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The primary aim of *World Journal of Hematology* (*WJH*, *World J Hematol*) is to provide scholars and readers from various fields of hematology with a platform to publish high-quality basic and clinical research articles and communicate their research findings online.

WJH mainly publishes articles reporting research results and findings obtained in the field of hematology and covering a wide range of topics including anemia, blood coagulation disorders, blood group incompatibility, blood platelet disorders, blood protein disorders, bone marrow diseases, hematologic neoplasms, hemoglobinopathies, hemorrhagic disorders, leukocyte disorders, methemoglobinemia, pancytopenia, polycythemia, hematologic pregnancy complications, preleukemia, sulfhemoglobinemia, and thrombophilia.

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CASE REPORT

Venous thromboembolism prophylaxis of a patient with MYH-9 related disease and COVID-19 infection: A case report

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Abstract

BACKGROUND

The May-Hegglin anomaly is among a group of genetic disorders known as MYH9-related disease. Patients with inherited platelet disorders such as May-Hegglin anomaly are at a variably increased risk for bleeding due to a combination of platelet dysfunction and thrombocytopenia. Patients admitted to the hospital with coronavirus disease 2019 (COVID-19) infection are at an increased risk for a venous thromboembolism event (VTE). The National Institutes of Health COVID-19 treatment guidelines recommend using a prophylactic dose of heparin as VTE prophylaxis for adults who are receiving high-flow oxygen. We describe a patient admitted for COVID-19 infection with pneumonia and a history of May-Hegglin anomaly. The patient presented a challenge to determine prophylactic anticoagulation as there are no clear guidelines for this patient population.

CASE SUMMARY

Herein, we describe the case of a 39-year-old woman admitted with acute hypoxic respiratory failure secondary to COVID-19 pneumonia. She had a history of May-Hegglin anomaly and demonstrated risk for bleeding since childhood, including a life-threatening bleeding event at the age of 9 years requiring blood and platelet transfusions. Her baseline platelet count was 40-50 × 10^9/L throughout her adult life. Her family history was also notable for May-Hegglin disorder in her mother, maternal uncle, maternal grandfather and her son. Computed tomography/pulmonary angiography revealed bilateral consolidative opacities consistent with multifocal pneumonia. Complete blood count was notable for platelet count of 54 × 10^9/L. She was admitted for inpatient respiratory support with high-flow oxygen per nasal cannula and was managed with guideline-directed therapy for COVID-19, including baricitinib and dexamethasone. The Hematology/Oncology consultation team was requested to assist with management of VTE prophylaxis

in the setting of active COVID-19 infection and an inherited bleeding disorder. After review of the literature and careful consideration of risks and benefits, it was decided to treat the patient with prophylactic enoxaparin. She was closely monitored in the hospital for bleeding and worsening thrombocytopenia. She had no bleeding or signs of VTE. Her respiratory status improved, and she was discharged home after 5 d of hospitalization with supplemental oxygen by nasal cannula and dexamethasone. At the 6-month follow-up, the patient successfully discontinued her home oxygen use after only a few weeks following discharge.

CONCLUSION

The patient presented a challenge to determine prophylactic anticoagulation as anticoagulation guidelines exist for patients with COVID-19, but there are no clear guidelines for management of patients with COVID-19 and inherited bleeding disorders, particularly those with MYH9- related disease. She was discharged after recovery from the COVID-19 infection without bleeding or thrombosis. As there are no published guidelines for this situation, we present a pragmatic, informed approach to a patient with MYH9-related disease who had an indication for anticoagulation.

Key Words: Venous thromboembolism event; Prophylaxis; MYH9-related disease; Anticoagulation in inherited platelet disorder; Low molecular heparin; COVID-19; Case report

Core Tip: May-Hegglin anomaly is one of several autosomal dominant disorders described as MYH9 mutation-related diseases (MYH9-RD). A mutation in the *MYH9* gene causes macrothrombocytopenia and a mild to moderate bleeding tendency. Severity of bleeding in patients with MYH9-RD is related to the degree of thrombocytopenia and to physical properties of the large platelets. MYH9-RD is not an absolute contraindication to anticoagulation or antiplatelet agents. If a patient with MYH9-RD presents with an indication for anticoagulation, such as coronavirus disease 2019 infection, one must take a careful history of previous bleeding episodes and weigh bleeding risk against the risk of thrombosis.

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INTRODUCTION

May-Hegglin anomaly (MHA) is a rare autosomal dominant platelet disorder characterized by macrothrombocytopenia and leukocyte inclusions. It is one of a group of diseases associated with myosin heavy chain gene defects, now known as MYH9-related disease (MYH9-RD), that present with macrothrombocytopenia, platelet dysfunction and varying clinical features such as sensorineural hearing loss, presenile cataracts and renal failure[1]. Patients with MYH9-RD have a mild to moderate bleeding tendency; thus, these patients are advised to avoid anti-platelet agents and anticoagulants[2]. However, patients with platelet disorders can acquire transient or permanent prothrombotic conditions that necessitate prophylactic or therapeutic anticoagulation.

Conditions such as obesity, hospitalization and immobility increase the risk for venous thromboembolism (VTE), even in patients with thrombocytopenia[3]. Inflammation and excess cytokine production in coronavirus disease 2019 (COVID-19) infection may cause endothelial dysfunction, platelet activation and thrombosis, leading to increased risk of VTE[4-6]. The American Society of Hematology guideline panel suggests using prophylactic-intensity anticoagulation in patients with COVID-19-related critical illness who do not have suspected or confirmed VTE. However, treatment decisions regarding anticoagulation for COVID-19-infected patients with coexisting MYH9-RD are challenging because of a potential increased risk of bleeding[7].

CASE PRESENTATION

Chief complaints

A 39-year-old woman with the past medical history significant for diabetes mellitus, hypothyroidism, obesity, and MYH9-RD (specifically MHA) presented to our medical center for acute hypoxic respiratory failure secondary to COVID-19 pneumonia.

History of present illness

She was admitted for inpatient respiratory support with high-flow oxygen per nasal cannula and was managed with guideline-directed therapy for COVID-19, including baricitinib and dexamethasone.

History of past illness

The patient was diagnosed with MHA in childhood. The patient experienced a life-threatening bleeding event at the age of 9 years during a tonsillectomy requiring blood and platelet transfusions. She was subsequently evaluated by a hematologist and was diagnosed with MHA. She later had another bleeding episode as a child during oral surgery. She had two vaginal deliveries and received a preventive platelet transfusion for one of these, as she had a platelet count of approximately 40 × 10^9/L. Her baseline platelet count was 40-50 × 10^9/L throughout her adult life. She denied history of spontaneous bleeding requiring transfusion or hospitalization in the past 9 years but reported mild gum bleeding and menorrhagia not requiring transfusion. She did not receive anticoagulation at any time. She was instructed by her hematologist to avoid nonsteroidal anti-inflammatory drugs or aspirin and used them sparingly.

Personal and family history

Her family history was notable for MHA in her mother, maternal uncle, maternal grandfather and her son.

Physical examination

In the emergency department, the patient's respiratory rate was 26 breaths/min, heart rate 78 beats/min and blood pressure 126/72 mmHg. The patient's SpO_2 was 95% on 5 L of oxygen per nasal cannula. The body mass index was 53.7. She was awake and alert but in moderate respiratory distress, with frequent cough and coarse and diminished breath sounds bilaterally.

Laboratory examinations

Complete blood count was notable for white blood cell count of 4.9 × 10^3/μL, hemoglobin of 11.4 g/dL, mean corpuscular volume of 72.8 and platelet count of 54 × 10^9/L. Peripheral smear revealed hypochromic, microcytic anemia with mild anisopoikilocytosis. Döhle body inclusions were seen in the neutrophils. Frequent macrothrombocytopenia was observed.

Imaging examinations

Computed tomography/pulmonary angiography revealed bilateral consolidative opacities consistent with multifocal pneumonia.

MULTIDISCIPLINARY EXPERT CONSULTATION

The Hematology/Oncology consultation team was requested to assist with management of VTE prophylaxis in the setting of active COVID-19 infection and an inherited bleeding disorder.

FINAL DIAGNOSIS

She was a patient with a platelet disorder who was admitted for severe COVID-19 infection.

TREATMENT

The treatment team felt that the patient's risk for VTE due to active COVID-19 infection, obesity and immobility outweighed her risk of bleeding from anticoagulation in the setting of thrombocytopenia and inherited platelet disorder. She was started on the standard prophylactic dose of enoxaparin 40 mg subcutaneously once daily and monitored carefully for bleeding. On day 3, the dose was escalated to 40 mg subcutaneously twice a day as it is recommended for obese patients. She was closely monitored in the hospital for bleeding and worsening thrombocytopenia.

OUTCOME AND FOLLOW-UP

The patient had no bleeding or signs of VTE. Her respiratory status improved, and she was discharged home after 5 d of hospitalization with supplemental oxygen by nasal cannula and dexamethasone. At the 6-mo follow-up, the patient reported successfully discontinuing her home oxygen use after only a few weeks following discharge. She had no VTE or bleeding episodes. She experienced COVID-19 sequelae, including dyspnea with exertion, palpitations, blurred vision, "brain fog" and diffuse hair loss. She plans to receive a post-COVID assessment at a recovery clinic for her symptoms.

DISCUSSION

Mutations in the *MYH9* gene cause a heterogeneous group of autosomal dominant disorders known as MYH9-RD. The population frequency of pathogenic *MYH9* mutations may be at least 1 in 20000[8]. These include MHA, Epstein syndrome, Fechtner syndrome and Sebastian platelet syndrome. Although these disorders are caused by different *MYH9* mutations, all patients present with macrothrombocytopenia but may later display other pathologies, including loss of hearing, renal failure and presenile cataracts[9].

The *MYH9* gene encodes the heavy chain of non-muscle myosin class II, isoform A, which is the only non-muscle myosin class II isoform expressed in megakaryocytes[10]. *In vitro* studies revealed that platelet aggregation is normal or only slightly defective in MYH9-RD[11,12]. Recent studies revealed that MYH9-RD mutations interrupt megakaryocyte migration toward the vasculature and impair proplatelet release in the bone marrow. This in turn results in macrothrombocytopenia[13].

The bleeding tendency in MYH9-RD is thought to be correlated more with the degree of thrombocytopenia and less with the platelet dysfunction[14-16]. The degree of bleeding tendency is usually mild to moderate and rarely severe. In the majority of patients, thrombocytopenia is the only manifestation of the disease throughout life[17]. Management includes avoiding anticoagulation and medications that hamper the function of platelets. Desmopressin is indicated for mild bleeding and platelet transfusion for severe bleeding[2].

To date, there is no disease-specific treatment for MHA and other MYH9-RD. However, recently a phase II clinical trial showed that a thrombopoietin receptor agonist, eltrombopag, was effective in improving thrombocytopenia and decreasing bleeding tendency in MYH9-RD patients with thrombocytopenia[18].

Due to the concern for bleeding tendency in people with MYH9-related disease, most patients are advised to avoid nonsteroidal anti-inflammatory drugs or anticoagulants. There is limited information about prophylaxis and management of VTE in patients with MYH9-RD and specifically MHA. The large retrospective SPATA-DVT study reported the impact of thromboprophylaxis and thrombotic outcomes in inherited platelet disorders in both elective and major surgeries[19]. Looking specifically at the subgroup of MYH9-RD, approximately 26.7% (8 of 30 surgeries) had excessive postsurgical bleeding, but no cases of VTE were reported in this subgroup. The study did not comment specifically on patients with MYH9-RD having this outcome. However, it concluded that low molecular weight heparin prophylaxis did not significantly influence postsurgical bleeding or need for antihemorrhagic interventions. Although a retrospective study, it inferred that prophylactic anticoagulation for VTE is safe for patients with inherited platelet disorders and should be used for inpatient management of patients at high risk for VTE.

Hospitalized COVID-19 infected patients have a significant risk for VTE, particularly hospitalized patients with severe COVID-19 infection. Severe COVID-19 infection, defined as requiring high-flow oxygen, noninvasive ventilation, mechanical ventilation, vasopressors or inotropes or ICU admission, is associated with high VTE risk despite prophylactic anticoagulation. There are five large clinical trials that compared the outcome and safety of therapeutic anticoagulant dosing with prophylactic anticoagulant dosing for thromboprophylaxis in patients hospitalized for COVID-19 infection (Table 1)[17-21]. HEP-COVID and mrRCT showed superiority of therapeutic heparin in non-critically ill patients. In contrast, the RAPID trial and ACTION study did not observe statistical significance in the primary outcome. The INSPIRATION trial, which specifically studied critically ill patients at time of admission, did not find a benefit from intermediate dose over standard prophylactic dose heparin in the prevention of the composite outcome of VTE, arterial thromboembolism, treatment with extracorporeal membrane oxygenation or mortality within 30 d. Therefore, prophylactic heparin remains the agent of choice for anticoagulation in patients with severe COVID-19 infection. Enoxaparin 40 mg subcutaneously twice daily was commonly used in the clinical trials above for obese patients with adequate renal function.

There is no guidance for starting anticoagulation in COVID-19-infected patients with hereditary platelet disorders such as MYH9-RD, as in our patient. A retrospective review suggested thrombocytopenia was an uncommon finding in all hospitalized COVID-19 patients, with 8% of ICU and 4% of non-ICU patients having initial platelet counts below 100×10^9/L[20]. Patients with thrombocytopenia or bleeding risk are not well studied in the above-described clinical trials, as these risk factors were listed as exclusion criteria (Table 2). Guidelines from the Mayo Clinic[21] and the International Society

Table 1 Summary of anticoagulation strategy in major clinical trials on coronavirus disease 2019 thromboprophylaxis

Trial	Anticoagulant	Therapeutic dose arm	Prophylactic dose arm
mpRCT (REMAP-CAP, ACTIV-4a, and ATTAC)[17]	Enoxaparin, dalteparin, tinzaparin, UFH	BMI < 40 and CrCl ≥ 30 mL/min: enoxaparin 1 mg/kg SC BID minus 10% or 1.5 mg/kg SC QD minus 10%; Dalteparin 200 units/kg SC QD minus 10% or 100 units/kg SC BID minus 10%; Tinzaparin 175 U/kg SC QD minus 10%; UFH per hospital protocol	BMI < 40 and CrCl ≥ 30 mL/min: enoxaparin 40 mg SQ QD; Dalteparin 5000 units SC QD; Tinzaparin 4500 units SC Q24H; UFH 5000 units SC Q8H-12H
			BMI ≥ 40 and CrCl ≥ 30 mL/min: enoxaparin 40 mg SC BID; Dalteparin 7500 units SC QD; Tinzaparin 8000 units SC QD; UFH 7500 units BID
		BMI ≥ 40 and CrCl ≥ 30 mL/min: enoxaparin 0.8 mg/kg SC BID minus 10%	BMI < 40 and CrCl < 30 mL/min: enoxaparin 30 mg SQ QD
INSPIRATION[18]	Enoxaparin, UFH	CrCl ≥ 30 mL/min: enoxaparin 1 mg/kg SC QD	CrCl ≥ 30 mL/min: enoxaparin 40 mg SC QD
		Obesity[1] and CrCl ≥ 30 mL/min: enoxaparin 0.6 mg/kg SC BID	Obesity[1] and CrCl ≥ 30 mL/min: enoxaparin 40 mg SC BID
		15 < CrCl < 30 mL/min: enoxaparin 0.5 mg/kg SC QD	15 < CrCl < 30 mL/min: enoxaparin 40mg SC QD
		CrCl ≤ 15 mL/min: UFH 10000 units SC BID	CrCl ≤ 15 mL/min: UFH 5000 units SC BID
HEP-COVID[21]	Enoxaparin, UFH	CrCl ≥ 30 mL/min: enoxaparin 1 mg/kg SC BID	BMI < 30 and CrCl > 15 mL/min: enoxaparin 40 mg SC QD
		15 < CrCl < 30 mL/min: Enoxaparin 0.5 mg/kg SC BID	BMI > 30 and CrCl ≥ 30 mL/min: enoxaparin 40 mg SC BID
			BMI < 30 and CrCl < 15 mL/min: UFH 5000 U SC BID or TID
			BMI > 30 and CrCl < 15 mL/min
			UFH 7500 SC BID or TID
ACTION[19]	Rivaroxaban, enoxaparin, UFH	Oral route (preferred) CrCl ≥ 30 mL/min: rivaroxaban 20 mg PO QD	BMI < 40 and CrCl ≥ 30 mL/min: enoxaparin 40 mg SC QD; Fondaparinux 2.5 mg SC QD; UFH 5000U SC Q8H or Q12H
		30 < CrCl < 49 mL/min: rivaroxaban 20 mg PO QD	
		Parenteral route 1: age < 75 enoxaparin 1 mg/kg SC Q12H, age ≥ 75 enoxaparin 0.75 mg/kg SC Q12H	BMI ≥ 40 and CrCl ≥ 30 mL/min: enoxaparin 60 mg SC QD or 40 mg SC Q12H; UFH 7500U SC Q8H or Q12H
			BMI < 40 and CrCl < 30 mL/min: UFH 5000 U SC Q8H or Q12H
		Parenteral route 2 (preferred option in DIC): UFH IV to achieve to achieve a 0·3-0·7 IU/mL anti-Xa concentration	BMI ≥ 40 and CrCl < 30 mL/min: UFH 7500 U SC BID or TID
RAPID[20]	Enoxaparin, dalteparin, tinzaparin, UFH	BMI < 40 and CrCl ≥ 30 mL/min: enoxaparin 1 mg/kg SC Q12H or 1.5 mg/kg SC QD; Dalteparin 200 units/kg SC Q24H or 100 units/kg SC Q12H; Tinzaparin 175 U/kg SC Q24H; UFH[2]	BMI < 40 and CrCl ≥ 30 mL/min: enoxaparin 40 mg SC Q24H; Dalteparin 5000 units SC Q24H; Tinzaparin 4500 units SC Q24H; Fondaparinux 2.5 mg SC Q24H; UFH 5000 units SC Q8-12H
		BMI ≥ 40 and CrCl ≥ 30 mL/min: enoxaparin 1mg/kg SC Q12H; Dalteparin 100 units/kg SC Q12H; Tinzaparin 175 units/kg SC Q24H; UFH[2]	BMI ≥ 40 and CrCl ≥ 30 mL/min: enoxaparin 40 mg SC Q12H; Dalteparin 5000 units SC Q12H; Tinzaparin 9000 units SC Q24H; UFH 7500 units SC Q8H
		BMI < 40 and CrCl < 30 mL/min: UFH[2] or LMWH per hospital protocol	BMI < 40 and CrCl < 30 mL/min: UFH 5000 units SC Q8-12H or LMWH per hospital protocol
		BMI ≥ 40 and CrCl < 30 mL/min: UFH[2] or LMWH per hospital protocol	BMI ≥ 40 and CrCl < 30 mL/min: UFH 7500 units SC Q8H or LMWH per hospital protocol

[1]Weight ≥ 120 kg or body mass index ≥ 35 kg/m^2.

[2]Unfractionated heparin intravenous bolus with continuous infusion to titrate to institution specific anti-Xa or activated partial thromboplastin time values.

BID: Two times a day; BMI: Body mass index; CrCl: Creatinine clearance; DIC: Disseminated intravascular coagulation; IV: Intravenous; LMWH: Low molecular weight heparin; PO: By mouth; Q12H: Every 12 h; Q24H: Every 24 h; Q8H: Every 8 h; Q8-12H: Every 8-12 h; QD: Daily; SC: Subcutaneous; TID: Three times a day; UFH: Unfractionated heparin.

Table 2 Summary of exclusion criteria regarding thrombocytopenia and bleeding risk in major clinical trials on coronavirus disease 2019 thromboprophylaxis

Trial	Anticoagulant	Thrombocytopenia	Bleeding risk
mpRCT (REMAP-CAP, ACTIV-4a, and ATTAC)[17]	Enoxaparin, Dalteparin, Tinzaparin, UFH	Platelet count < 50 × 10^9 /L	ATTAC: DAPT therapy, intracranial surgery or stroke within 3 mo, history of intracerebral AVM, brain aneurysm of CNS mass lesion, intracranial malignancy, history of intracranial bleeding, history of bleeding disorder, GI bleed within 3 mo, thrombolysis within 7 d, current epidural/spinal catheter, major surgery within 14 d, uncontrolled hypertension or other physician perceived contraindications to anticoagulation ACTIV-4a: bleed within last 30 d REMAP-CAP: clinical and/or laboratory bleeding risk to contraindicate anticoagulation
INSPIRATION[18]	Enoxaparin, UFH	Platelet count < 50 × 10^9 /L	Major bleeding within 30 d, major surgery or ischemic stroke within 2 wk, head trauma within 30 d, neurosurgery within 3 mo, intracranial malignancy or AVM
HEP-COVID[21]	Enoxaparin, UFH	Platelet count < 25 × 10^9 /L	Recent bleed within 1 mo, active GI or intracranial malignancy, DAPT therapy, IMPROVE bleed score of ≥ 7
ACTION[19]	Rivaroxaban, enoxaparin, UFH	Platelet count < 50 × 10^9 /L	Use of ASA (> 100 mg) or P2Y12 inhibitor, chronic NSAIDS use, active bleeding, liver failure, blood dyscrasia, prohibitive hemorrhage risk, history of intracranial bleed, DIC, active cancer
RAPID[20]	Enoxaparin, dalteparin, tinzaparin, UFH	Platelet count < 50 × 10^9 /L within 72 h	History of an inherited or active acquired bleeding disorder, bleeding within 30 d requiring hospital presentation, DAPT therapy, Hgb < 80 g/L

ASA: Aspirin; AVM: Arteriovenous malformation; CNS: Central nervous system; DAPT: Dual antiplatelet therapy; DIC: Disseminated intravascular coagulation; GI: Gastrointestinal; Hgb: Hemoglobin; IMPROVE: International Medical Prevention Registry on Venous Thromboembolism; NSAIDS: Nonsteroidal anti-inflammatory drugs; UFH: Unfractionated heparin.

of Thrombosis and Haemostasis[22] advise against anticoagulation in COVID-19 patients with severe thrombocytopenia (platelets < 25 × 10^9/L) and suggest nonpharmacological prophylaxis with sequential compression devices.

Our patient had several features that put her at an increased risk for thrombosis, including severe COVID-19 infection, obesity and immobility. She also had a history of spontaneous gingival bleeding, menorrhagia and postprocedure bleeding that required transfusion. Based on our assessment of the patient and review of the literature, we felt that the benefit of thromboprophylaxis outweighed the risk of bleeding. With the information above, low molecular weight heparin seemed the best choice for the patient with MYH9-RD, as it has a shorter-half life with reversibility, and was shown to be the optimal choice for patients with severe COVID-19 infection. For these reasons, it was recommended that the patient be given prophylactic anticoagulation with enoxaparin 40 mg once daily, then transition to enoxaparin 40 mg twice daily if there was no evidence of bleeding[23].

CONCLUSION

MYH9-RD is a spectrum of autosomal dominant diseases that present with macrothrombocytopenia, platelet dysfunction and varying clinical features such as sensorineural hearing loss, presenile cataracts, renal failure and mild to moderate bleeding tendency. When these patients are admitted for COVID-19-related critical illness, having a platelet disorder should not exclude them from receiving anticoagulation when it is needed. Low molecular weight heparin seemed to be the best choice for the patient with MYH9-RD, as it has a shorter-half life with reversibility, and was shown to be the optimal choice for patients with severe COVID-19 infection.

FOOTNOTES

Author contributions: All authors contributed equally; all authors conceptualized the manuscript; Jiang B wrote the initial manuscript; Jiang B, Hartzell M, Yu S and Masab M edited and conducted the literature research; Lyckholm L edited and critically corrected and finalized the manuscript; Jiang B, Hartzell M and Lyckholm L were directly involved in the patient management.

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REFERENCES

1 **Althaus K**, Greinacher A. MYH9-related platelet disorders. *Semin Thromb Hemost* 2009; **35**: 189-203 [PMID: 19408192 DOI: 10.1055/s-0029-1220327]
2 **Althaus K**, Greinacher A. MYH-9 Related Platelet Disorders: Strategies for Management and Diagnosis. *Transfus Med Hemother* 2010; **37**: 260-267 [PMID: 21113248 DOI: 10.1159/000320335]
3 **Tufano A**, Guida A, Di Minno MN, Prisco D, Cerbone AM, Di Minno G. Prevention of venous thromboembolism in medical patients with thrombocytopenia or with platelet dysfunction: a review of the literature. *Semin Thromb Hemost* 2011; **37**: 267-274 [PMID: 21455860 DOI: 10.1055/s-0031-1273090]
4 **Aktaa S**, Wu J, Nadarajah R, Rashid M, de Belder M, Deanfield J, Mamas MA, Gale CP. Incidence and mortality due to thromboembolic events during the COVID-19 pandemic: Multi-sourced population-based health records cohort study. *Thromb Res* 2021; **202**: 17-23 [PMID: 33711754 DOI: 10.1016/j.thromres.2021.03.006]
5 **Mai V**, Tan BK, Mainbourg S, Potus F, Cucherat M, Lega JC, Provencher S. Venous thromboembolism in COVID-19 compared to non-COVID-19 cohorts: A systematic review with meta-analysis. *Vascul Pharmacol* 2021; **139**: 106882 [PMID: 34087481 DOI: 10.1016/j.vph.2021.106882]
6 **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; **4**: 1178-1191 [PMID: 33043231 DOI: 10.1002/rth2.12439]
7 **Zaninetti C**, Thiele T. Anticoagulation in Patients with Platelet Disorders. *Hamostaseologie* 2021; **41**: 112-119 [PMID: 33860519 DOI: 10.1055/a-1344-7279]
8 **Fernandez-Prado R**, Carriazo-Julio SM, Torra R, Ortiz A, Perez-Gomez MV. MYH9-related disease: it does exist, may be more frequent than you think and requires specific therapy. *Clin Kidney J* 2019; **12**: 488-493 [PMID: 31384439 DOI: 10.1093/ckj/sfz103]
9 **Seri M**, Pecci A, Di Bari F, Cusano R, Savino M, Panza E, Nigro A, Noris P, Gangarossa S, Rocca B, Gresele P, Bizzaro N, Malatesta P, Koivisto PA, Longo I, Musso R, Pecoraro C, Iolascon A, Magrini U, Rodriguez Soriano J, Renieri A, Ghiggeri GM, Ravazzolo R, Balduini CL, Savoia A. MYH9-related disease: May-Hegglin anomaly, Sebastian syndrome, Fechtner syndrome, and Epstein syndrome are not distinct entities but represent a variable expression of a single illness. *Medicine (Baltimore)* 2003; **82**: 203-215 [PMID: 12792306 DOI: 10.1097/00005792-200305000-00006]
10 **Pecci A**, Ma X, Savoia A, Adelstein RS. MYH9: Structure, functions and role of non-muscle myosin IIA in human disease. *Gene* 2018; **664**: 152-167 [PMID: 29679756 DOI: 10.1016/j.gene.2018.04.048]
11 **Canobbio I**, Noris P, Pecci A, Balduini A, Balduini CL, Torti M. Altered cytoskeleton organization in platelets from patients with MYH9-related disease. *J Thromb Haemost* 2005; **3**: 1026-1035 [PMID: 15869600 DOI: 10.1111/j.1538-7836.2005.01244.x]
12 **Noris P**, Spedini P, Belletti S, Magrini U, Balduini CL. Thrombocytopenia, giant platelets, and leukocyte inclusion bodies (May-Hegglin anomaly): clinical and laboratory findings. *Am J Med* 1998; **104**: 355-360 [PMID: 9576409 DOI: 10.1016/s0002-9343(98)00062-x]
13 **Asensio-Juárez G**, Llorente-González C, Vicente-Manzanares M. Linking the Landscape of *MYH9*-Related Diseases to the Molecular Mechanisms that Control Non-Muscle Myosin II-A Function in Cells. *Cells* 2020; **9** [PMID: 32545517 DOI: 10.3390/cells9061458]
14 **Pecci A**, Klersy C, Gresele P, Lee KJ, De Rocco D, Bozzi V, Russo G, Heller PG, Loffredo G, Ballmaier M, Fabris F, Beggiato E, Kahr WH, Pujol-Moix N, Platokouki H, Van Geet C, Noris P, Yerram P, Hermans C, Gerber B, Economou M, De Groot M, Zieger B, De Candia E, Fraticelli V, Kersseboom R, Piccoli GB, Zimmermann S, Fierro T, Glembotsky AC, Vianello F, Zaninetti C, Nicchia E, Güthner C, Baronci C, Seri M, Knight PJ, Balduini CL, Savoia A. MYH9-related disease: a novel prognostic model to predict the clinical evolution of the disease based on genotype-phenotype correlations. *Hum Mutat* 2014; **35**: 236-247 [PMID: 24186861 DOI: 10.1002/humu.22476]
15 **Eckly A**, Strassel C, Freund M, Cazenave JP, Lanza F, Gachet C, Léon C. Abnormal megakaryocyte morphology and proplatelet formation in mice with megakaryocyte-restricted MYH9 inactivation. *Blood* 2009; **113**: 3182-3189 [PMID: 18984861 DOI: 10.1182/blood-2008-06-164061]

16 **Léon C**, Eckly A, Hechler B, Aleil B, Freund M, Ravanat C, Jourdain M, Nonne C, Weber J, Tiedt R, Gratacap MP, Severin S, Cazenave JP, Lanza F, Skoda R, Gachet C. Megakaryocyte-restricted MYH9 inactivation dramatically affects hemostasis while preserving platelet aggregation and secretion. *Blood* 2007; **110**: 3183-3191 [PMID: 17664350 DOI: 10.1182/blood-2007-03-080184]

17 **Pecci A**, Panza E, Pujol-Moix N, Klersy C, Di Bari F, Bozzi V, Gresele P, Lethagen S, Fabris F, Dufour C, Granata A, Doubek M, Pecoraro C, Koivisto PA, Heller PG, Iolascon A, Alvisi P, Schwabe D, De Candia E, Rocca B, Russo U, Ramenghi U, Noris P, Seri M, Balduini CL, Savoia A. Position of nonmuscle myosin heavy chain IIA (NMMHC-IIA) mutations predicts the natural history of MYH9-related disease. *Hum Mutat* 2008; **29**: 409-417 [PMID: 18059020 DOI: 10.1002/humu.20661]

18 **Bastida JM**, Gonzalez-Porras JR, Rivera J, Lozano ML. Role of Thrombopoietin Receptor Agonists in Inherited Thrombocytopenia. *Int J Mol Sci* 2021; **22** [PMID: 33919295 DOI: 10.3390/ijms22094330]

19 **Paciullo F**, Bury L, Noris P, Falcinelli E, Melazzini F, Orsini S, Zaninetti C, Abdul-Kadir R, Obeng-Tuudah D, Heller PG, Glembotsky AC, Fabris F, Rivera J, Lozano ML, Butta N, Favier R, Cid AR, Fouassier M, Podda GM, Santoro C, Grandone E, Henskens Y, Nurden P, Zieger B, Cuker A, Devreese K, Tosetto A, De Candia E, Dupuis A, Miyazaki K, Othman M, Gresele P. Antithrombotic prophylaxis for surgery-associated venous thromboembolism risk in patients with inherited platelet disorders. The SPATA-DVT Study. *Haematologica* 2020; **105**: 1948-1956 [PMID: 31558677 DOI: 10.3324/haematol.2019.227876]

20 **Iba T**, Levy JH, Levi M, Connors JM, Thachil J. Coagulopathy of Coronavirus Disease 2019. *Crit Care Med* 2020; **48**: 1358-1364 [PMID: 32467443 DOI: 10.1097/CCM.0000000000004458]

21 **McBane RD 2nd**, Torres Roldan VD, Niven AS, Pruthi RK, Franco PM, Linderbaum JA, Casanegra AI, Oyen LJ, Houghton DE, Marshall AL, Ou NN, Siegel JL, Wysokinski WE, Padrnos LJ, Rivera CE, Flo GL, Shamoun FE, Silvers SM, Nayfeh T, Urtecho M, Shah S, Benkhadra R, Saadi SM, Firwana M, Jawaid T, Amin M, Prokop LJ, Murad MH. Anticoagulation in COVID-19: A Systematic Review, Meta-analysis, and Rapid Guidance From Mayo Clinic. *Mayo Clin Proc* 2020; **95**: 2467-2486 [PMID: 33153635 DOI: 10.1016/j.mayocp.2020.08.030]

22 **Thachil J**, Tang N, Gando S, Falanga A, Cattaneo M, Levi M, Clark C, Iba T. ISTH interim guidance on recognition and management of coagulopathy in COVID-19. *J Thromb Haemost* 2020; **18**: 1023-1026 [PMID: 32338827 DOI: 10.1111/jth.14810]

23 **Sebaaly J**, Covert K. Enoxaparin Dosing at Extremes of Weight: Literature Review and Dosing Recommendations. *Ann Pharmacother* 2018; **52**: 898-909 [PMID: 29592538 DOI: 10.1177/1060028018768449]

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