Venous Thromboembolism Prophylaxis in Hospitalized Patients with COVID-19

References

1. Home. Johns Hopkins Coronavirus Resource Center. Available via: coronavirus.jhu.edu. Accessed: March 10, 2021.
2. Dobesh P. The importance of appropriate prophylaxis for the prevention of venous thromboembolism in at-risk medical patients. *Int J Clin Pract* 2010;64(11):1554-62. 10.1111/j.1742-1241.2010.02447.x
3. Group PIftCCCT, the A, New Zealand Intensive Care Society Clinical Trials G, et al. Dalteparin versus unfractionated heparin in critically ill patients. *N Engl J Med* 2011;364(14):1305-14. 10.1056/NEJMoa1014475
4. Lim W, Meade M, Lauzier F, et al. Failure of anticoagulant thromboprophylaxis: risk factors in medical-surgical critically ill patients*. *Crit Care Med* 2015;43(2):401-10. 10.1097/CCM.0000000000000713
5. Nopp S, Moik F, Jilma B, Pabinger I, Ay C. Risk of venous thromboembolism in patients with COVID-19: A systematic review and meta-analysis. *Res Pract Thromb Haemost* 2020. 10.1002/rth2.12439
6. Franchini M, Marano G, Cruciani M, et al. COVID-19-associated coagulopathy. *Diagnosis (Berl)* 2020;7(4):357-63. 10.1515/dx-2020-0078
7. McFadyen JD, Stevens H, Peter K. The Emerging Threat of (Micro)Thrombosis in COVID-19 and Its Therapeutic Implications. *Circ Res* 2020;127(4):571-87. 10.1161/CIRCRESAHA.120.317447
8. Han H, Yang L, Liu R, et al. Prominent changes in blood coagulation of patients with SARS-CoV-2 infection. *Clin Chem Lab Med* 2020;58(7):1116-20. 10.1515/cclm-2020-0188
9. Lippi G, Favaloro EJ. D-dimer is Associated with Severity of Coronavirus Disease 2019: A Pooled Analysis. *Thromb Haemost* 2020;120(5):876-8. 10.1055/s-0040-1709650
10. Lippi G, Plebani M, Henry BM. Thrombocytopenia is associated with severe coronavirus disease 2019 (COVID-19) infections: A meta-analysis. *Clin Chim Acta* 2020;506:145-8. 10.1016/j.cca.2020.03.022
11. Terpos E, Ntanasis-Stathopoulos I, Elalamy I, et al. Hematological findings and complications of COVID-19. *Am J Hematol* 2020;95(7):834-47. 10.1002/ajh.25829
12. Henry BM, Vikse J, Benoit S, Favaloro EJ, Lippi G. Hyperinflammation and derangement of renin-angiotensin-aldosterone system in COVID-19: A novel hypothesis for clinically suspected hypercoagulopathy and microvascular immunothrombosis. *Clin Chim Acta* 2020;507:167-73. 10.1016/j.cca.2020.04.027
13. Mehta P, McAuley DF, Brown M, et al. COVID-19: consider cytokine storm syndromes and immunosuppression. *Lancet* 2020;395(10229):1033-4. 10.1016/S0140-6736(20)30628-0
14. Jackson SP, Darbousset R, Schoenwaelder SM. Thromboinflammation: challenges of therapeutically targeting coagulation and other host defense mechanisms. *Blood* 2019;133(9):906-18. 10.1182/blood-2018-11-882993
15. Kwaan HC. Coronavirus Disease 2019: The Role of the Fibrinolytic System from Transmission to Organ Injury and Sequelae. *Semin Thromb Hemost* 2020;46(7):841-4. 10.1055/s-0040-1709996
16. Conway EM, Pryzdial ELG. Is the COVID-19 thrombotic catastrophe complement-connected? *J Thromb Haemost* 2020;18(11):2812-22. 10.1111/jth.15050
17. Schulman S. Coronavirus Disease 2019, Prothrombotic Factors, and Venous Thromboembolism. *Semin Thromb Hemost* 2020;46(7):772-6. 10.1055/s-0040-1710337
18. Wichmann D, Sperhake JP, Lutgehetmann M, et al. Autopsy Findings and Venous Thromboembolism in Patients With COVID-19: A Prospective Cohort Study. *Ann Intern Med*

2020;173(4):268-77. 10.7326/M20-2003
19. Cheung S, Quiwa JC, Pillai A, et al. Superior Mesenteric Artery Thrombosis and Acute Intestinal Ischemia as a Consequence of COVID-19 Infection. *Am J Case Rep* 2020;21:e925753. 10.12659/AJCR.925753
20. Klein DE, Libman R, Kirsch C, Arora R. Cerebral venous thrombosis: A typical presentation of COVID-19 in the young. *J Stroke Cerebrovasc Dis* 2020;29(8):104989. 10.1016/j.jstrokecerebrovasdis.2020.104989
21. Veyre F, Poulain-Veyre C, Esparcieux A, et al. Femoral Arterial Thrombosis in a Young Adult after Nonsevere COVID-19. *Ann Vasc Surg* 2020;69:85-8. 10.1016/j.avsg.2020.07.013
22. Dolhnikoff M, Duarte-Neto AN, de Almeida Monteiro RA, et al. Pathological evidence of pulmonary thrombotic phenomena in severe COVID-19. *J Thromb Haemost* 2020;18(6):1517-9. 10.1111/jth.14844
23. Rapkiewicz AV, Mai X, Carsons SE, et al. Megakaryocytes and platelet-fibrin thrombi characterize multi-organ thrombosis at autopsy in COVID-19: A case series. *EClinicalMedicine* 2020;24:100434. 10.1016/j.eclinm.2020.100434
24. Spyropoulos AC, Levy JH, Ageno W, et al. Scientific and Standardization Committee communication: Clinical guidance on the diagnosis, prevention, and treatment of venous thromboembolism in hospitalized patients with COVID-19. *J Thromb Haemost* 2020;18(8):1859-65. 10.1111/jth.14929
25. Cuker A, Tseng EK, Nieuwlaat R, et al. American Society of Hematology 2021 guidelines on the use of anticoagulation for thromboprophylaxis in patients with COVID-19. *Blood Adv* 2021;5(3):872-88. 10.1182/bloodadvances.2020003763
26. Moores LK, Tritschler T, Brosnahan S, et al. Prevention, Diagnosis, and Treatment of VTE in Patients With Coronavirus Disease 2019: CHEST Guideline and Expert Panel Report. *Chest* 2020;158(3):1143-63. 10.1016/j.chest.2020.05.559
27. COVID-19 Treatment Guidelines Panel. Coronavirus Disease 2019 (COVID-19) Treatment Guidelines. National Institutes of Health. Available at https://www.covid19treatmentguidelines.nih.gov/. Accessed March 10, 2021. .
28. Mouhat B, Besutti M, Bouiller K, et al. Elevated D-dimers and lack of anticoagulation predict PE in severe COVID-19 patients. *Eur Respir J* 2020;56(4). 10.1183/13993003.01811-2020
29. Tang N, Bai H, Chen X, et al. Anticoagulant treatment is associated with decreased mortality in severe coronavirus disease 2019 patients with coagulopathy. *J Thromb Haemost* 2020;18(5):1094-9. 10.1111/jth.14817
30. Barnes, GD, Cuker A, Gluckman T, Piazza G, Siegal DM. Thrombosis and COVID-19: FAQs for current practice. Available from: https://www.acc.org/latest-in-cardiology/articles/2020/04/17/14/42/thrombosis-and-coronavirus-disease-2019-covid-19-faqs-for-current-practice. Accessed March 10, 2021. .
31. Barnes GD, Burnett A, Allen A, et al. Thromboembolism and anticoagulant therapy during the COVID-19 pandemic: interim clinical guidance from the anticoagulation forum. *J Thromb Thrombolysis* 2020;50(1):72-81. 10.1007/s11239-020-02138-z
32. Rentsch CT, Beckman JA, Tomlinson L, et al. Early initiation of prophylactic anticoagulation for prevention of coronavirus disease 2019 mortality in patients admitted to hospital in the United States: cohort study. *BMJ* 2021;372:n311. 10.1136/bmj.n311
33. Patell R, Chiasakul T, Bauer E, Zwicker JI. Pharmacologic Thromboprophylaxis and Thrombosis in Hospitalized Patients with COVID-19: A Pooled Analysis. *Thromb Haemost* 2021;121(1):76-85. 10.1055/s-0040-1721664
34. Al-Samkari H, Gupta S, Leaf RK, et al. Thrombosis, Bleeding, and the Observational Effect of Early Therapeutic Anticoagulation on Survival in Critically Ill Patients With COVID-19. *Ann Intern Med* 2021. 10.7326/M20-6739
35. ATTACC, ACTIV-4a & REMAP-CAP multiplatform RCT. Results of Interim Analysis. January 28, 2021.
36. Liew AY, Piran S, Eikelboom JW, Douketis JD. Extended-duration versus short-duration

pharmacological thromboprophylaxis in acutely Ill hospitalized medical patients: a systematic review and meta-analysis of randomized controlled trials. *J Thromb Thrombolysis* 2017;43(3):291-301. 10.1007/s11239-016-1461-1
37. Patell R, Bogue T, Koshy A, et al. Postdischarge thrombosis and hemorrhage in patients with COVID-19. *Blood* 2020;136(11):1342-6. 10.1182/blood.2020007938

Sodium-Glucose Cotransporter-2 (SGLT2) Inhibitors in Patients Without Type 2 Diabetes Mellitus

References

1. Fowler MJ. Microvascular and macrovascular complications of diabetes. *Clinical Diabetes*. 2008;26(2):77-82.
2. Sharma A, Pagidipati NJ, Califf RM, et al. Impact of regulatory guidance on evaluating cardiovascular risk of new glucose-lowering therapies to treat type 2 diabetes mellitus: lessons learned and future directions. *Circulation*. 2020;141(10):843-862.
3. Zinman B, Wanner C, Lachin JM, et al. Empagliflozin, cardiovascular outcomes, and mortality in type 2 diabetes. *N Engl J Med*. 2015;373(22):2117-2128.
4. Wiviott SD, Raz I, Bonaca MP, et al. Dapagliflozin and cardiovascular outcomes in type 2 diabetes. *N Engl J Med*. 2019;380(4):347-357.
5. Neal B, Perkovic V, Mahaffey KW, et al. Canagliflozin and cardiovascular and renal events in type 2 diabetes. *N Engl J Med*. 2017;377(7):644-657.
6. Cannon CP, Pratley R, Dagogo-Jack S, et al. Cardiovascular Outcomes with Ertugliflozin in Type 2 Diabetes. *N Engl J Med.* 2020;383:1425-35.
7. Ferrannini E, Baldi S, Frascerra S, et al. Renal handling of ketones in response to sodium–glucose cotransporter 2 inhibition in patients with type 2 diabetes. *Dia Care*. 2017;40(6):771-776.
8. Lopaschuk GD, Verma S. Mechanisms of cardiovascular benefits of sodium glucose co-transporter 2 (SGLT2) inhibitors. *JACC: Basic Transl Sci*. 2020;5(6):632-644.
9. Santos-Gallego CG, Requena-Ibanez JA, San Antonio R, et al. Empagliflozin ameliorates adverse left ventricular remodeling in nondiabetic heart failure by enhancing myocardial energetics. *J Am Coll Cardiol*. 2019;73(15):1931-1944.
10. Heerspink HJL, Kosiborod M, Inzucchi SE, Cherney DZI. Renoprotective effects of sodium-glucose cotransporter-2 inhibitors. *Kidney Int*. 2018;94:26-39.
11. Van Bommel EJM, Muskiet MHA, van Baar MJB, et al. The renal hemodynamic effects of the SGLT2 inhibitor dapagliflozin are caused by post-glomerular vasodilatation rather than pre-glomerular vasoconstriction in metformin-treated patients with type 2 diabetes in the randomized, double-blind RED trial. *Kidney Int*. 2020;97:202-12.
12. Thomas MC, Cherney DZI. The actions of SGLT2 inhibitors on metabolism, renal function and blood pressure. *Diabetologia*. 2018;61(10):2098-107.
13. Virani SS, Alonso A, Aparicio HJ, et al. Heart disease and stroke statistics—2021 update: a report from the American Heart Association. *Circulation*. 2021;143(8).
14. Maddox TM, Januzzi JL, Allen LA, et al. 2021 update to the 2017 ACC expert consensus decision pathway for optimization of heart failure treatment: answers to 10 pivotal issues about heart failure with reduced ejection fraction. *J Am Coll Cardiol*. 2021;77(6):772-810.
15. Shah KS, Xu H, Matsouaka RA, et al. Heart failure with preserved, borderline, and reduced ejection fraction. *J Am Coll Cardiol*. 2017;70(20):2476-2486.
16. American Diabetes Association. 9. Pharmacologic approaches to glycemic treatment: standards of medical care in diabetes—2021. Dia Care. 2021;44(Supplement 1):S111-S124.

17. Nassif ME, Windsor SL, Tang F, et al. Dapagliflozin effects on biomarkers, symptoms, and functional status in patients with heart failure with reduced ejection fraction: the DEFINE-HF trial. Circulation. 2019;140(18):1463-1476.
18. McMurray JJV, Solomon SD, Inzucchi SE, et al. Dapagliflozin in patients with heart failure and reduced ejection fraction. *N Engl J Med*. 2019;381(21):1995-2008.
19. Farxiga® [package insert]. Wilmington, DE: AstraZeneca Pharmaceuticals LP; 2020.
20. Packer M, Anker SD, Butler J, et al. Cardiovascular and renal outcomes with empagliflozin in heart failure. *N Engl J Med*. 2020;383(15):1413-1424.
21. Santos-Gallego CG, Vargas-Delgado AP, Requena-Ibanez JA, et al. Randomized trial of empagliflozin in nondiabetic patients with heart failure and reduced ejection fraction. *J Am Coll Cardiol*. 2021;77(3):243-255.
22. Shaw M. "Jardiance 1 Step Closer to FDA Approval for Use in Heart Failure." *AJMC.* January 11, 2021. Accessed March 14, 2021. https://www.ajmc.com/view/jardiance-1-step-closer-to-fda-approval-for-use-in-heart-failure.
23. Wanner C, Inzucchi SE, Lachin JM. Empagliflozin and Progression of Kidney Disease in Type 2 Diabetes. *N Engl J Med.* 2016;375:323-34.
24. Perkovic V, Jardine MJ, Neal B. Canagliflozin and Renal Outcomes in Type 2 Diabetes and Nephropathy. *N Engl J Med.* 2019;380:2295-306.
25. Kidney Disease: Improving Global Outcomes (KDIGO) Diabetes Work Group. KDIGO 2020 Clinical Practice Guideline for Diabetes Management in Chronic Kidney Disease. *Kidney Int*. 2020;98(4S):S1-S115.
26. Heerspink HJL, Stefansson BV, Correa-Rotter R, et al. Dapagliflozin in Patients with Chronic Kidney Disease. *N Engl J Med*. 2020;383:1436-46.
27. "Information for Health Professionals." *EMPA-KIDNEY.* https://www.empakidney.org/professionals-2. Accessed March 14, 2021.
28. "EMPA-KIDNEY (The Study of Heart and Kidney Protection With Empagliflozin)." *ClinicalTrials.gov*. July 20, 2018. Accessed March 11, 2021. http://clinicaltrials.gov/ct2/show/NCT03594110.
29. Sayour, A.A., Oláh, A., Ruppert, M. et al. Characterization of left ventricular myocardial sodium-glucose cotransporter 1 expression in patients with end-stage heart failure. *Cardiovasc Diabetol*. 2020;19(159):1-16.
30. Bhatt DL, Szarek M, Steg PG, et al. Sotagliflozin in patients with diabetes and recent worsening heart failure. *N Engl J Med*. 2021;384(2):117-128.
31. Bhatt DL, Szarek M, Pitt B, et al. Sotagliflozin in Patients with Diabetes and Chronic Kidney Disease. *N Engl J Med*. 2021;384:129-39.
32. Ruggenenti P, Perna A, Gherardi G, et al. Renoprotective properties of ACE-inhibition in non-diabetic nephropathies with non-nephrotic proteinuria. *Lancet*. 1999;354:359-64.