

The Maltese Zebra: An Investigation of Drug-Induced Immune Thrombocytopenia

Richard Schultz, PharmD
Pharmacist, HSHS St John's Hospital
Springfield, IL

2026 ICHP Annual Meeting



1

Disclosures

I have no conflicts of interest with ineligible companies to disclose

2026 ICHP Annual Meeting



2

Learning Objectives

- Describe the presentation and pathophysiology of immune thrombocytopenias (ITP)
- Discuss the initial management of new onset ITP
- Discuss the investigation and management of suspect drug-induced ITP

2026 ICHP Annual Meeting



3

Abbreviations

- AERS: Adverse event reporting system
- BBW: Black Box Warning
- DIC: Disseminated intravascular coagulation
- DITP: Drug-induced immune thrombocytopenia
- ED: Emergency department
- EHR: Electronic health record
- HIT: Heparin-induced thrombocytopenia
- ITP: Immune thrombocytopenia
- IVIG: Intravenous immune globulin
- PLT: Platelets
- TMP/SMX: Trimethoprim/sulfamethoxazole
- UTI: Urinary tract infection
- WNL: Within normal limits

2026 ICHP Annual Meeting



4



5

2026 ICHP Annual Meeting

GNT Presents to the ED

- 34-year-old woman
- Purpuric rash on lower legs
- History of depression, recent UTI
- No known drug allergies
- Vitals WNL
- Platelets = $7 \times 10^3/\mu\text{L}$
- CBC and BMP otherwise WNL
- Coagulation studies and peripheral blood smear WNL

George Henry Fox, "Purpura". Marked as public domain. https://commons.wikimedia.org/wiki/File:Fox_Plate_130X.jpg

6

2026 ICHP Annual Meeting

1. Devalla V, et al. *Br J Haematol*. 2014;156(4):496-513.
 2. Adamski J. *Hematology Am Soc Hematol Educ Program*. 2014;2014(1):444-449.
 3. Sánchez-Fuentes A, et al. *Biomolecules*. 2025;15(8):846.
 4. Toh CH and Hoots WK. *J Thromb Haemost*. 2007;5(3):604-606.

7

2026 ICHP Annual Meeting

Immune Thrombocytopenia

8

2026 ICHP Annual Meeting

Immune Thrombocytopenia (ITP)

- Acquired thrombocytopenia
- Epidemiology: 2-5 per 100,000
- Autoantibody mediated platelet destruction
- Diagnosis of exclusion
- Variable
 - Symptoms/severity
 - Chronicity
 - Management



5. Neunert C, et al. Blood Adv. 2019;3(23):3829-3866.
6. Cines DB, et al. Blood. 2009;113(26):6511-6521.

9

2026 ICHP Annual Meeting

ITP Presentation

- Platelets < $100 \times 10^3/\mu\text{L}$
- Asymptomatic
- Mild-moderate bleeding
 - Petechiae and purpura
 - Mucocutaneous bleeding



5. Neunert C, et al. Blood Adv. 2019;3(23):3829-3866
6. Cines DB, et al. Blood. 2009;113(26):6511-6521

10

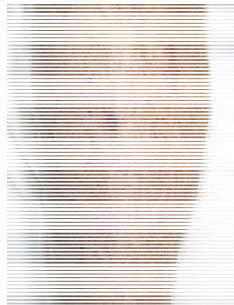
2026 ICHP Annual Meeting

ITP Presentation

- Platelets < $100 \times 10^3/\mu\text{L}$
- Asymptomatic
- Mild-moderate bleeding
 - Petechiae and purpura
 - Mucocutaneous bleeding



"Purpura". George Henry Fox. https://commons.wikimedia.org/wiki/File:Fox_Plate_XXX.jpg
Marked as public domain.



"Petechiae of the lower leg in a person with platelets of 3 due to ITP". James Holman, MD.
https://commons.wikimedia.org/wiki/File:Petechiae_lower_leg.jpg Licensed for use [CC BY 4.0](https://creativecommons.org/licenses/by/4.0/)

5. Neunert C, et al. Blood Adv. 2019;3(23):3829-3866.
6. Cines DB, et al. Blood. 2009;113(26):6511-6521

11

2026 ICHP Annual Meeting

ITP Presentation

- Platelets < $100 \times 10^3/\mu\text{L}$
- Asymptomatic
- Mild-moderate bleeding
 - Petechiae and purpura
 - Mucocutaneous bleeding
- Severe bleeding
 - Gastrointestinal bleed
 - Intracranial hemorrhage



5. Neunert C, et al. Blood Adv. 2019;3(23):3829-3866.
6. Cines DB, et al. Blood. 2009;113(26):6511-6521

12

2026 ICHP Annual Meeting

Types of ITP

Primary

- ITP without apparent trigger
- Most prevalent: ~80% of ITP
- Deepest diagnosis of exclusion

Secondary

- Predisposing condition
 - Autoimmune syndromes
 - Immunodeficiency syndromes
 - Infections
 - Lymphoid malignancies
 - Drugs
- Less prevalent
- Under recognized

6. Cines DB, et al. Blood. 2009;113(26):6511-6521
 7. Kashiwagi H et al. Int J Hematol. 2024;130(1):1-13
 8. Provan D, et al. Blood Adv. 2019;3(22):3780-3817



13

2026 ICHP Annual Meeting

ITP Initial Management



14

2026 ICHP Annual Meeting

ITP: Initial Management

- Indications for inpatient management
 - $PLT < 20 \times 10^3/\mu L$
 - Severe bleeding
 - Child with minor mucocutaneous bleeding
- Observation only
 - Adult: $PLT \geq 30 \times 10^3/\mu L$ with only minor or absent bleeding
 - Children: minor or absent bleeding
- Corticosteroids
- IV immune globulin (IVIG) and anti-D immunoglobulin
- Platelet transfusion

5. Neunert C, et al. Blood Adv. 2019;3(23):3829-3866.
 9. Provan D, et al. Blood Adv. 2019;3(22):3780-3817.



15

2026 ICHP Annual Meeting

ITP: Corticosteroids

- First line pharmacotherapy
- Suppress of phagocytic cell function
- Reduce autoantibody production
- Pulse doses preferred when rapid recovery is required
- Non-pulsed doses preferred for children without severe bleed

5. Neunert C, et al. Blood Adv. 2019;3(23):3829-3866.
 9. Provan D, et al. Blood Adv. 2019;3(22):3780-3817.
 10. Mizutani H, et al. Blood. 1992;79(4):942-947.



16

2026 ICHP Annual Meeting

ITP: Corticosteroid Options

	Non-Pulse	Pulse
	Prednisone* / Prednisolone	Dexamethasone* Methylprednisolone
Adult Dosing	0.5-2.0 mg/kg/day (max 80 mg daily)	40 mg daily 1 g daily
Adult Duration	2-3 weeks + taper (max 6 weeks total)	4 days 3 days
Pediatric Dosing	2-4 mg/kg/day (max 120 mg daily)	0.6 mg/kg per day (max 40 mg daily) 30 mg/kg/dose daily
Pediatric Duration	5-7 days (max 7 days)	4 days 1-3 days

*Corticosteroids specifically named in guidelines

5. Neunert C, et al. Blood Adv. 2019;3(23):3829-3866.
 11. Prednisolone. Lexi-Drugs. UpToDate LexiDrug.
 12. Prednisone. Lexi-Drugs. UpToDate LexiDrug.
 13. Dexamethasone. Lexi-Drugs. UpToDate LexiDrug.
 14. Methylprednisolone. Lexi-Drugs. UpToDate LexiDrug.

17

2026 ICHP Annual Meeting

ITP: IVIG & Anti-D Place in Therapy

- Alternative when corticosteroids are contraindicated
- Addition to corticosteroid
 - Severe/critical bleed (IVIG only)
 - Urgent recovery required
 - Refractory to corticosteroid

9. Provost D, et al. Blood Adv. 2019;3(22):3780-3817.
 5. Neunert C, et al. Blood Adv. 2019;3(23):3829-3866.

18

2026 ICHP Annual Meeting

ITP: IVIG & Anti-D Mechanisms

- Concentrated immunoglobulin infusion
- Competes with antiplatelet antibody for Fcγ receptor
- Stimulate inhibitory receptor (FcγRIIB)
- Anti-D: binds Rho(D) on Rh(+) RBC

15. Immune globulin. Lexi-Drugs. UpToDate LexiDrug.
 16. Jin F, Balhassar JP. Hum Immunol. 2005;66(4):403-410.
 17. Anti-D Immune globulin. Lexi-Drugs. UpToDate LexiDrug.

19

2026 ICHP Annual Meeting

ITP: IVIG Dose & Pearls

- Dose: 1 g/kg IV
- May repeat dose after 24 hours
- Preferred over anti-D for severe/critical bleed
- BBW: thrombosis & acute renal dysfunction

5. Neunert C, et al. Blood Adv. 2019;3(23):3829-3866.
 15. Immune globulin. Lexi-Drugs. UpToDate LexiDrug.
 16. Linger B, et al. J Pediatr. 2010;204(2):225-233.e8.
 19. Kane L, et al. Br J Haematol. 2010;149(1):79-83.

20

2026 ICHP Annual Meeting

ITP: Anti-D Dose & Pearls

- Rhophylac®: 50 mcg/kg
- WinRho SDF®: 25-50 mcg/kg
- IV administration only
- Rh(+) patients only
- BBW: intravascular hemolysis
 - Anemia, DIC, multisystem organ failure, etc
 - Monitor with serial urinalyses
 - Transfuse Rh(-) blood only

5. Neunert C, et al. Blood Adv. 2019;3(23):3829-3866.
 17. Anti-D immune globulin. Lexi-Drugs. UpToDate LexiDrug.
 18. Linger B, et al. J Pediatr. 2019;204:225-233.e8.
 19. Kane I, et al. Br J Haematol. 2000;109(1):79-83.

21

2026 ICHP Annual Meeting

ITP: Platelet Transfusion

- Pharmacotherapy only prevents platelet destruction
- Only treatment that can increase platelets within 24 hours
 - Life threatening bleed
 - Severe, refractory bleed
 - Urgent surgical procedure
- Priority: platelets → IVIG → corticosteroids

9. Provan D, et al. Blood Adv. 2019;3(22):3780-3817.
 5. Neunert C, et al. Blood Adv. 2019;3(23):3829-3866.
 12. Balchoul T, Marin L. Hematology Am Soc Hematol Educ Program. 2018;2018(1):576-583.

22

2026 ICHP Annual Meeting

Back to GNT

23

2026 ICHP Annual Meeting

Q1: Initial treatment of GNT

- 34-year-old woman
- Purpuric rash
- No mucosal bleed
- No GIB or ICH
- PLT = $7 \times 10^3/\mu\text{L}$
- Blood counts WNL otherwise
- Blood type: AB-
- No known drug allergy

Which treatment is most appropriate for GNT?

- Outpatient prescription for prednisone for 14 days
- Initiate methylprednisolone
- Initiate dexamethasone and anti-D
- Initiate STAT platelet transfusion, IVIG, and dexamethasone

24

Drug-induced Immune Thrombocytopenia (DITP)

25

Drug-induced Immune Thrombocytopenia

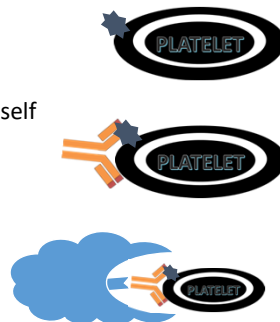
- Suspect whenever $PLT < 20 \times 10^3/\mu L$
- Epidemiology
 - General population: 10 per 1 million
 - TMP/SMX: 26 per 1 million
 - Quinine/quinidine: 38 per 1 million
- Likely underreported

22. Aster RH, Bougie DW. *N Engl J Med*. 2007;357(6):580-587.
 23. Reese JA, et al. *Pediatr Blood Cancer*. 2013;60(12):1975-1983.

26

DITP Pathophysiology

- Drug binds to platelet
- Alters surface protein
- Drug/platelet complex recognized as non-self
- Antiplatelet antibody is drug dependent



24. Arnold DM, et al. *Transfus Med Rev*. 2013;27(3):137-145.
 25. Warrenton TL. *N Engl J Med*. 2007;356(9):893-899.
 26. George JN, et al. *Ann Intern Med*. 1998;129(11):886-890.
 27. Pedersen-Bjergaard, et al. *Eur J Clin Pharmacol*. 1997;52(3):183-189.

27

DITP vs ITP

	DITP	ITP
Antiplatelet antibodies	Drug dependent	Not drug dependent
Thrombocytopenia	Severe, $PLT < 20 \times 10^3/\mu L$	Variable, $PLT < 100 \times 10^3/\mu L$
Asymptomatic	Rarely asymptomatic	Often asymptomatic
Severe bleed risk	Major bleed: 19%	Variable Correlated with platelet counts

9. Provan D, et al. *Blood Adv*. 2019;3(22):3780-3817.
 21. Bakchoul T, Martinelli L. *Hematology Am Soc Hematol Educ Program*. 2018;2018(1):576-583.
 24. Arnold DM, et al. *Transfus Med Rev*. 2013;27(3):137-145.
 25. Warrenton TL. *N Engl J Med*. 2007;356(9):893-899.
 26. George JN, et al. *Ann Intern Med*. 1998;129(11):886-890.
 27. Pedersen-Bjergaard, et al. *Eur J Clin Pharmacol*. 1997;52(3):183-189.

28

DITP vs ITP

	DITP	ITP
Antiplatelet antibodies	Drug dependent	Not drug dependent
Thrombocytopenia	Severe, $PLT < 20 \times 10^3/\mu L$	Variable, $PLT < 100 \times 10^3/\mu L$
Asymptomatic	Rarely asymptomatic	Often asymptomatic
Severe bleed risk	Major bleed: 19%	Variable Correlated with platelet counts
Platelet trend	Distinct nadir then recovery	Fluctuates
Duration	1 – 2 weeks	Weeks to years

9. Provan D, et al. *Blood Adv*. 2019;3(22):3760-3817.
 21. Bakchoul T, Marin L. *Hematology Am Soc Hematol Educ Program*. 2018;2018(1):576-583.
 24. Arnold DM, et al. *Transfus Med Rev*. 2013;27(3):137-145.
 25. Warrenton TE, Jr. *Engl J Med*. 2007;356(8):891-893.
 26. George JN, et al. *Ann Intern Med*. 1998;129(11):886-890.
 27. Pedersen-Bjergaard, et al. *Eur J Clin Pharmacol*. 1997;52(3):183-189.

29

Back to GNT

30

Q2: Red Herring or Red Handed?

- 34-year-old woman
- Purpuric rash
- No mucosal bleed
- No GIB or ICH
- $PLT = 7 \times 10^3/\mu L$
- Blood counts WNL otherwise
- Blood type: AB-
- No known drug allergy

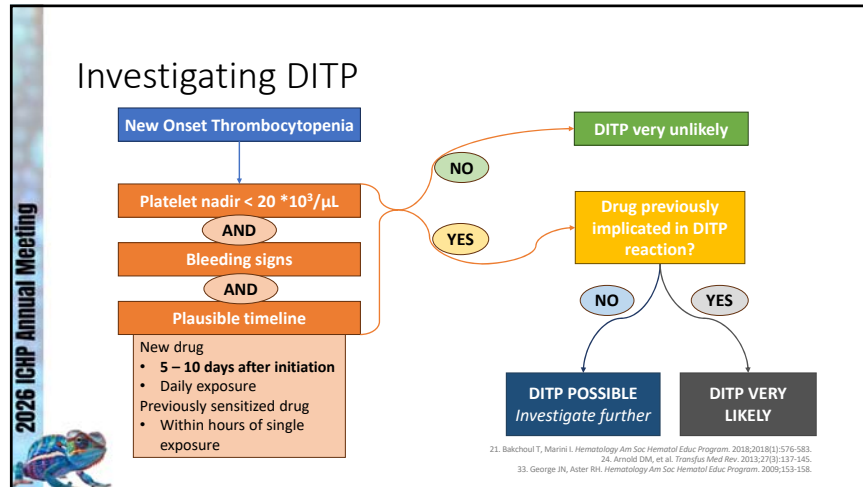
Is DITP a suspect cause of GNT's thrombocytopenia? Why/why not?

- No, GNT is not actively bleeding
- No, GNT has no known drug allergies
- Yes, GNT's $PLT < 20 \times 10^3/\mu L$
- Yes, DITP should be suspected for anyone taking medications

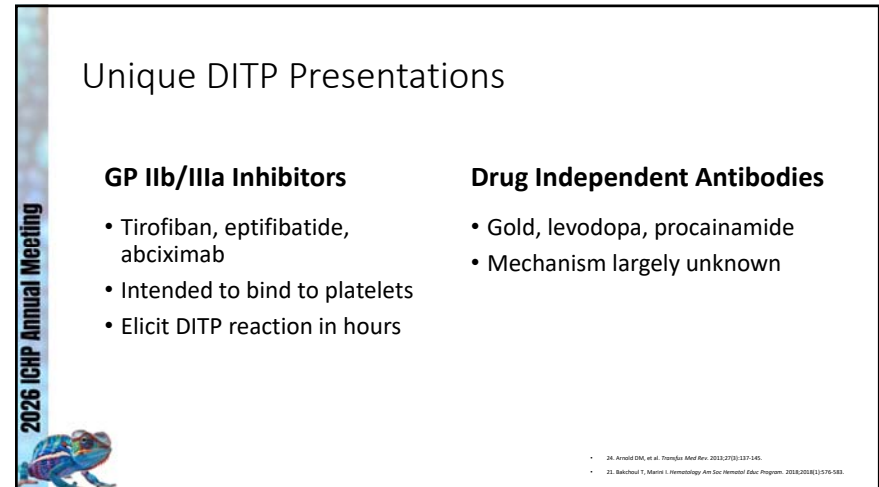
31

Investigating DITP

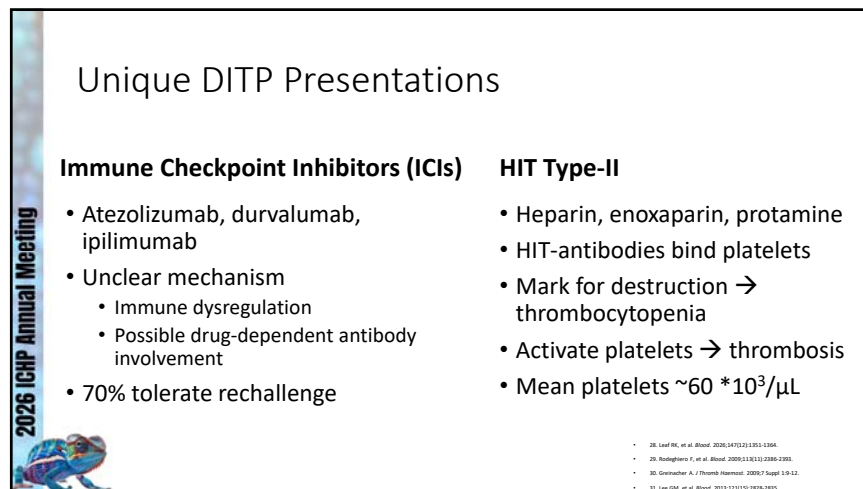
32



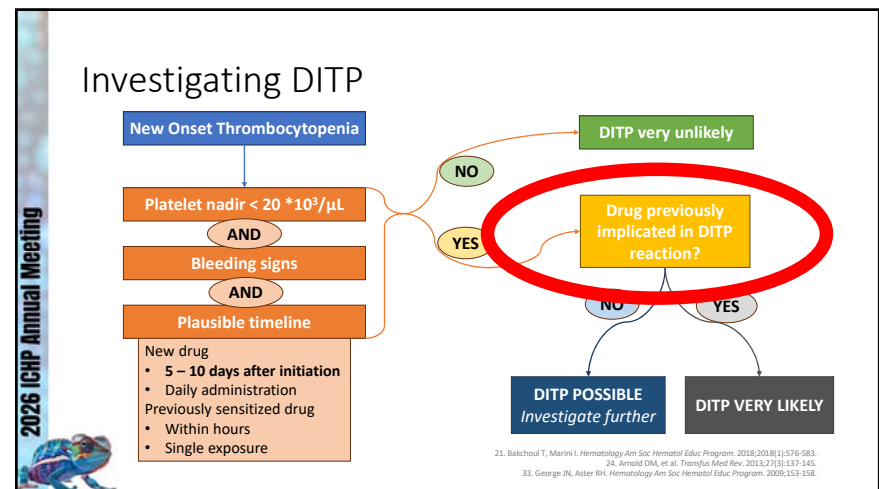
33



34



35



36

2026 ICHP Annual Meeting

“Identifying Drugs That Cause Acute Thrombocytopenia: an Analysis Using 3 Distinct Methods”

Reese JA, et al. *Blood*. 2010;116(12):2127-2133.



37

2026 ICHP Annual Meeting

Design

Clinical	Lab	Data Mining
- Systemic review of case reports - Establishment of causal relationship	- Data from BloodCenter of Wisconsin - Drug-dependent, platelet reactive antibodies	- Data mining FDA's AERS database - Statistical association with thrombocytopenia

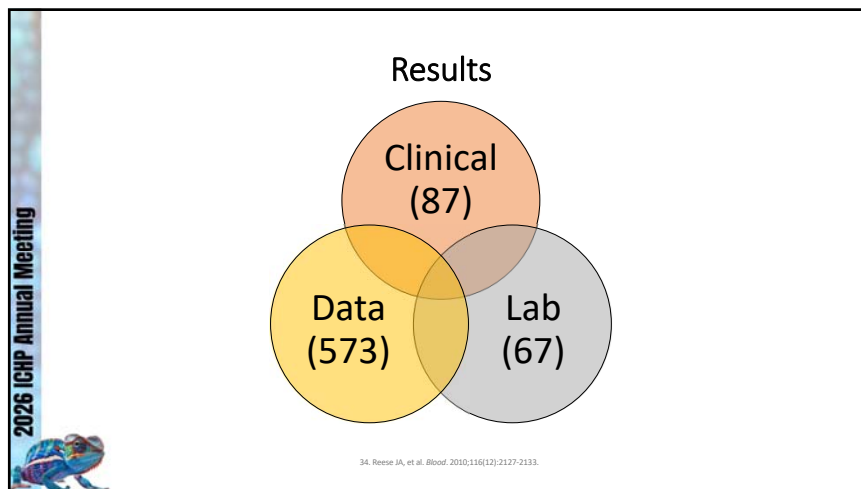
Excluded

- Marrow-suppressive thrombocytopenias
- Heparin + heparin analogues

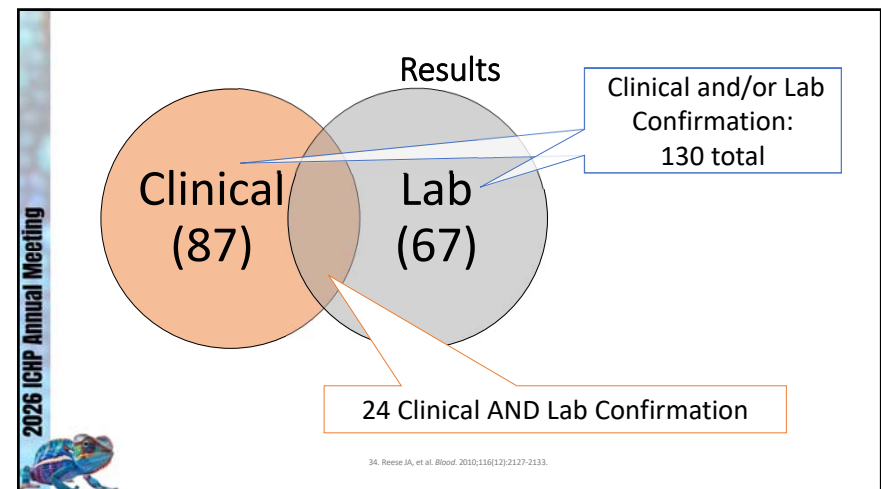
34. Reese JA, et al. *Blood*. 2010;116(12):2127-2133.



38



39



40

2026 ICHP Annual Meeting

DITP: Most Wanted

Both Clinical and Lab Confirmation	
Abciximab	Phenytoin
Acetaminophen	Piperacillin
Amiodarone	Quinidine
Ampicillin	Quinine
Carbamazepine	Ranitidine
Eptifibatide	Rifampin
Ethambutol	Simvastatin
Haloperidol	Sulfisoxazole
Ibuprofen	SMX-TMP
Irinotecan	Tirofiban
Naproxen	Valproic acid
Oxaliplatin	Vancomycin

≥10 Lab Reports + Clinical Confirmation	
Abciximab	Quinine
Carbamazepine	Rifampin
Eptifibatide	SMX-TMP
Phenytoin	Tirofiban
Piperacillin	Vancomycin
Quinidine	

≥10 Lab Reports + ≥10 Case Reports	
Abciximab	
Carbamazepine	
Quinidine	
Quinine	
Rifampin	
SMX-TMP	



41

2026 ICHP Annual Meeting

DITP: Quinine

- BBW: Thrombocytopenia
- Known cause of purpura for >150 years
- Non-drug sources
 - Tonic water, gin and tonics, bitter lemon
 - Fluorescent cocktails aka "Shocktails"
 - Natural leg cramp remedies

17. Vipan, W. H. "Quinine as a cause of purpura." The Lancet 86.2184 (1865): 37.
35. Quinine. Lexi-Drugs. UpToDate Lexi-Drugs.



42

2026 ICHP Annual Meeting

DITP: Food, Alternative Meds, etc.



Walnuts



Lupin Beans



Tahini



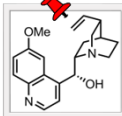
Cranberry Juice



Cow's Milk



Jui, Herbal Tea



Adulterants

Image attributions are listed by title at the end of this presentation.

36. Royer DL, et al. Eur J Haematol. 2010;94(5):421-429.
37. Achterbergh R, et al. Lancet. 2012;379(9817):776.
38. Christie DL, et al. Arch Intern Med. 1983;143(6):1174-1175.
39. Phillips KA, et al. J Gen Intern Med. 2012;27(12):1722-1725.
40. Aouno Y, et al. Lancet. 1999;354(9175):304-305.



43

2026 ICHP Annual Meeting

GNT Medication History



44

Q3: Ms GNT, Just One More Thing...

- Citalopram daily for 7 years. Last taken last night
- Cephalexin daily for 10 days. Last taken ~2 weeks ago
- Acetaminophen prn. Typically, every few months. Single dose 4 days ago.
- "Vertigo Glowing Vodka Tonic" past 6 evenings

Which of the following is the most likely cause of suspect DITP?

- a) Citalopram
- b) Cephalexin
- c) Acetaminophen
- d) Quinine

45

DITP Treatment and Recovery

46

DITP Treatment and Recovery

- Definitive treatment: **stop offending agent**
- Treat ITP as appropriate
- Stop all drugs started in past 2 weeks
- Investigate possible offending agent
- Expected platelet recovery
 - Starts after 4-5 half-lives of offending drug
 - Complete ~1 week

21. Bakchoud T, Martin L. Hematology Am Soc Hematol Educ Program. 2018;2018(1):576-583.
33. George JN, Aster RH. Hematology Am Soc Hematol Educ Program. 2009;153-158.

47

DITP Treatment and Recovery

- Drug-dependent antibodies linger for years
 - Counsel on avoidance
 - Non-drug sources
- Case report of a definite or probable reaction
 - If few exist for offending drug
 - Management relies on historical association

34. Reese JA, et al. Blood. 2010;116(12):2127-2133.

48

References

- Desautels V, Hamilton MG, Melloy AM. British Committee for Standards in Haematology: Guidelines for the diagnosis and treatment of coagulation and fibrinolytic disorders. *Br J Haematol*. 2014;146(4):496-511. doi:10.1111/bjh.12099
- Adelman J. Thrombotic microangiopathy and indicators for therapeutic plasma exchange. *Hematology Am Soc Hematol Educ Program*. 2014;2014(1):444-448. doi:10.1182/leheducation.2014.1.444
- Sánchez-Fuentes A, Pérez-Rodero J, Restida RM, Rivera J. Diagnosis of Inherited Platelet Disorders: Clinical Evaluation and Functional and Molecular Assays. *Biomolecules*. 2021;15(8):846. Published 2021 Jun 10. doi:10.3390/biom15080846
- Tah CH, Hoots WK, SSC on Disseminated Intravascular Coagulation of the ISTH: The scoring system of the Scientific and Standardization Committee on Disseminated Intravascular Coagulation of the International Society on Thrombosis and Hemostasis: a 5-year overview. *J Thromb Haemost*. 2007;7(10):1948-495. doi:10.1111/j.1538-7836.2007.02112.x
- Kauwe C, Terrell DM, Arnold DM, et al. American Society of Hematology 2013 guidelines for immune thrombocytopenia. *Blood Adv*. 2013;3(21):3829-3855. doi:10.1182/bloodadvances.2013000066
- Chen DS, Basal JJ, Salzman HA, Luning Prak ET. The TTP syndrome: pathogenic and clinical diversity. *Blood*. 2009;113(24):6211-6221. doi:10.1182/blood-2009-01-128035
- Kashiwagi H, Kawana M, Murata M, et al. Reference guide for the diagnosis of adult primary immune thrombocytopenia, 2023 edition. *Int J Hematol*. 2024;119(1):1-11. doi:10.1007/s12185-023-03670-1
- Provan D, Arnold DM, Basal JJ, et al. Updated international consensus report on the investigation and management of primary immune thrombocytopenia. *Blood Adv*. 2019;3(23):3810-3817. doi:10.1182/bloodadvances.2019000811
- Provan D, Arnold DM, Basal JJ, et al. Updated international consensus report on the investigation and management of primary immune thrombocytopenia. *Blood Adv*. 2019;3(23):3810-3817. doi:10.1182/bloodadvances.2019000811
- Masuda H, Furukawa T, Imai Y, et al. Mechanisms of corticosteroid action in immune thrombocytopenic purpura (ITP): experimental studies using TTP genome mice. *NOV & BSC*. 1992;79(4):942-947.
- Prednisolone. Lexi-Comp. UpToDate Lasting. UpToDate Inc. Rosewood, IL. Accessed February 18th, 2026. <http://online.lexi.com>
- Prednisolone. Lexi-Comp. UpToDate Lasting. UpToDate Inc. Rosewood, IL. Accessed February 18th, 2026. <http://online.lexi.com>
- Methylprednisolone. Lexi-Comp. UpToDate Lasting. UpToDate Inc. Rosewood, IL. Accessed February 18th, 2026. <http://online.lexi.com>
- Immune globulin. Lexi-Comp. UpToDate Lasting. UpToDate Inc. Rosewood, IL. Accessed February 18th, 2026. <http://online.lexi.com>
- In F, Bellhouse JP. Mechanisms of intravenous immunoglobulin action in immune thrombocytopenic purpura. *Hum Immun*. 2005;66(6):403-410. doi:10.1016/j.humimm.2005.05.029
- Anti-D immune globulin. Lexi-Comp. UpToDate Lasting. UpToDate Inc. Rosewood, IL. Accessed February 18th, 2026. <http://online.lexi.com>
- Salzer B, Muller F, Terrell D, Provan D, Rajan-Angelwal T. Efficacy and Safety of Anti-D Immunoglobulin versus Intravenous Immunoglobulin for Immune Thrombocytopenia in Children: Systematic Review and Meta-analysis of Randomized Controlled Trials. *J Pediatr*. 2020;234:252-259.e16. doi:10.1016/j.jpeds.2019.07.040
- Kaw K, Rajan D, Bhat S, Basal J, Bajaj R. Comparison of intravenous immune globulin and high-dose anti-D immune globulin as initial therapy for childhood immune thrombocytopenic purpura. *Br J Haematol*. 2010;149(1):79-83. doi:10.1111/j.1365-2141.2009.08207.x
- Neunert C, Lim W, Crowther M, et al. The American Society of Hematology 2011 evidence-based practice guideline for immune thrombocytopenia. *Blood*. 2011;117(16):4130-4207. doi:10.1182/blood-2010-08-302086

49

References

- Seltschak T, Martini I. Drug-associated thrombocytopenia. *Hematology Am Soc Hematol Educ Program*. 2018;2018(1):176-181. doi:10.1182/leheducation.2018.1.176
- Antar RH, Regehr DW. Drug-induced immune thrombocytopenia. *N Engl J Med*. 2007;357(6):585-587. doi:10.1056/NEJMe060460
- Reese JA, et al. Drug-induced thrombocytopenia in children. *Pediatr Blood Cancer*. 2013;60(12):1975-1981. doi:10.1002/pbc.24682
- Arnold DM, Neal T, Warkentin TE, et al. Approach to the diagnosis and management of drug-induced immune thrombocytopenia. *Transfus Med Rev*. 2013;27(1):137-145. doi:10.1016/j.trans.2013.05.005
- Warkentin TE. Drug-induced immune-mediated thrombocytopenia—from purpura to thrombosis. *N Engl J Med*. 2007;356(6):695-697. doi:10.1056/NEJMp060300
- George JN, Raskob GE, Shah SA, et al. Drug-induced thrombocytopenia: a systematic review of published case reports. *Am Intern Med*. 1998;129(11):886-890. doi:10.7326/0003-4819-129-11_paw_1-199812010-00000
- Pedersen-Bjergaard U, Andersen M, Hansen PB. Drug-induced thrombocytopenia: clinical data on 309 cases and the effect of corticosteroid therapy. *Eur J Clin Pharmacol*. 1997;52(3):183-189. doi:10.1007/s002280002072
- Loef RM, Mores AV, Sherry T, et al. Immune thrombocytopenia in patients treated with immune checkpoint inhibitors. *Eur J Clin Pharmacol*. 2020;164(12):1351-1364. doi:10.1182/blood.2020031440
- Reddy AS, Sisti R, Gershenwald T, et al. Standardization of terminology, definitions and outcome criteria in immune thrombocytopenic purpura of adults and children: report from an international working group. *Blood*. 2009;113(11):2386-2393. doi:10.1182/blood-2008-07-017023
- Greenrath A. Heparin-induced thrombocytopenia. *J Thromb Haemost*. 2000;7 Suppl 1:9-12. doi:10.1111/j.1538-7836.2008.02385.x
- Lee GM, Whitley LJ, Phillips-Bute B, Ortel TL, Anapali GM. High incidence of antibodies to protamine and protamine/heparin complexes in patients undergoing cardiopulmonary bypass. *Blood*. 2013;121(11):2028-2035. doi:10.1182/blood-2012-11-409130
- Levine LA, Shen M, Molyneux JC, et al. Treatment and prevention of heparin-induced thrombocytopenia. Antithrombotic Therapy and Prevention of Thrombosis, 9th ed. American College of Chest Physicians Evidence-Based Clinical Practice Guidelines. *Chest*. 2012;142(2 Suppl):e495S-503S. doi:10.1378/chest.117.2104
- George JN, Aster RH. Drug-induced thrombocytopenia: pathogenesis, evaluation, and management. *Hematology Am Soc Hematol Educ Program*. 2009;153-158. doi:10.1182/leheducation.2008.1.153
- Reese JA, Li X, Hudson M, et al. Identifying drugs that cause acute thrombocytopenia: an analysis using 5 distinct methods. *Blood*. 2010;116(12):2127-2133. doi:10.1182/blood-2010-02-276891
- Quinine. Lexi-Comp. UpToDate Lasting. UpToDate Inc. Rosewood, IL. Accessed February 18th, 2026. <http://online.lexi.com>
- Rogier DJ, George JN, Terrell DR. Thrombocytopenia as an adverse effect of complementary and alternative medicines, herbal remedies, nutritional supplements, foods, and beverages. *Eur J Haematol*. 2015;94(5):421-429. doi:10.1111/ejh.12453
- Anderson R, Vermeir W, Curtis RB, et al. Thrombocytopenia in herbal. *Lancet*. 2012;379(9779):1176. doi:10.1016/S0140-6736(12)60457-7
- Christie DL, Walker RH, Koloski MD, Wilber PM, Aster RH. Quinine-induced thrombocytopenia following intravenous use of heroin. *Arch Intern Med*. 1981;141(6):1176-1175.
- Phillips KA, Hirsch GA, Spaten DH, Preston EL. Cardiac complications of unwitting co-ingestion of quinine/quinidine with heroin in an intravenous drug user. *J Gen Intern Med*. 2012;27(12):1772-1775. doi:10.1007/s12060-012-2089-2
- Acute Y, Yaga K, Sawanya T, Kinoshita K. Thrombocytopenia induced by lic, a traditional Chinese herbal medicine. *Lancet*. 1998;354(9171):304-305. doi:10.1016/S0140-6736(98)01386-7

50

Image Attributions

- "Lupinus albus". Calapito. https://commons.wikimedia.org/wiki/File:Lupinus_albus.JPG. Marked as public domain
- "Walnuts – whole and open". Mister rf. https://commons.wikimedia.org/wiki/File:Walnuts_whole_and_open.jpg. Licensed for use by CC BY-SA-4.0
- "Tahini with roasted sesame". Miansari66. https://commons.wikimedia.org/wiki/File:Tahini_with_roasted_sesame.JPG. Licensed for use by CC0 1.0
- "Cranberry juice in a cup". Lisa Pinehill. https://commons.wikimedia.org/wiki/File:Cranberry_juice_in_a_cup.jpg. Licensed for use by CC BY-SA-2.0
- "Glass of Milk". NIAID. [https://commons.wikimedia.org/wiki/File:Glass_of_Milk_\(33657535532\).jpg](https://commons.wikimedia.org/wiki/File:Glass_of_Milk_(33657535532).jpg). Licensed for use by CC BY-SA-2.0
- No title. McKay Savage. [https://commons.wikimedia.org/wiki/File:China_-_Chengdu_22_-_green_tea_\(140902695\).jpg](https://commons.wikimedia.org/wiki/File:China_-_Chengdu_22_-_green_tea_(140902695).jpg). Licensed for use by CC BY-SA-2.0
- "Quinine Structure". Ymwang42. https://commons.wikimedia.org/wiki/File:Quinine_structure.png. Licensed for use by CC0 1.0

51

The Maltese Zebra: An Investigation of Drug-Induced Immune Thrombocytopenia

Richard Schultz, PharmD
Pharmacist, HSHS St John's Hospital
Springfield, IL

52