequently, increased levels of CAR and consequently can be regarded as significant risk factors for contrast-induced acute kidney injury prediction in patients with type 2 diabetes. Specifically, CAR levels are elevated in patients with contrast-induced acute kidney injury than in those with CRP only, suggesting that CAR is a serious risk factor for CIN.

*Please cite this paper as:* Mirfendereski S, Ahmadnia M, Hasanpour Dehkordi A. C-reactive protein to albumin ratio as a predictor of contrast-induced nephropathy; a systematic review and meta-analysis. J Renal Inj Prev. 2026; 15(1): e38399. doi: 10.34172/jrip.2025.38399.

Meta-analysis

## Introduction

Contrast-induced nephropathy (CIN) is defined as an increase of more than 0.5 mg/dL in serum creatinine levels within 48 hours after administering an intravascular contrast agent or a 25% or greater increase compared to baseline serum creatinine levels (1,2). The incidence of CIN can vary from approximately 0% to 50% (3,4). Currently, CIN accounts for about 11% of acute kidney

***Corresponding author**: Ali Hasanpour Dehkordi, Email: alihassanpourdehkordi@gmail.com

injuries, ranking second after drug-induced and ischemic acute kidney injury (AKI) (5, 6). Risk factors for CIN include kidney failure, diabetes, advanced age, type and dose of contrast agent, and accompanying cardiovascular diseases (7,8). Several pathophysiological factors have been proposed for the development of CIN. However, the reason for the variability in CIN development among patients with similar risk factors or those exposed to equal amounts of contrast agents remains unclear (9,10).

Inflammation is known to affect the development of CIN (11). High-sensitivity C-reactive protein (hs-CRP) measures systemic inflammation and has been linked to postoperative AKI in high-risk patients (12-15). Indeed, hs-CRP can potentially be a diagnostic and therapeutic marker for CIN prediction and management (15). On the other hand, low albumin levels may be associated with the development of CIN (16). A recently introduced marker of inflammation, the CRP/ALB ratio (CAR), has been proven to be better than CRP and albumin levels in identifying inflammation conditions in cardiovascular diseases (17-19). The CAR, which has been recently proposed as a new parameter of inflammation, provides a more accurate prognosis for individuals with various inflammatory diseases, including cardiovascular diseases, sepsis, ulcerative colitis, cancer, acute pancreatitis, and hepatitis B (17,20,21).

Contrast-induced acute kidney injury is associated with prolonged hospital stays, increased complications, and mortality (22-24), and this topic has so far been reviewed in no meta-analysis study. Therefore, the present study aimed to consider the association amongst the CAR and the risk of CIN using a systematic review and meta-analysis approach.

## Materials and Methods

### *Study design*

This systematic review and meta-analysis were designed and conducted following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (25). The study protocol was registered on the PROSPERO (International Prospective Register of Systematic Reviews) website.

### *Search strategy*

The Google Scholar search engine and the Cochrane, PubMed, ProQuest, and Web of Science databases were searched by two authors until August 8, 2024, with no time limit. Keywords used in the search included Medical Subject Headings (MeSH) terms and their equivalents, namely Contrast-Induced Nephropathy, C-reactive protein, High Sensitivity C-reactive protein, hsCRP, Albumins, Albumin, and CAR. In the advanced search stage, the keywords were combined using the "AND" and "OR" Operators. A manual search was also performed by reviewing the references of the primary studies (See Supplementary file 1).

### *PICO components*

- Population: Studies evaluating the association between CAR and the risk of CIN.
- Intervention/Exposure: Increased CAR.
- Comparison: Individuals who did not develop CIN.
- Outcomes: The primary outcome was the odds ratio of the association between CAR and the risk of CIN. Secondary outcomes included the odds ratios of the associations between CRP, diabetes, hypertension, albumin, and age with the risk of CIN.

### *Inclusion and exclusion criteria*

Observational studies evaluating the association between CAR and the risk of CIN were included in the current meta-analysis. Duplicate studies, conference abstracts, non-observational studies, those of low qualitative quality, studies without full-text access, and studies lacking sufficient data for analysis were excluded from this study.

### *Quality assessment*

Two authors assessed the quality of the studies using the Newcastle-Ottawa Scale (NOS), consisting of nine questions with a total score ranging from 0 to 10, indicating the lowest and highest quality, respectively. The cut-off point for this tool was a score of 6, and high-quality studies were scored 6 or higher (26).

### *Data extraction*

The following data, namely author name, sample size, study type, year, country, age, study duration, type of disease, and the odds ratios of the associations between CAR, CRP, diabetes, hypertension, albumin, and age with the risk of CIN, along with the upper and lower limits of each, were extracted from the selected studies by two authors. The extracted data were then entered into SPSS version 19.

### *Statistical analysis*

The log OR (odds ratio) was used for each study. The studies were then combined for data analysis. The $I^2$ index was used to assess heterogeneity. A random-effects model was employed due to significant heterogeneity ($I^2$ = 87.6%). Additional analyses were conducted using meta-regression and sensitivity analysis. Data were analyzed using STATA 14 software at a significance level of $P < 0.05$ for all tests.

## Results

In the mentioned databases, 652 articles were extracted after the search. Among the titles, 319 duplicate articles were excluded from the analysis. The abstracts were screened for 333 included articles, 49 of which were excluded due to the unavailability of full texts or incomplete abstract data. Then, 93 out of 284 full-text articles were excluded due to insufficient data for the analysis. In the next stage, 186 out of 191 screened articles

were excluded for the other exclusion criteria. Finally, five articles of good quality were selected for the systematic review and meta-analysis (Figure 1).

Although the present study did not limit the search by geographical locations, all the published studies reviewed in the present study were conducted in Turkey. Out of the five analyzed investigations, two and three studies were cross-sectional and cohort research, respectively. In total, 1,442 patients were investigated in these studies, and the average participants' ages ranged from 51 to 70 years (Table 1).

As shown in Figure 2, CAR (OR: 2.11, 95% CI: 1.41, 3.14) was positively associated with CIN, with an odds ratio of 1. 19, indicating the increased risk of CIN with the increase of CAR.

The elevated levels of CRP were accompanied by a significantly increased risk of CIN (OR: 1.11, 95% CI: 1.02, 1.20). However, the analysis of the correlation between the risk of CIN and the patients' ages (OR: 1.02, 95% CI: 0.96, 1.09), albumin level (OR: 0.64, 95% CI: 0.14, 2.90), hypertension (OR: 2.12, 95% CI: 0.86, 5.21), and diabetes mellitus (OR: 0.80, 95% CI: 0.28, 2.29) did not reveal statistically significant differences (Table 2).

In the meta-regression analysis, no statistically significant relationships were detected among "CAR and CIN risk" and factors such as sample size ($P$ = 0. 583) and year of publication ($P$ = 0.378) (Figures 3 and 4).

The results of the current research were most influenced by the studies of Altiparmak et al (31) and Satilmis et al (27), as revealed by the sensitivity analysis (Figure 5).

## Discussion

The findings of this meta-analysis with 1,442 participants reveal that high levels of CAR and CRP are associated with increased CIN risk. Nevertheless, no noteworthy association was detected between albumin levels and the rates of CIN. Furthermore, no significant associations were established amongst age, hypertension, diabetes mellitus, and CIN.

In an attempt to determine the effectiveness of the CAR in the prognosis of CIN development in emergency department patients, Temel et al established that high CAR was a risk factor for increased CIN risk (OR: 2.32, 95% CI: 1.39, 3.89) (30). In a cross-sectional investigation, Satilmis et al assessed the correlation amongst the CAR and the development of CIN in individuals with non-ST-elevating myocardial infarction. The results of logistic regression analysis showed that the increase in CAR was associated with the increased risk of CIN (OR: 1.24, 95% CI: 1.10-1.39) (27). In a retrospective study, Kelesoglu et

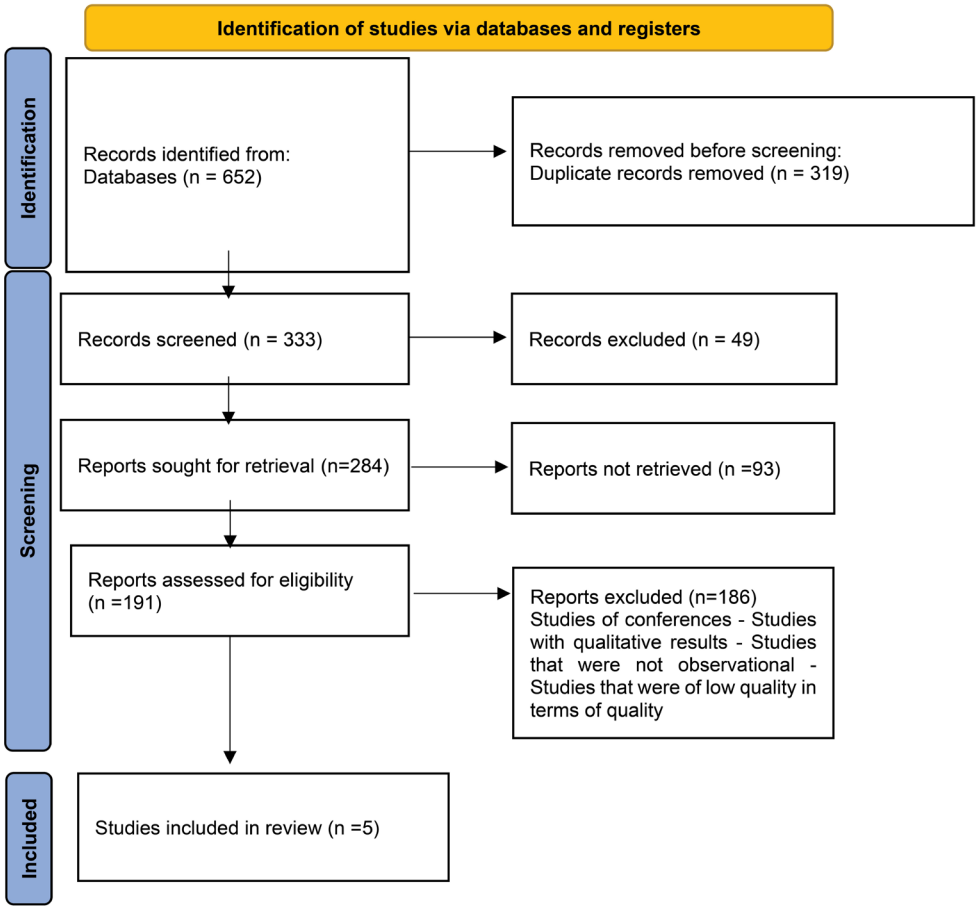


**Figure 1.** The PRISMA flowchart of study selection.

**Table 1.** Part of the information of the reviewed studies

| Name, year | Type of study | Sample size | Age (year) | Sample size in CIN group | Age in CIN group | Sample size in comparison group | Age in comparison group | Duration of study | Patients | CRP/ Albumin | CAR | Low limit | Up limit |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Satilmis S, 2020 (27) | Cross-sectional | 205 | 61.3 | 21 | 64.4 | 184 | 61 | Between Aug 1, 2015, and Aug 21, 2018 | Non-ST-elevation myocardial infarction | 8.54 | 1.24 | 1.11 | 1.39 |
| Yasar E, 2022 (28) | Cohort | 148 | NR | 26 | 67.6 | 122 | 70.4 | From Oct 2020 through Sep 2021 | Acute stroke | 0.52 | 2.84 | 1.81 | 4.47 |
| Kelesoglu S, 2024 (29) | Cohort | 410 | NR | 69 | 65 | 341 | 51 | Between Jan 2016 and Mar 2022 | Carotid artery stenosis | 2.4 | 1.77 | 1.36 | 2.29 |
| Temel TZ, 2023 (30) | Cohort | 125 | 65.96 | 112 | 65.74 | 13 | 67.85 | Between Jan 1, 2018 and Jan 1, 2021 | Emergency Department Patients | 0.02 | 2.32 | 1.39 | 3.89 |
| Altiparmak IH, 2023 (31) | Cross-sectional | 554 | NR | 87 | 59 | 467 | 56 | Between Jul 2020 and Jan 2022 | Stable angina pectoris | 0.04 | 3.71 | 2.13 | 6.46 |

NR: Not reported; CRP: C-reactive protein; CAR: CRP/Albumin.

**Table 2.** Association between secondary outcomes and risk of contrast-induced nephropathy

| Variables | OR | Low limit | Up limit | $I^2$ (%) | *P* value |
|---|---|---|---|---|---|
| CRP | 1.11 | 1.02 | 1.20 | 53.6 | 0.142 |
| Age | 1.02 | 0.96 | 1.09 | 91.9 | <0.001 |
| Albumin | 0.64 | 0.14 | 2.90 | 0 | - |
| Hypertension | 2.12 | 0.86 | 5.21 | 51.2 | 0.152 |
| Diabetes mellitus | 0.80 | 0.28 | 2.29 | 68.2 | 0.043 |

al investigated the relationship between the CAR/ and the development of CIN after carotid angiography. The authors found higher neutrophil-to-lymphocyte ratios (OR: 1.098, 95% CI: 1.051, 1.148), higher hs-CRP (OR: 1.166, 95% CI: 1.094, 1.243), and higher CAR (OR: 1.786, 95% CI: 1.415, 2.254) in patients with CIN than in those without CIN (29). The results of these studies are similar to the current study, confirming that increased levels of CAR can act as a risk factor and a prognosis factor for the progression of CIN. It might be possible to prevent CIN and decrease the burden of the disease by evaluating and regulating CAR levels.

Aksoy et al sought to evaluate the relationship between the CAR and new-onset atrial fibrillation (AFib) after coronary artery bypass grafting (CABG). They found that CAR was a risk factor for AFib after CABG (OR: 1.82, 95% CI: 1.53, 2.16) (32). In a prospective cohort study with 62,067 participants, Yang et al assessed the relationship between the Hs-CAR - and cardiovascular disease risk. The authors found that high CAR levels could enhance the risk

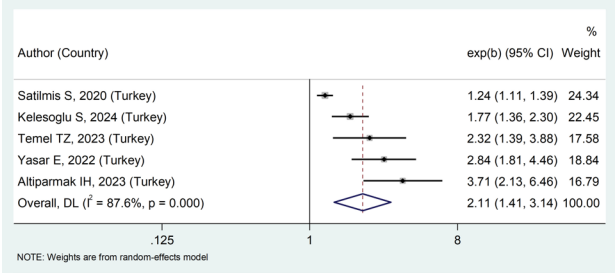


**Figure 2.** Forest plot of the relationship between CAR and the risk of contrast-induced nephropathy, with its 95% confidence interval.

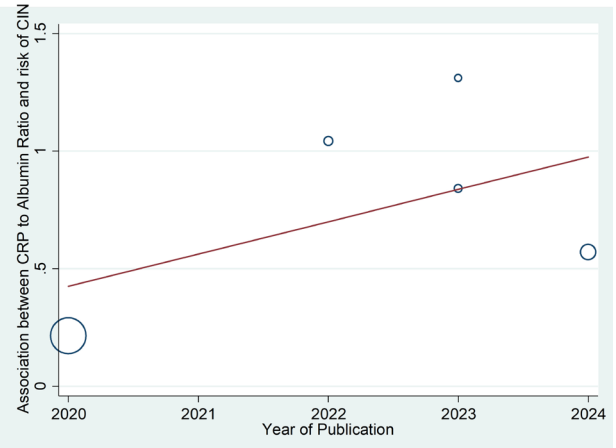


**Figure 3.** Meta-regression plot of the association among CAR and the risk of contrast-induced nephropathy with the year of publication of the studies.

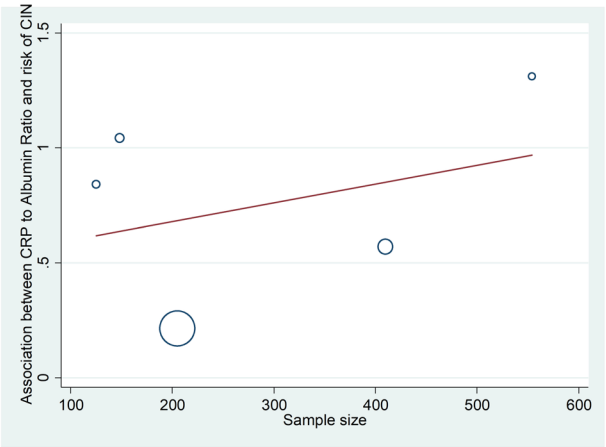


**Figure 4.** Meta-regression plot of the relationship between CAR and the risk of contrast-induced nephropathy with the sample size.

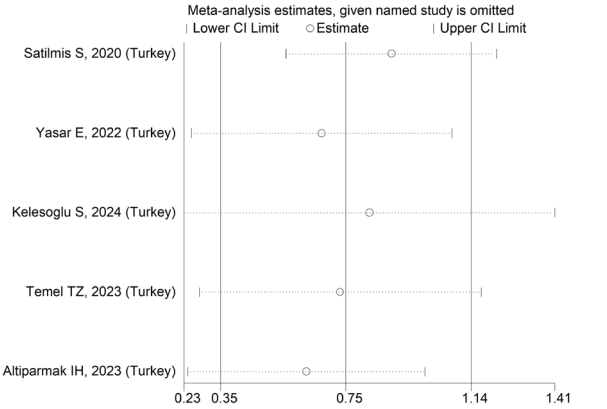


**Figure 5.** Plot of sensitivity analysis.

of cardiovascular diseases and the prognosis performance of CAR for cardiovascular diseases (HR: 1.26, 95% CI: 1.15, 1.38) was better than hs-CRP or albumin alone (33). These studies indicate that CAR is not only a prognosis for CIN development but also a risk factor predictor for other diseases, including cardiovascular diseases and AFib. Hence, the measurement of CAR levels is an important determinant for the prognosis and management of diseases such as CIN, which will lower hospital expenses caused by such diseases. Similar to the findings of Yang et al, the present study demonstrated that CAR had better predictive accuracy than CRP or albumin alone because no relationship was detected between albumin levels and CIN incidence.

In a previous meta-analysis, Wu et al evidenced that a high pretreatment CAR was significantly linked to lower overall survival (HR: 2.21, 95% CI: 1.86, 2.62) and progression-free survival (HR: 1.85, 95% CI: 1.36, 2.52) in patients with urological cancers (34). In a meta-analysis, Utsumi et al reported that the preoperative CAR/was inversely associated with overall survival (HR: 2.44, 95% CI: 1.98, 2.90) and recurrence-free survival (HR: 2.73, 95% CI: 2.01, 3.70) in patients with biliary tract cancers (35). In a recent meta-analysis by Xu et al, high pretreatment CAR was significantly higher in patients with malignancies, which was a predictor of poor overall survival (HR: 1.99, 95% CI: 1.65, 2.40) (36). In their meta-analysis designed to assess the ability of CAR as a predictor of renal cell carcinoma outcomes, Zhou et al concluded that high pre-treatment CAR was inversely correlated with overall survival (HR: 2.14, 95% CI: 1.64, 2.79) and progression-free survival (HR: 1.75, 95% CI: 1.31, 2.35) (37). Similar to the present study, the reviewed meta-analysis studies support our conclusions, suggesting that high CAR levels are a risk factor for cancer patients' survival, decreasing their lifespan.

## Conclusion

CAR and CRP are proteins that raise CIN risk, hence, their value can be expended to diagnose the condition. However, the correlation between the albumin levels and the incidence of CIN was not statistically significant. Therefore, increased levels of CAR and CRP can be regarded as significant risk factors for contrast-induced acute kidney injury prediction in patients with type 2 diabetes. Specifically, CAR levels are elevated in patients with CIN than in those with CRP only, suggesting that CAR is a serious risk factor for CIN.

## Limitations of the study

A limitation of this study was that all the published studies were conducted in Turkey, although no geographical constraints were used during the search process. Additionally, the number of female and male participants was not reported in the reviewed studies; hence, the relationship between the CAR and CIN risk was not assessed separately for male and female patients. Because the present analysis was based on a few studies, the authors were not able to carry out a subgroup analysis.

## Acknowledgments

The authors would like to thanks Yassamin Rabiei and Mohsen Abdi for guidance and editing of manuscript registration on the PROSPERO website.

## Ethical issues

This study has been compiled based on the PRISMA checklist, and its protocol was registered on the PROSPERO website (ID: CRD42024580053) and Research Registry website with (Unique Identifying Number (UIN) reviewregistry1874). Besides, ethical issues (including plagiarism, data fabrication, double publication) have been completely observed by the author.

## Authors' contribution

**Conceptualization:** Sam Mirfendereski, Ali Hasanpour Dehkordi.
**Data curation:** Sam Mirfendereski, Mahdieh Ahmadnia.
**Formal analysis:** All authors.

**Investigation:** All authors.
**Methodology:** Mahdieh Ahmadnia.
**Resources:** Mahdieh Ahmadnia
**Supervision:** All authors.
**Validation:** All authors.
**Visualization:** All authors.
**Writing–original draft:** All authors.
**Writing–review & editing:** Sam Mirfendereski, Ali Hasanpour Dehkordi.

## Conflicts of interest

The authors declare that they have no competing interests.

## Funding/Support

None.

## Supplementary files

Supplementary file 1 contains search strategy in databases.

## References

1. Porter GA. Contrast-associated nephropathy. Am J Cardiol. 1989;64:22E-26E. doi: 10.1016/0002-9149(89)90730-3.
2. Heyman SN, Reichman J, Brezis M. Pathophysiology of radiocontrast nephropathy: a role for medullary hypoxia. Invest Radiol. 1999;34:685-91. doi: 10.1097/00004424-199911000-00004.
3. Rundback JH, Nahl D, Yoo V. Contrast-induced nephropathy. J Vasc Surg. 2011;54:575-9. doi: 10.1016/j.jvs.2011.04.047.
4. Zhang F, Lu Z, Wang F. Advances in the pathogenesis and prevention of contrast-induced nephropathy. Life Sci. 2020;259:118379. doi: 10.1016/j.lfs.2020.118379.
5. Sůva M, Kala P, Poloczek M, Kaňovský J, Štípal R, Radvan M, et al. Contrast-induced acute kidney injury and its contemporary prevention. Front Cardiovasc Med. 2022;9:1073072. doi: 10.3389/fcvm.2022.1073072.
6. Koch C, Chaudru S, Lederlin M, Jaquinandi V, Kaladji A, Mahé G. Remote ischemic preconditioning and contrast-induced nephropathy: a systematic review. Ann Vasc Surg. 2016;32:176-87. doi: 10.1016/j.avsg.2015.10.017.
7. Shams E, Mayrovitz HN. Contrast-Induced Nephropathy: A Review of Mechanisms and Risks. Cureus. 2021;13:e14842. doi: 10.7759/cureus.14842.
8. Zhang J, Li J, Huang J. Network meta-analysis of four Chinese patent medicines combined with angiotensin converting enzyme inhibitors or angiotensin receptor blockers in early diabetic nephropathy treatment. World J Tradit Chin Med. 2020;6:51-60.
9. James MT, Samuel SM, Manning MA, Tonelli M, Ghali WA, Faris P, et al. Contrast-induced acute kidney injury and risk of adverse clinical outcomes after coronary angiography: a systematic review and meta-analysis. Circ Cardiovasc Interv. 2013;6:37-43. doi: 10.1161/CIRCINTERVENTIONS.112.974493.
10. Caiazza A, Russo L, Sabbatini M, Russo D. Hemodynamic and tubular changes induced by contrast media. Biomed Res Int. 2014;2014:578974. doi: 10.1155/2014/578974.
11. Kwasa EA, Vinayak S, Armstrong R. The role of inflammation in contrast-induced nephropathy. Br J Radiol. 2014;87:20130738. doi: 10.1259/bjr.20130738.
12. Ridker PM. A Test in context: high-sensitivity C-reactive protein. J Am Coll Cardiol. 2016;67:712-723. doi: 10.1016/j.jacc.2015.11.037.
13. Gao F, Zhou YJ, Zhu X, Wang ZJ, Yang SW, Shen H. C-reactive protein and the risk of contrast-induced acute kidney injury in patients undergoing percutaneous coronary intervention. Am J Nephrol. 2011;34:203-10. doi: 10.1159/000329534.
14. Jian-Wei Z, Yu-Jie Z, Shu-Jun C, Qing Y, Shi-Wei Y, Bin N. Impact of preprocedural high-sensitivity C-reactive protein on contrast-induced nephropathy in patients undergoing primary percutaneous coronary intervention. Angiology. 2014;65:402-7. doi: 10.1177/0003319713482177.
15. Liu Y, Tan N, Zhou YL, Chen YY, Chen JY, Chen J, et al. High-sensitivity C-reactive protein predicts contrast-induced nephropathy after primary percutaneous coronary intervention. J Nephrol. 2012;25:332-40. doi: 10.5301/jn.5000007.
16. Murat SN, Kurtul A, Yarlioglues M. Impact of serum albumin levels on contrast-induced acute kidney injury in patients with acute coronary syndromes treated with percutaneous coronary intervention. Angiology. 2015;66:732-7. doi: 10.1177/0003319714551979.
17. Çalık AN, İnan D, Karataş MB, Akdeniz E, Genç D, Çanga Y, et al. The association of preprocedural C-reactive protein/albumin ratio with in-stent restenosis in patients undergoing iliac artery stenting. J Cardiovasc Thorac Res. 2020;12:179-184. doi: 10.34172/jcvtr.2020.31.
18. Kalyoncuoglu M, Durmus G. Relationship between C-reactive protein-to-albumin ratio and the extent of coronary artery disease in patients with non-ST-elevated myocardial infarction. Coron Artery Dis. 2020;31:130-136. doi: 10.1097/MCA.0000000000000768.
19. Çınar T, Çağdaş M, Rencüzoğulları İ, Karakoyun S, Karabağ Y, Yesin M, et al. Prognostic efficacy of C-reactive protein/albumin ratio in ST elevation myocardial infarction. Scand Cardiovasc J. 2019;53:83-90. doi: 10.1080/14017431.2019.1590628.
20. Kelesoglu S, Yilmaz Y, Elcık D, Çetınkaya Z, Inanc MT, Dogan A, et al. Systemic immune inflammation index: a novel predictor of contrast-induced nephropathy in patients with non-ST segment elevation myocardial infarction. Angiology. 2021;72:889-895. doi: 10.1177/00033197211007738.
21. Söğüt Ö, Akdemir T, Can MM. Prognostic value of the C-reactive protein to albumin ratio in patients undergoing primary percutaneous coronary intervention for ST-segment elevation myocardial infarction. Turk J Med Sci. 2021;51:1281-1288. doi: 10.3906/sag-2003-188.
22. Lucreziotti S, Centola M, Salerno-Uriarte D, Ponticelli G, Battezzati PM, Castini D, et al. Female gender and contrast-induced nephropathy in primary percutaneous intervention for ST-segment elevation myocardial infarction. Int J Cardiol. 2014;174:37-42. doi: 10.1016/j.ijcard.2014.03.087.
23. Barbieri L, Verdoia M, Nardin M, Marino P, Suryapranata H, De Luca G; Novara Atherosclerosis Study Group (NAS). Gender Difference in the Risk of Contrast-Induced Nephropathy in Patients Undergoing Coronary Angiography or Percutaneous Coronary Intervention. Angiology.

2017;68:542-546. doi: 10.1177/0003319716669429.
24. He H, Chen XR, Chen YQ, Niu TS, Liao YM. Prevalence and Predictors of Contrast-Induced Nephropathy (CIN) in Patients with ST-Segment Elevation Myocardial Infarction (STEMI) Undergoing Percutaneous Coronary Intervention (PCI): A Meta-Analysis. J Interv Cardiol. 2019;2019:2750173. doi: 10.1155/2019/2750173.
25. Moher D, Shamseer L, Clarke M, Ghersi D, Liberati A, Petticrew M, et al; PRISMA-P Group. Preferred reporting items for systematic review and meta-analysis protocols (PRISMA-P) 2015 statement. Syst Rev. 2015;4:1. doi: 10.1186/2046-4053-4-1.
26. Stang A. Critical evaluation of the Newcastle-Ottawa scale for the assessment of the quality of nonrandomized studies in meta-analyses. Eur J Epidemiol. 2010;25:603e5.
27. Satilmis S, Karabulut A. Value of C-reactive protein/albumin ratio in predicting the development of contrast-induced nephropathy in patients with non-ST elevation myocardial infarction. Angiology. 2020;71:366-371. doi: 10.1177/0003319719898057.
28. Yaşar E. Predictive value of C-reactive protein/Albumïn ratio in the development of contrast-induced nephropathy in patients with acute ischemic stroke treated percutaneously. Journal of Inonu University Health Services Vocational School. 2022;10:130-9.
29. Kelesoglu S, Yilmaz Y, Elcik D, Tuncay A, Birecikliogluu F, Balci M, et al. C-Reactive Protein to Albumin Ratio as a Predictor of Contrast-Induced Nephropathy After Carotid Angiography. Angiology. 2024;75:90-97. doi: 10.1177/00033197221135950.
30. Zengin Temel T, Satilmis D, Yavuz BG, Afacan MA, Colak S. The Value of C-reactive protein/albumin ratio in the prediction of contrast-induced nephropathy in emergency department patients. Cureus. 2023;15:e39230. doi: 10.7759/cureus.39230.
31. Altıparmak IH, Tanrıverdi Z, Taşcanov MB, Güngören F, Biçer A, Fedai H, et al. C-reactive protein/albumin ratio as a novel predictor of contrast induced nephropathy in patients with stable angina pectoris. Angiology. 2023;74:189-196. doi: 10.1177/00033197221103635.
32. Aksoy F, Uysal D, Ibrişim E. Relationship between c-reactive protein/albumin ratio and new-onset atrial fibrillation after coronary artery bypass grafting. Rev Assoc Med Bras (1992). 2020;66:1070-1076. doi: 10.1590/1806-9282.66.8.1070.
33. Yang X, Yang X, Yang J, Wen X, Wu S, Cui L. High levels of high-sensitivity C reactive protein to albumin ratio can increase the risk of cardiovascular disease. J Epidemiol Community Health. 2023;77:721-727. doi: 10.1136/jech-2023-220760.
34. Wu M, Zhou Y, Chen Q, Yu Z, Gu H, Lin P, et al. Prognostic Role of Pretreatment C-Reactive Protein to Albumin Ratio in Urological Cancers: A Systematic Review and Meta-Analysis. Front Oncol. 2022 Apr 11;12:879803. doi: 10.3389/fonc.2022.879803.
35. Utsumi M, Inagaki M, Kitada K, Tokunaga N, Kondo M, Yunoki K, et al. Preoperative C-reactive protein-to-albumin ratio as a prognostic factor in biliary tract cancer: A systematic review and meta-analysis. Medicine (Baltimore). 2023;102:e33656. doi: 10.1097/MD.0000000000033656.
36. Xu HJ, Ma Y, Deng F, Ju WB, Sun XY, Wang H. The prognostic value of C-reactive protein/albumin ratio in human malignancies: an updated meta-analysis. Onco Targets Ther. 2017;10:3059-3070. doi: 10.2147/OTT.S137002.
37. Zhou W, Zhang GL. C-reactive protein to albumin ratio predicts the outcome in renal cell carcinoma: A meta-analysis. PLoS One. 2019;14:e0224266. doi: 10.1371/journal.pone.0224266.