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Insidensi dan Risiko Contrast Induced Acute Kidney Injury (CIAKI) berdasarkan Kadar Neutrophil Gelatinase-Associated Lipocalin (NGAL) Serum pada Pasien STEMI yang Menjalani Intervensi Koroner

Perkutan Primer

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DAFTAR PUSTAKA

- Abbasi, A., Nabizadeh, F., Gardeh, M., Ali, K.M., Yousefifard, M. & Hosseini, M. 2020. Discriminatory Precision of Neutrophil Gelatinase-Associated Lipocalin in Detection of Urinary Tract Infection in Children: a Systematic Review and Meta-Analysis. *Archives of Academic Emergency Medicine*, 8(1): e56.
- Alharazy, S.M., Kong, N., Saidin, R., Gafor, A.H.A., Maskon, O., Mohd, M. & Zakaria, S.Z.S. 2014. Neutrophil gelatinase-associated lipocalin as an early marker of contrast-induced nephropathy after coronary angiography. *Angiology*, 65(3): 216–223.
- Almendarez, M., Gurm, H.S., Mariani, J., Montorfano, M., Brilakis, E.S., Mehran, R. & Azzalini, L. 2019. Procedural Strategies to Reduce the Incidence of Contrast-Induced Acute Kidney Injury During Percutaneous Coronary Intervention. *JACC Cardiovasc Interv*, 12(19): 1877–1888.
- Bachorzewska-Gajewska, H., Malyszko, J., Sitniewska, E., Malyszko, J.S. & Dobrzycki, S. 2006. Neutrophil-gelatinase-associated lipocalin and renal function after percutaneous coronary interventions. *Am J Nephrol*, 26(3): 287–292.
- Bachorzewska-Gajewska, H., Poniatowski, B. & Dobrzycki, S. 2009. NGAL (neutrophil gelatinase-associated lipocalin) and L-FABP after percutaneous coronary interventions due to unstable angina in patients with normal serum creatinine. *Adv Med Sci*, 54(2): 221–224.
- Bagshaw, S.M. & Bellomo, R. 2007. Early diagnosis of acute kidney injury. *Curr Opin Critical Care*, 13(6): 638–644.
- Banai, A., Rozenfeld, K.L., Lewit, D., Merdler, I., Loewenstein, I., Banai, S. & Shacham, Y. 2021. Neutrophil gelatinase-associated lipocalin (NGAL) for the prediction of acute kidney injury in chronic kidney disease patients treated with primary percutaneous coronary intervention. *IJC Heart and Vasculature*, 32.
- Beatrice, R., Olivia, M., Cenko, E. & Bugiardini, R. 2018. STEMI: Management. *Encyclopedia of Cardiovascular Research and Medicine*: 474–488.
- Caspi, O., Habib, M., Cohen, Y., Kerner, A., Roguin, A., Abergel, E., Boulos, M., Kapeliovich, M.R., Beyar, R., Nikolsky, E. & Aronson, D. 2017. Acute Kidney Injury After Primary Angioplasty: Is Contrast-Induced Nephropathy the Culprit? *J Am Heart Assoc*, 6(6): 1–10.
- Chakraborty, S., Kaur, S., Tong, Z., Batra, S.K. & Guha, S. 2011. Neutrophil Gelatinase Associated Lipocalin : Structure , Function and Role in Human Pathogenesis. In P. F. Veas, ed. *Acute Phase Protein*. Europe: In Tech Europe, University Campus STeP Ri: 345–368.
- Chalikias, G., Drosos, I. & Tziakas, D.N. 2016. Contrast-Induced Acute Kidney Injury: An Update. *Cardiovasc Drugs Ther*, 30(2): 215–228.
- Clerico, A., Galli, C., Fortunato, A. & Ronco, C. 2012. Neutrophil gelatinase-associated lipocalin (NGAL) as biomarker of acute kidney injury: A review of the laboratory characteristics and clinical evidences. *Clin Chem Lab Med*, 50(9): 1505–1517.
- Dalal, R., Zs, B. & Js, S. 2022. Physiology , Renal Blood Flow and Filtration Pathophysiology. *NCBI Bookshelf*: 11–14.
- Devarajan, P. 2014. NGAL for the detection of acute kidney injury in the emergency room. *NIH Public Access*, 8(2): 217–219.
- Devarajan, P. 2010. Review: Neutrophil gelatinase-associated lipocalin: A troponin-like biomarker for human acute kidney injury. *Nephrology*, 15(4): 419–428.



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- Faucon, A.L., Bobrie, G. & Clément, O. 2019. Nephrotoxicity of iodinated contrast media: From pathophysiology to prevention strategies. *Eur J Radiol*, 116(March): 231–241.
- Fliser, D., Laville, M., Covic, A., Fouque, D., Vanholder, R., Juillard, L. & Van Biesen, W. 2012. A European Renal Best Practice (ERBP) position statement on the Kidney Disease Improving Global Outcomes (KDIGO) Clinical Practice Guidelines on Acute Kidney Injury: Part 1: Definitions, conservative management and contrast-induced nephropathy. *Nephrol Dial Transplant*, 27(12): 4263–4272.
- Giacoppo, D., Madhavan, M. V., Baber, U., Warren, J., Bansilal, S., Witzenbichler, B., Dangas, G.D., Kirtane, A.J., Xu, K., Kornowski, R., Brener, S.J., Génereux, P., Stone, G.W. & Mehran, R. 2015. Impact of contrast-induced acute kidney injury after percutaneous coronary intervention on short- and long-term outcomes: Pooled analysis from the HORIZONS-AMI and ACUITY trials. *Circ: Cardiovasc Interv*, 8(8): 1–9.
- Guo, L., Zhu, B., Yuan, H. & Zhao, W. 2020. Evaluation of serum neutrophil gelatinase-associated lipocalin in older patients with chronic kidney disease. *Aging Med*, 3(1): 32–39.
- Haase, M., Bellomo, R., Devarajan, P., Schlattmann, P., Haase-Fielitz, A., Bagshaw, S.M., Bogle, R., Changchun, C., Constantin, J.M., Cruz, D., Dragun, D., Frei, U., Goldstein, S.L., Koyner, J., Krawczeski, C.D., Lima, E.Q., Ling, W., Makris, K., Malyszko, J., Murray, P., Nickolas, T.L., Puntnmann, V., Ronco, C., Wagener, G., Wheeler, D.S., Xin, C., Zappitelli, M. & Zhaohui, N. 2009. Accuracy of Neutrophil Gelatinase-Associated Lipocalin (NGAL) in Diagnosis and Prognosis in Acute Kidney Injury: A Systematic Review and Meta-analysis. *Am J Kidney Dis*, 54(6): 1012–1024.
- Harselia, S. 2018. Tindakan Percutaneous Coronary Intervention Pada Pasien Stenosis Arteri Koroner. *Arsip Kardiovask. Indones*, 1: 186–191.
- Helanova, K., Spinar, J. & Parenica, J. 2014. Diagnostic and prognostic utility of Neutrophil Gelatinase-Associated Lipocalin (NGAL) in patients with cardiovascular diseases - Review. *Kidney Blood Press Res*, 39(6): 623–629.
- Hirsch, R., Dent, C., Pfriem, H., Allen, J., Iii, R.H.B., Ma, Q., Dastrala, S., Bennett, M. & Mitsnefes, M. 2007. NGAL is an early predictive biomarker of contrast-induced nephropathy in children. *Pediatr Nephrol*, (22): 2089–2095.
- Hossain, M.A., Costanzo, E., Cosentino, J., Patel, C., Qaisar, H., Singh, V., Khan, T., Cheng, J.S., Asif, A. & Vachharajani, T.J. 2018. Contrast-Induced Nephropathy : Pathophysiology , Risk Factors , and Prevention. *Saudi J Kidney Dis Transplat*, 29(1): 1–9.
- Hou, X., Liu, C., Lian, H., Xu, Z., Ma, L., Zang, X., Sun, J., Jia, K. & Cui, L. 2020. The value of neutrophil gelatinase-associated lipocalin and citrullinated alpha enolase peptide-1 antibody in diagnosis, classification, and prognosis for patients with sepsis. *Medicine*, 99(34): e21893.
- Idris, S., Ezenwaka, C., Davis, G. & Campus, A. 2020. Reference Interval for Serum Neutrophil Gelatinase-Associated Lipocalin in Apparently Healthy Caribbean Population. *Trop J Nephrol*, 15(1): 25–32.
- Jain, T., Shah, S., Shah, J., Jacobsen, G. & Khandelwal, A. 2018. Contrast-induced nephropathy in STEMI patients with and without chronic kidney disease. *Crit Pathw Cardiol*, 17(1): 25–31.
- Kabeer, M.A., Cross, J., Hamilton, G. & Rashid, S.T. 2020. Obesity as a Risk Factor for Radiographic Contrast-Induced Nephropathy. *Angiology*, 72(3): 274–278.
- Kashani, K., Cheungpasitporn, W. & Ronco, C. 2017. Biomarkers of acute kidney injury: The pathway from discovery to clinical adoption. *Clinical Chemistry and Laboratory Medicine*, 55(8): 1074–1089.



- Kellum, J.A., Lameire, N., Aspelin, P., Barsoum, R.S., Burdmann, E.A., Goldstein, S.L., Herzog, C.A., Joannidis, M., Kribben, A., Levey, A.S., MacLeod, A.M., Mehta, R.L., Murray, P.T., Naicker, S., Opal, S.M., Schaefer, F., Schetz, M. & Uchino, S. 2012. Kidney disease: Improving global outcomes (KDIGO) acute kidney injury work group. KDIGO clinical practice guideline for acute kidney injury. *Kidney Int Suppl*, 2(1): 1–138.
- Kim, S. & Joo, K.W. 2007. Electrolyte and Acid-Base Disturbances Associated with Non-Steroidal Anti-Inflammatory Drugs. *Electrolyte Blood Press*, 5: 116–125.
- Klein, L.W., Sheldon, M.W., Brinker, J., Mixon, T.A., Skelding, K., Strunk, A.O., Tommaso, C.L., Weiner, B., Bailey, S.R., Uretsky, B., Kern, M. & Laskey, W. 2009. The Use of Radiographic Contrast Media During PCI : A Focused Review A Position Statement of the Society of Cardiovascular Angiography and Interventions. *Catheter Cardiovasc Interv*, 74: 728–746.
- Kuboyama, O. & Tokunaga, T. 2016. The prevalence and prognosis of contrast-induced acute kidney injury according to the definition in patients with acute myocardial infarction who underwent primary percutaneous coronary intervention. *Clin Trials Regul*, 13(June): 29–33.
- Liao, B., Nian, W., Xi, A. & Zheng, M. 2019. Evaluation of a diagnostic test of serum neutrophil gelatinase-associated lipocalin (NGAL) and urine KIM-1 in contrast-induced nephropathy (CIN). *Med Sci Monit*, 25: 565–570.
- Liebetrau, C., Gaede, L., Doerr, O., Blumenstein, J., Rixe, J., Teichert, O., Willmer, M., Weber, M., Rolf, A., Möllmann, H., Hamm, C. & Nef, H. 2014. Neutrophil gelatinase-associated lipocalin (NGAL) for the early detection of contrast-induced nephropathy after percutaneous coronary intervention. *Scand J Clin Lab*, 74(2): 81–88.
- Liu, Z., Shang, A., Chen, Z., Yin, L. & Qi, H. 2020. Neutrophil gelatinase-associated lipocalin as an early predictor of contrast-induced nephropathy following endovascular therapy for arteriosclerosis obliterans. *Medicine*, 99(37): e21386.
- Lupu, L., Abukatash, H., Banai, A., Rozenfeld, K.L., Lewit, D., Merdler, I., Loewenstein, I., Bornstein, G., Banai, S. & Shacham, Y. 2021. Relation of baseline neutrophil gelatinase-associated lipocalin (Ngal) levels and contrast-induced nephropathy following percutaneous coronary intervention among chronic kidney disease patients. *J Clin Med*, 10(22): 1–8.
- Maioli, M., Toso, A., Gallopin, M., Leoncini, M., Tedeschi, D., Micheletti, C. & Bellandi, F. 2010. Preprocedural score for risk of contrast-induced nephropathy in elective coronary angiography and intervention. *J Cardiovasc Med*, 11(6): 444–449.
- Martling, C., Bell, M. & Ma, J. 2012. Novel biomarkers of acute kidney injury and failure : clinical applicability. *Br J Anaesth*, 109(October): 843–850.
- Maulana, R.F. 2021. Tata laksana Intervensi Koroner Perkutan Primer pada Infark Miokardium dengan Elevasi pada Segmen ST. *Jurnal Penelitian Perawat Profesional*, 3(1): 1–8.
- Mehran, R., Aymong, E.D., Nikolsky, E., Lasic, Z., Iakovou, I., Fahy, M., Mintz, G.S., Lansky, A.J., Moses, J.W., Stone, G.W., Leon, M.B. & Dangas, G. 2004. A simple risk score for prediction of contrast-induced nephropathy after percutaneous coronary intervention: Development and initial validation. *J AM Coll Cardiol*, 44(7): 1393–1399.
- Mehta, R., Kellum, J., Shah, S., Molitoris, B., Ronco, C. & Warnock, D. 2007. Acute Kidney Injury Network: report of an initiative to improve outcomes in acute kidney injury. *Crit Care*, 11(2).
- Meinel, F.G., De Cecco, C.N., Schoepf, U.J. & Katzberg, R. 2014. Contrast-induced acute



- kidney injury: Definition, epidemiology, and outcome. *Biomed Rest Int*, 2014.
- Morcos, R., Kucharik, M., Bansal, P., Al Taii, H., Manam, R., Casale, J., Khalili, H. & Maini, B. 2019. Contrast-Induced Acute Kidney Injury: Review and Practical Update. *Clin Med Insights: Cardiol*, 13(Table 1).
- Murat, S.N., Kurtul, A. & Yarlioglu, M. 2015. Impact of Serum Albumin Levels on Contrast-Induced Acute Kidney Injury in Patients with Acute Coronary Syndromes Treated with Percutaneous Coronary Intervention. *Angiology*, 66(8): 732–737.
- Nash, K., Hafeez, A. & Hou, S. 2002. Hospital-acquired renal insufficiency. *Am J Kidney Dis*, 39: 930–936.
- Novrianti, I., Wijaya, D., Mustamin, F. & Wijayanti, S. 2020. Pharmacological Therapy for ST-Segment Elevation Myocardial Infarction: A Review. *J Islam Pharm*, 5(2): 9–13.
- Nusca, A., Miglionico, M., Proscia, C., Ragni, L., Carassiti, M., Pepe, F.L. & Sciascio, G. Di. 2018. Early prediction of contrast-induced acute kidney injury by a ‘bedside’ assessment of Neutrophil Gelatinase-Associated Lipocalin during elective percutaneous coronary interventions. *PLoS ONE*, 13(5): 1–12. <http://dx.doi.org/10.1371/journal.pone.0197833>.
- Oduncu, V., Erkol, A., Karabay, C.Y., Kurt, M., Akgün, T., Bulut, M., Pala, S. & Kirma, C. 2013. The prognostic value of serum albumin levels on admission in patients with acute ST-segment elevation myocardial infarction undergoing a primary percutaneous coronary intervention. *Coron Artery Dis.*, 24(2): 88–94.
- Oweis, A.O., Alshelleh, S.A., Saadeh, N., Jarrah, M.I., Ibdah, R. & Alzoubi, K.H. 2020. Long-Term Follow-Up of Contrast-Induced Acute Kidney Injury: A Study from a Developing Country. *Int J Vasc*, 2020: 15–20.
- Ozkok, S. & Ozkok, A. 2017. Contrast-induced acute kidney injury: A review of practical points. *World J Nephrol*, 6(3): 86.
- Padhy, M., Kaushik, S., Girish, M.P., Mohapatra, S., Shah, S. & Koner, B.C. 2014. Serum neutrophil gelatinase associated lipocalin (NGAL) and cystatin C as early predictors of contrast-induced acute kidney injury in patients undergoing percutaneous coronary intervention. *Clinica Chimica Acta*, 435: 48–52. <http://dx.doi.org/10.1016/j.cca.2014.04.016>.
- Pedersen, K.R., Ravn, H.B., Hjortdal, V.E., Nørregaard, R. & Povlsen, J. V. 2010. Neutrophil Gelatinase-Associated Lipocalin (NGAL): Validation of commercially available ELISA. *Scan J Clin Lab*, 70(5): 374–382.
- Perhimpunan Dokter Spesialis Kardiovaskular Indonesia (PERKI). 2021. *PEDOMAN NASIONAL PELAYANAN KEDOKTERAN INTERVENSI KORONER PERKUTAN*.
- Quintavalle, C., Anselmi, C.V., De Micco, F., Roscigno, G., Visconti, G., Golia, B., Focaccio, A., Ricciardelli, B., Perna, E., Papa, L., Donnarumma, E., Condorelli, G. & Briguori, C. 2015. Neutrophil gelatinase-associated lipocalin and contrast-induced acute kidney injury. *Circ Cardiovasc Interv*, 8(9): 1–11.
- Rear, R., Bell, R.M. & Hausenloy, D.J. 2016. Contrast-induced nephropathy following angiography and cardiac interventions. *Heart*, 102(8): 638–648.
- Ronco, F., Tarantini, G. & McCullough, P.A. 2020. Contrast induced acute kidney injury in interventional cardiology: An update and key guidance for clinicians. *Rev Cardiovasc Med*, 21(1): 9–23.
- Sahu, A.K., Goel, P.K., Khanna, R., Kumar, S., Kapoor, A., Tewari, S. & Garg, N. 2022. Neutrophil Gelatinase-Associated Lipocalin as a Marker for Contrast-Induced Nephropathy in Patients Undergoing Percutaneous Coronary Intervention: A Prospective Observational Analysis. *Indian J Nephrol*, 31: 247–255.
- Schiffl, H. & Lang, S.M. 2012. Update on Biomarkers of Acute Kidney Injury. *Mol Diagn*



- Ther*, 16(4): 199–207.
- Sendeski, M.M. 2011. Pathophysiology of renal tissue damage by iodinated contrast media. *Clinical and Experimental Pharmacology and Physiology*, 38(5): 292–299.
- Shah, R., Le, F.K., Labroo, A. & Khan, M.R. 2020. Contrast-associated acute kidney injury. *Quant Imaging Med Surg*, 10(4): 891–894.
- Shaker, O., el-Shehaby, A. & el-Khatib, M. 2010. Early Diagnostic Markers for Contrast Nephropathy in Patients Undergoing Coronary Angiography. *Angiology*, 61(8): 731–736.
- Silvain, J., Nguyen, L.S., Spagnoli, V., Kerneis, M., Guedeney, P., Vignolles, N., Cosker, K., Barthelemy, O., Le Feuvre, C., Helft, G., Collet, J.P. & Montalescot, G. 2018. Contrast-induced acute kidney injury and mortality in ST elevation myocardial infarction treated with primary percutaneous coronary intervention. *Heart*, 104(9): 767–772.
- Solomon, R. & Dauerman, H.L. 2010. Contrast-induced acute kidney injury. *Circulation*, 122(23): 2451–2455.
- Stacul, F., Van Der Molen, A.J., Reimer, P., Webb, J.A.W., Thomsen, H.S., Morcos, S.K., Almén, T., Aspelin, P., Bellin, M.F., Clement, O. & Heinz-Peer, G. 2011. Contrast induced nephropathy: Updated ESUR Contrast Media Safety Committee guidelines. *Eur Radiol*, 21(12): 2527–2541.
- Syadiah, A.R., Febrina, E. & Levita, J. 2021. Review Neutrophil Gelatinase-Associated Lipocalin (NGAL): Perannya sebagai Biomarker pada Kerusakan Ginjal Akut. *J Sains Farm Klin*, 8(1): 35.
- Tehrani, S., Laing, C., Yellon, D.M. & Hausenloy, D.J. 2013. Contrast-induced acute kidney injury following PCI. *Eur J Clin Invest*, 43(5): 483–490.
- Tsai, T.T., Patel, U.D., Chang, T.I., Kennedy, K.F., Masoudi, F.A., Matheny, M.E., Kasiborod, M. & Amin, A.P. 2014. Contemporary Incidence, Predictors, and Outcomes of Acute Kidney Injury in Patients Undergoing Percutaneous Coronary Interventions. *JACC Cardiovasc Interv*, 7(1): 1–9.
- Turner, N.N., Lameire, N., Goldsmith, D.J., Winearls, C.G., Himmelfarb, J. & Remuzzi, G. 2016. *Clinical Nephrology*. Fourth. United States of America: Oxford University Press.
- Valero, E., Rodriguez, J.C., Moyano, P., Minana, G., Sanchis, J. & Nunez, J. 2016. Role of Neutrophil Gelatinase-associated Lipocalin in the Detection of Contrast-induced Nephropathy in Patients Undergoing a Coronary Angiography. *Rev Esp Cardiol*, 69(5): 520–530.
- Vogel, B., Claessen, B.E., Arnold, S. V., Chan, D., Cohen, D.J., Giannitsis, E., Gibson, C.M., Goto, S., Katus, H.A., Kerneis, M., Kimura, T., Kunadian, V., Pinto, D.S., Shiomi, H., Spertus, J.A., Steg, P.G. & Mehran, R. 2019. ST-segment elevation myocardial infarction. *Nat Rev Dis Primers*, 5(1): 1–20.
- Waikar, S. & Bonventre, J. 2009. Creatinine kinetics and the definition of acute kidney injury. *J Am Soc Nephrol*, 3: 672–679.
- Wessely, R., Kopparla, T., Bradaric, C., Vorpahl, M., Braun, S., Schulz, S., Mehilli, J. & Scho, A. 2009. Choice of Contrast Medium in Patients With Impaired Coronary Intervention. *Circ Cardiovasc Interv*, 2: 430–437.
- Xiang, D., Zhang, H., Bai, J., Ma, J., Li, M., Gao, W., Zhang, X., Gao, J. & Wang, C. 2013. Particle-enhanced turbidimetric immunoassay for determination of serum neutrophil gelatinase-associated lipocalin on the Roche Cobas c501 analyzer. *Clin Biochem*, 46(16–17): 1756–1760.
- Yang, Y., George, K.C., Luo, R., Cheng, Y., Shang, W., Ge, S. & Xu, G. 2018. Contrast-induced acute kidney injury and adverse clinical outcomes risk in acute coronary



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syndrome patients undergoing percutaneous coronary intervention: A meta-analysis.
BMC Nephrol, 19(1): 1–10.

Yim, H.E. 2015. Neutrophil Gelatinase-Associated Lipocalin and Kidney Diseases. *J Korean Soc Pediatr Nephrol*, 0242: 79–88.

Zdziechowska, M., Gluba-Brzózka, A., Poliwczał, A.R., Franczyk, B., Kidawa, M., Zielinska, M. & Rysz, J. 2020. Serum NGAL, KIM-1, IL-18, L-FABP: new biomarkers in the diagnostics of acute kidney injury (AKI) following invasive cardiology procedures. *Int Urol Nephrol*, 52(11): 2135–2143.