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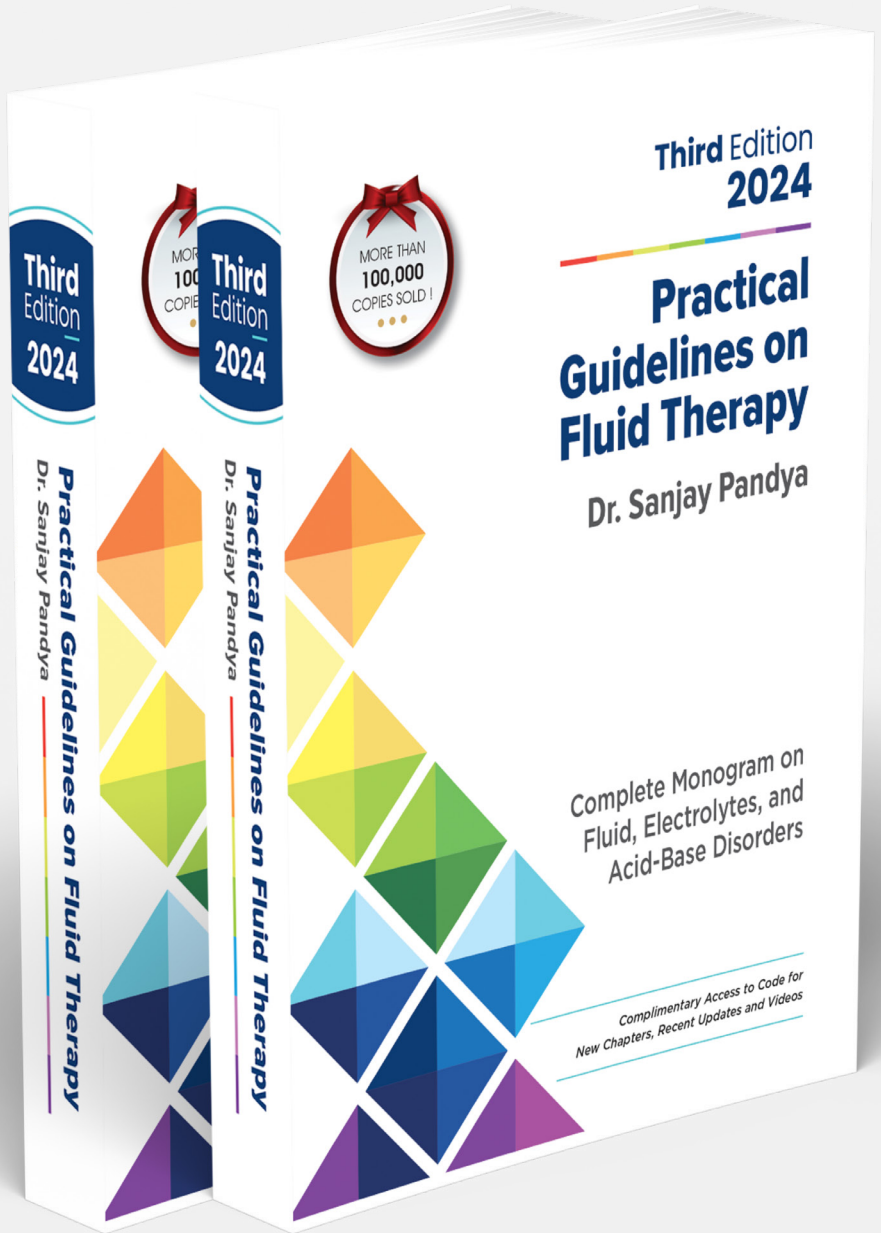
Chapter 37:
Hepatorenal Syndrome



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37 Hepatorenal Syndrome

Kidney failure is the most frequent organ failure in patients with acute or chronic liver disease, with a frequency of 20–50% in hospitalized cirrhotic patients [1–3].

Hepatorenal syndrome (HRS) is a life-threatening complication and one of many causes of acute kidney injury in patients with acute or chronic liver disease. HRS frequently occurs in hospitalized patients and is associated with a high mortality rate (about 32 to 37%) [4–6], readmission rate (about 23%) [5], hospital and health care costs [6, 7], and longer stay in hospital [4].

The most common precipitating factors of HRS are gastrointestinal bleeding, large volume paracentesis, diuretics, non-steroidal anti-inflammatory drugs (NSAIDs), spontaneous bacterial peritonitis, and other infections [5, 8].

DEFINITIONS AND TYPES OF HEPATORENAL SYNDROME

Hepatorenal syndrome is a specific cause of acute kidney injury (AKI) frequently encountered in advanced cirrhosis characterized by rapidly progressive renal failure, which occurs without apparent pathologic abnormalities in the kidneys [9].

Hepatorenal syndrome is traditionally classified into Type 1 and Type 2 HRS based on the severity of diseases reflected by the rapidity of decline in kidney function [10]. Type 1 (HRS-1) is a serious form of AKI that occurs in advanced cirrhosis with ascites.

Type 1 HRS is characterized by a rapid and progressive reduction in renal function (a 2-fold increase of serum

creatinine to at least 2.5 mg/dL or a decrease of creatinine clearance by 50% to less than 20 mL/min within 2 weeks) [11], and has a poor prognosis (median survival only 8 to 12 weeks) [12]. Type 2 HRS is a less severe form of kidney function impairment that is slowly progressive and clinically characterized by ascites resistant to diuretics [11] and has a median survival of about 6 months [12].

REFERENCE

1. Garcia-Tsao G, Parikh CR, Viola A. Acute kidney injury in cirrhosis. Hepatology. 2008;48(6):2064–77.
2. Tandon P, James M, Abraldes J, et al. Relevance of New Definitions to Incidence and Prognosis of Acute Kidney Injury in Hospitalized Patients with Cirrhosis: A Retrospective Population-Based Cohort Study. PLoS One 2016;11(8):e0160394.
3. Bajaj JS, O'Leary JG, Lai JC, et al. Acute-on-Chronic Liver Failure Clinical Guidelines. Am J Gastroenterol. 2022;117(2):225–252.
4. Pant C, Jani BS, Desai M, et al. Hepatorenal syndrome in hospitalized patients with chronic liver disease: results from the Nationwide Inpatient Sample 2002–2012. J Investig Med 2016;64(1):33–38.
5. Jamil K, Huang X, Hayashida D, et al. The Hepatorenal Syndrome Patient Pathway: Retrospective Analysis of Electronic Health Records. Curr Ther Res Clin Exp. 2022;96:100663.
6. Jamil K, Huang X, Lovelace B, et al. The burden of illness of hepatorenal syndrome (HRS) in the United States: a retrospective analysis of electronic health records. J Med Econ. 2019;22(5):421–429.
7. Rice JP, Skagen C, Said A. Liver transplant outcomes for patients with hepatorenal syndrome treated with pretransplant vasoconstrictors and albumin. Transplantation, 2011;91(10):1141–7.
8. Low G, Alexander GJ, Lomas DJ. Hepatorenal syndrome: aetiology, diagnosis, and treatment. Gastroenterol Res Pract. 2015;2015:207012.
9. Durand F, Graupera I, Ginès P, et al. Pathogenesis of hepatorenal syndrome: implications for therapy. Am J Kidney Dis 2016;67(2):318–328.
10. Arroyo V. New treatments for hepatorenal syndrome. Liver Transplantation. 2000;6(3):287–289.
11. Arroyo V, Gines P, Gerbes AL, et al. Definition and diagnostic criteria of refractory ascites and hepatorenal syndrome in cirrhosis. International Ascites Club. Hepatology 1996;23(1):164–176.
12. Ng CK, Chan MH, Tai MH, et al. Hepatorenal syndrome. Clin Biochem Rev. 2007;28(1):11–17.
13. Angeli P, Garcia-Tsao G, Nadim MK, et al. News in pathophysiology, definition and classification of hepatorenal syndrome: A step beyond the International Club of Ascites (ICA) consensus document. J Hepatol. 2019;71(4):811–822.
14. European Association for the Study of the Liver. EASL Clinical Practice Guidelines for the management of patients with decompensated cirrhosis. J Hepatol. 2018;69(2):406–60.
15. Angeli P, Garcia-Tsao G, Nadim MK, et al. News in pathophysiology, definition and classification of hepatorenal syndrome: a step beyond the International Club of Ascites (ICA) consensus document. J Hepatol 2019;71(4):811–22.
16. Schrier RW, Arroyo V, Bernardi M, et al. Peripheral arteriolar vasodilation hypothesis: a proposal for the initiation of renal sodium and water retention in cirrhosis. Hepatology 1988;8(5):1151–1157.
17. Francoz C, Durand F, Kahn JA, et al. Hepatorenal Syndrome. Clin J Am Soc Nephrol. 2019;14(5):774–781.

18. Morelli MC, Rendina M, La Manna G, et al. Position paper on liver and kidney diseases from the Italian Association for the Study of Liver (AISF), in collaboration with the Italian Society of Nephrology (SIN). Dig Liver Dis. 2021;53(Suppl 2):S49–S86.
19. Neong SF, Adebayo D, Wong F. An update on the pathogenesis and clinical management of cirrhosis with refractory ascites. Expert Rev Gastroenterol Hepatol 2019;13(4):293–305.
20. Krag A, Bendtsen F, Henriksen JH, et al. Low cardiac output predicts development of hepatorenal syndrome and survival in patients with cirrhosis and ascites. Gut. 2010;59(1):105–10.
21. Kazory A, Ronco C. Hepatorenal Syndrome or Hepatocardiorenal Syndrome: Revisiting Basic Concepts in View of Emerging Data. Cardiorenal Med. 2019;9(1):1–7.
22. Albillos A, Lario M, Alvarez-Mon M. Cirrhosis-associated immune dysfunction: distinctive features and clinical relevance. J Hepatol 2014;61(6):1385–1396.
23. Bernardi M, Moreau R, Angeli P, et al. Mechanisms of decompensation and organ failure in cirrhosis: From peripheral arterial vasodilation to systemic inflammation hypothesis. J Hepatol 2015;63(5):1272–84.
24. Arroyo V, Angeli P, Moreau R, et al. The systemic inflammation hypothesis: towards a new paradigm of acute decompensation and multiorgan failure in cirrhosis. J Hepatol 2021;74(3):670–685.
25. Terra C, Mattos ÂZ, Pereira G, et al. Recommendations of the Brazilian society of hepatology for the management of acute kidney injury in patients with cirrhosis. Arq Gastroenterol. 2018;55(3):314–320.
26. Velez JCQ, Therapondos G, Juncos LA. Reappraising the spectrum of AKI and hepatorenal syndrome in patients with cirrhosis. Nat Rev Nephrol 2020;16(3):137–155.
27. Ginès P, Schrier RW. Renal failure in cirrhosis. N Engl J Med 2009;361(13):1279–1290.
28. Ginès P, Solà E, Angeli P, et al. Hepatorenal syndrome. Nat Rev Dis Primers 2018;4(1):23.
29. Velez JCQ. Hepatorenal Syndrome Type 1: From Diagnosis Ascertainment to Goal-Oriented Pharmacologic Therapy. Kidney360. 2021;3(2):382–395.
30. Biggins SW, Angeli P, Garcia-Tsao G, et al. Diagnosis, Evaluation, and Management of Ascites, Spontaneous Bacterial Peritonitis and Hepatorenal Syndrome: 2021 Practice Guidance by the American Association for the Study of Liver Diseases. Hepatology. 2021;74(2):1014–1048.
31. Pozzoli S, Simonini M, Manunta P. Predicting acute kidney injury: current status and future challenges. J Nephrol. 2018;31(2):209–223.
32. Lee HA, Seo YS. Current knowledge about biomarkers of acute kidney injury in liver cirrhosis. Clin Mol Hepatol. 2022;28(1):31–46.
33. Salerno F, Navickis RJ, Wilkes MM. Albumin infusion improves outcomes of patients with spontaneous bacterial peritonitis: a meta-analysis of randomized trials. Clin Gastroenterol Hepatol 2013;11(2):123–30.e1.
34. Sort P, Navasa M, Arroyo V, et al. Effect of intravenous albumin on renal impairment and mortality in patients with cirrhosis and spontaneous bacterial peritonitis. N Engl J Med 1999;341(6):403–9.
35. Salerno F, Gerbes A, Ginès P, et al. Diagnosis, prevention and treatment of hepatorenal syndrome in cirrhosis. Gut. 2007;56(9):1310–8.
36. Bernardi M, Caraceni P, Navickis RJ, et al. Albumin infusion in patients undergoing large-volume paracentesis: a meta-analysis of randomized trials. Hepatology. 2012;55(4):1172–81.
37. Bernardi M, Angeli P, Claria J, et al. Albumin in decompensated cirrhosis: new concepts and perspectives. Gut 2020;69(8):1127–38.
38. Fernández J, Navasa M, Planas R, et al. Primary prophylaxis of spontaneous bacterial peritonitis delays hepatorenal syndrome and improves survival in cirrhosis. Gastroenterology 2007;133(3):818–24.
39. Dong T, Aronsohn A, Gautham Reddy K, et al. Rifaximin decreases the incidence and severity of acute kidney injury and hepatorenal syndrome in cirrhosis. Dig Dis Sci 2016;61(12):3621–6.
40. Flamm SL, Mullen KD, Heimanson Z, et al. Rifaximin has the potential to prevent complications of cirrhosis. Therap Adv Gastroenterol 2018;11:175628481880030.
41. Akriviadis E, Botla R, Briggs W, et al. Pentoxifylline improves short-term survival in severe acute alcoholic hepatitis: a double-blind, placebo-controlled trial. Gastroenterology. 2000;119(6):1637–1648.
42. Tyagi P, Sharma P, Sharma BC, et al. Prevention of hepatorenal syndrome in patients with cirrhosis and ascites: a pilot randomized control trial between pentoxifylline and placebo. Eur J Gastroenterol Hepatol 2011;23(3):210–217.
43. Ozturk H, Cetinkaya A, Firat TS, et al. Protective effect of pentoxifylline on oxidative renal cell injury associated with renal crystal formation in a hyperoxaluric rat model. Urolithiasis 2019;47(5):415–424.
44. Lee YS, Kim HJ, Kim JH, et al. Treatment of severe alcoholic hepatitis with corticosteroid, pentoxifylline, or dual therapy: a systematic review and meta-analysis. J Clin Gastroenterol. 2017;51(4):364–377.
45. Whitfield K, Rambaldi A, Wetterslev J, et al. Pentoxifylline for alcoholic hepatitis. Cochrane Database Syst Rev 2009;2009(4):CD007339.
46. Stine JG, Wang J, Cornella SL, et al. Treatment of Type-1 hepatorenal syndrome with pentoxifylline: a randomized placebo controlled clinical trial. Ann Hepatol 2018;17(2):300–6.
47. Tariq R, Singal AK. Management of Hepatorenal Syndrome: A Review. J Clin Transl Hepatol. 2020;8(2):192–199.
48. Velez JC, Nietert PJ. Therapeutic response to vasoconstrictors in hepatorenal syndrome parallels increase in mean arterial pressure: a pooled analysis of clinical trials. Am J Kidney Dis. 2011;58(6):928–38.
49. Velez JC, Kadian M, Taburyanskaya M, et al. Hepatorenal Acute Kidney Injury and the Impor-

tance of Raising Mean Arterial Pressure. Nephron. 2015;131(3):191–201.

50. Russ KB, Stevens TM, Singal AK. Acute Kidney Injury in Patients with Cirrhosis. J Clin Transl Hepatol. 2015;3(3):195–204.
51. Velasco JAVR, García-Jiménez ES, Aldana-Ledesma JM, et al. Evaluation and management of emergencies in the patient with cirrhosis Rev Gastroenterol Méx. 2022;87(2):198–215.
52. Cullaro G, Kanduri SR, Velez JCQ. Acute Kidney Injury in Patients with Liver Disease. Clin J Am Soc Nephrol. 2022:CJN.03040322.
53. Piano S, Angeli P. Dopamine and Furosemide for the Treatment of Hepatorenal Syndrome: A Reappraisal or Just Smoke and Mirrors? J Clin Exp Hepatol. 2015;5(4):273–5.
54. Dundar HZ, Yılmazlar T. Management of hepatorenal syndrome. World J Nephrol. 2015;4(2):277–86.
55. Leao GS, Neto GJ, Jotz RF, et al. Albumin for cirrhotic patients with extraperitoneal infections: a meta-analysis. J Gastroenterol Hepatol. 2019;34(12):2071–2076.
56. Zaccherini G, Tufoni M, Bernardi M. Albumin administration is efficacious in the management of patients with cirrhosis: a systematic review of the literature. Hepat Med 2020;12:153–72.
57. Aithal GP, Palaniyappan N, China L, et al. Guidelines on the management of ascites in cirrhosis. Gut. 2021;70(1):9–29.
58. Tufoni M, Zaccherini G, Caraceni P, et al. Albumin: Indications in chronic liver disease. United European Gastroenterol J. 2020;8(5):528–535.
59. Valerio C, Theocharidou E, Davenport A, et al. Human albumin solution for patients with cirrhosis and acute on chronic liver failure: Beyond simple volume expansion. World J Hepatol 2016;8(7):345–354.
60. Arroyo V, García-Martinez R, Salvatella X. Human serum albumin, systemic inflammation, and cirrhosis. J Hepatol. 2014;61(2):396–407.
61. Fernández J, Clària J, Amorós A, et al. Effects of albumin treatment on systemic and portal hemodynamics and systemic inflammation in patients with decompensated cirrhosis. Gastroenterology 2019;157(1):149–162.
62. Bortoluzzi A, Ceolotto G, Gola E, et al. Positive cardiac inotropic effect of albumin infusion in rodents with cirrhosis and ascites: molecular mechanisms. Hepatology 2013;57(1):266–276.
63. Garcia-Martinez R, Noiret L, Sen S, et al. Albumin infusion improves renal blood flow autoregulation in patients with acute decompensation of cirrhosis and acute kidney injury. Liver Int. 2015;35(2):335–43.
64. Aldecoa C, Llau JV, Nuvials X, et al. Role of albumin in the preservation of endothelial glycocalyx integrity and the microcirculation: a review. Ann Intensive Care. 2020;10(1):85.
65. Zhang WJ, Frei B. Albumin selectively inhibits TNF alpha-induced expression of vascular cell adhesion molecule-1 in human aortic endothelial cells. Cardiovasc Res 2002;55(4):820–9.
66. China L, Freemantle N, Forrest E, et al. A randomized trial of albumin infusions in hospitalized patients with cirrhosis. N Engl J Med. 2021;384(9):808–817.
67. Ortega R, Gines P, Uriz J, et al. Terlipressin therapy with and without albumin for patients with hepatorenal syndrome: results of a prospective, nonrandomized study. Hepatology. 2002;36(4 Pt 1):941–948.
68. Martín-Llahí M, Pépin MN, Guevara M, et al. Terlipressin and albumin vs albumin in patients with cirrhosis and hepatorenal syndrome: a randomized study. Gastroenterology 2008;134(5):1352–1359.
69. Boyer TD, Sanyal AJ, Wong F, et al. Terlipressin plus albumin is more effective than albumin alone in improving renal function in patients with cirrhosis and hepatorenal syndrome type 1. Gastroenterology 2016;150(7):1579–1589.e2.
70. Wong F, Pappas SC, Curry MP, et al. Terlipressin plus Albumin for the Treatment of Type 1 Hepatorenal Syndrome. N Engl J Med. 2021;384(9):818–828.
71. Gluud LL, Christensen K, Christensen E, et al. Systematic review of randomized trials on vasoconstrictor drugs for hepatorenal syndrome. Hepatology 2010;51(2):576–84.
72. Facciorusso A, Chandar AK, Murad MH, et al. Comparative efficacy of pharmacological strategies for management of type 1 hepatorenal syndrome: a systematic review and network meta-analysis. Lancet Gastroenterol Hepatol. 2017;2(2):94–102.
73. Arora A, Kumar A, Prasad N, et al. INASL-ISN Joint Position Statements on Management of Patients with Simultaneous Liver and Kidney Disease. J Clin Exp Hepatol. 2021;11(3):354–386.
74. Qi X, Bai Z, Zhu Q, et al. Practice guidance for the use of terlipressin for liver cirrhosis-related complications. Therap Adv Gastroenterol. 2022;15:17562848221098253.
75. Moreau R, Durand F, Poynard T, et al. Terlipressin in patients with cirrhosis and type 1 hepatorenal syndrome: a retrospective multicenter study. Gastroenterology 2002;122(4):923–930.
76. Sanyal AJ, Boyer T, Garcia-Tsao G, et al. A randomized, prospective, double-blind, placebo-controlled trial of terlipressin for type 1 hepatorenal syndrome. Gastroenterology 2008;134(5):1360–1368.
77. Sanyal AJ, Boyer TD, Frederick RT, et al. Reversal of hepatorenal syndrome type 1 with terlipressin plus albumin vs. placebo plus albumin in a pooled analysis of the OT-0401 and REVERSE randomised clinical studies. Aliment Pharmacol Ther. 2017;45(11):1390–1402.
78. Best LM, Freeman SC, Sutton AJ, et al. Treatment for hepatorenal syndrome in people with decompensated liver cirrhosis: a network meta-analysis. Cochrane Database Syst Rev. 2019;9(9):CD013103.
79. Moore K, Jamil K, Verleger K, et al. Real-world treatment patterns and outcomes using terlipressin in 203 patients with the hepatorenal syndrome. Aliment Pharmacol Ther. 2020;52(2):351–358.
80. Gifford FJ, Morling JR, Fallowfield JA. Systematic review with meta-analysis: vasoactive drugs for the

treatment of hepatorenal syndrome type 1. Aliment Pharmacol Ther 2017;45(5):593–603.

81. Allegretti AS, Israelsen M, Krag A, et al. Terlipressin versus placebo or no intervention for people with cirrhosis and hepatorenal syndrome. Cochrane Database Syst Rev 2017;6(6):CD005162.
82. Nanda A, Reddy R, Safraz H, et al. Pharmacological Therapies for Hepatorenal Syndrome: A Systematic Review and Meta-Analysis. J Clin Gastroenterol. 2018;52(4):360–367.
83. Wang L, Long Y, Li KX, et al. Pharmacological treatment of hepatorenal syndrome: a network meta-analysis. Gastroenterol Rep 2019;8(2):111–118.
84. Sridharan K, Sivaramakrishnan G. Vasoactive agents for hepatorenal syndrome: a mixed treatment comparison network meta-analysis and trial sequential analysis of randomized clinical trials. J Gen Intern Med 2018;33(1):97–102.
85. Terres AZ, Balbinot RS, Muscope ALF, et al. Evidence-based protocol for diagnosis and treatment of hepatorenal syndrome is independently associated with lower mortality. Gastroenterol Hepatol 2022;45(1):25–39.
86. Facciorusso A. Hepatorenal Syndrome Type 1: Current Challenges and Future Prospects. Ther Clin Risk Manag. 2019;15:1383–1391.
87. Cavallin M, Piano S, Romano A, et al. Terlipressin given by continuous intravenous infusion versus intravenous boluses in the treatment of hepatorenal syndrome: a randomized controlled study. Hepatol Baltim Md. 2016;63(3):983–992.
88. Piano S, Schmidt HH, Ariza X, et al. Association between grade of acute on chronic liver failure and response to terlipressin and albumin in patients with hepatorenal syndrome. Clin Gastroenterol Hepatol Off Clin Pract J Am Gastroenterol Assoc. 2018;16(11):1792–1800.e3.
89. Boyer TD, Sanyal AJ, Garcia-Tsao G, et al. Predictors of response to terlipressin plus albumin in hepatorenal syndrome (HRS) type 1: relationship of serum creatinine to hemodynamics. J Hepatol. 2011;55(2):315–321.
90. Rodríguez E, Elia C, Solà E. Terlipressin and albumin for type-1 hepatorenal syndrome associated with sepsis. J Hepatol. 2014;60(5):955–961.
91. Sarin SK, Sharma P. Terlipressin: an asset for hepatologists! Hepatology. 2011;54(2):724–8.
92. Buccheri S, Da BL. Hepatorenal Syndrome: Definitions, Diagnosis, and Management. Clin Liver Dis. 2022;26(2):181–201.
93. Pichler RH, Swenson ER, Leary PJ, et al. Terlipressin: Hopes Fulfilled or Dashed? CJASN 2022;17(1):140–142.
94. Belcher JM, Parada XV, Simonetto DA, et al. Terlipressin and the Treatment of Hepatorenal Syndrome: How the CONFIRM Trial Moves the Story Forward. Am J Kidney Dis. 2022;79(5):737–745.
95. FDA Approved Drug Products: TERLIVAZ (terlipressin) for injection, for intravenous use (https://www.accessdata.fda.gov/drugsatfda_docs/label/2022/022231s000lbl.pdf).
96. Alessandria C, Ottobrelli A, Debernardi-Venon W, et al. Noradrenalin vs terlipressin in patients with hepatorenal syndrome: a prospective, randomized, unblinded, pilot study. J Hepatol. 2007;47(4):499–505.
97. Sharma P, Kumar A, Shrama BC, et al. An open label, pilot, randomized controlled trial of noradrenaline versus terlipressin in the treatment of type 1 hepatorenal syndrome and predictors of response. Am J Gastroenterol. 2008;103(7):1689–1697.
98. Singh V, Ghosh S, Singh B, et al. Noradrenaline vs. terlipressin in the treatment of hepatorenal syndrome: a randomized study. J Hepatol 2012;56(6):1293–1298.
99. Junior APN, Farias AQ, D' Albuquerque LAC, et al. Terlipressin versus norepinephrine in the treatment of hepatorenal syndrome: a systematic review and meta-analysis. PloS One. 2014;9(9):e107466.
100. Goyal O, Sidhu SS, Sehgal N, et al. Noradrenaline is as effective as terlipressin in hepatorenal syndrome type 1: a prospective, randomized trial. J Assoc Physicians India. 2016;64(9):30–35.
101. Saif RU, Dar HA, Sofi SM, et al. Noradrenaline versus terlipressin in the management of type 1 hepatorenal syndrome: a randomized controlled study. Indian J Gastroenterol. 2018;37(5):424–429.
102. Arora V, Maiwall R, Rajan V, et al. Terlipressin is superior to noradrenaline in the management of acute kidney injury in acute on chronic liver failure. Hepatology 2020;71(2):600–610.
103. Ghosh S, Choudhary NS, Sharma AK, et al. Noradrenaline vs terlipressin in the treatment of type 2 hepatorenal syndrome: a randomized pilot study. Liver Int 2013;33(8):1187–93.
104. Subedi A, Suresh Kumar VC, Subedi AS, et al. A Review of Hepatorenal Syndrome. Cureus. 2021;13(7):e16084.
105. Bera C, Wong F. Management of hepatorenal syndrome in liver cirrhosis: a recent update. Therap Adv Gastroenterol. 2022;15:17562848221102679.
106. Gupta K, Rani P, Rohatgi A, et al. Noradrenaline for reverting hepatorenal syndrome: a prospective, observational, single-center study. Clin Exp Gastroenterol. 2018;11:317–324.
107. Cavallin M, Kamath PS, Merli M, et al. Terlipressin plus albumin versus midodrine and octreotide plus albumin in the treatment of hepatorenal syndrome: A randomized trial. Hepatology 2015;62(2):567–574.
108. Mahmoud EIED, Abdelaziz DH, Abd-Elsalam S, et al. Norepinephrine is more effective than midodrine/octreotide in patients with hepatorenal syndrome-acute kidney injury: a randomized controlled trial. Front Pharmacol 2021;12:675948.
109. Simonetto DA, Gines P, Kamath PS. Hepatorenal syndrome: pathophysiology, diagnosis, and management. BMJ. 2020;370:m2687.
110. Nadim MK, Kellum JA, Davenport A, et al. Hepatorenal syndrome: the 8th International Consensus Conference of the Acute Dialysis Quality Initiative (ADQI) Group. Crit Care. 2012;16(1):R23.
111. Velez JCQ. Patients with Hepatorenal Syndrome

Should Be Dialyzed? PRO. Kidney360. 2020;2(3):406–409.

112. Wadei HM. Patients with Hepatorenal Syndrome Should Be Dialyzed? CON. Kidney360. 2020;2(3):410–412.
113. Song T, Rössle M, He F, et al. Transjugular intrahepatic portosystemic shunt for hepatorenal syndrome: A systematic review and meta-analysis. Dig Liver Dis 2018;50(4):323–330.
114. Suhocki PV, Lungren MP, Kapoor B, et al. Transjugular intrahepatic portosystemic shunt complications: prevention and management. Semin Intervent Radiol. 2015;32(2):123–32.
115. Allaire M, Walter A, Sutter O, et al. TIPS for management of portal-hypertension-related complications in patients with cirrhosis. Clin Res Hepatol Gastroenterol. 2020;44(3):249–263.
116. Formica RN, Aeder M, Boyle G, et al. Simultaneous Liver-Kidney Allocation Policy: A Proposal to Optimize Appropriate Utilization of Scarce Resources. Am J Transplant. 2016;16(3):758–766.
117. Colliou É, Del Bello A, Milongo D, et al. Kidney failure after liver transplantation. Transplantology 2021;2(3):315–335.