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RESEARCH ARTICLE

Utilization of 4T score to determine the pretest probability of heparin-induced thrombocytopenia in a community hospital in upstate New York

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Background: Thrombocytopenia is common in hospitalized patients. Heparin-induced thrombocytopenia (HIT) is a life-threatening condition which can lead to extensive thrombosis. Diagnosis of HIT relies on clinical suspicion determined by 4T score and immunoassays through testing for anti-PF4/heparin antibodies. Clinical practice guidelines published by the American Society of Hematology in 2013 recommended use of the 4T score before ordering the immunoassays as a measure of pretest probability. The purpose of this study was to evaluate the utilization of 4T score before ordering anti-PF4/heparin antibodies at Unity Hospital.
Methods: We did a retrospective chart review for patients who are 18 years or older, admitted to Unity Hospital between July 1, 2013, and December 31, 2014, and had anti-PF4/heparin antibodies ordered. Subjects who had prior history of HIT or had end-stage renal disease on hemodialysis were excluded. After calculating 4T score retrospectively, we calculated the proportion of patients who had 4T score documented prior to ELISA testing and proportion of ELISA tests, which were not indicated due to a 4T score less than or equal to 3 using Minitab 16.
Results: Review of 123 patients, with an average age of 69.4 years, showed that testing was indicated in 18 patients. Six subjects had positive results, and testing was indicated in all of them. 4T score was documented in three patients. This quality improvement study showed that 4T score documentation rate at Unity Hospital is 2.4%. Anti-PF4/heparin antibody testing was indicated in 14.6%. This test is being overused in thrombocytopenia work up at Unity Hospital, costing $9,345. The topic was reviewed for residents. A prompt and calculator for 4T score were added to electronic medical records before ordering the test as a step to improve high value care.

Keywords: *4Ts score*; *HIT*; *pretest probability*; *thrombocytopenia*; *thrombosis*; *community hospital*

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Thrombocytopenia is common in hospitalized patients. In contrast to other conditions caused by enhanced consumption, impaired production, or destruction of platelets, which lead to bleeding complications, heparin-induced thrombocytopenia (HIT) does not induce bleeding but rather results in a paradoxical prothrombotic state (1). This prothrombotic action makes the early recognition of HIT very important.

HIT occurs in approximately 1 in 5,000 hospitalized patients, with a large variability among patient populations. Thromboembolic complications develop in approximately 50% of patients with confirmed HIT. Venous thrombosis of the large vessels of the lower limbs and pulmonary embolism are the most frequent complications (2).

HIT is induced by IgG antibodies recognizing epitopes on the positively charged chemokine platelet activating factor-4 (PF4) within PF4–heparin complexes (3). The resulting immune complexes cross-link Fcγ receptors on platelets (Fcγ RIIa) (4), thus activating them. Further enhanced by the alteration of endothelial cells, the activation of platelets increases thrombin generation. Increased thrombin, not thrombocytopenia, causes clinical problems.

Diagnosis of HIT relies on clinical suspicion determined by 4T score and immunoassays through testing for anti-PF4/heparin antibodies. Clinical practice guidelines published by the American Society of Hematology in 2013 recommended use of the 4T score before ordering the immunoassays as a measure of pretest probability. If the score is less than or equal to 3, a low probability for HIT is

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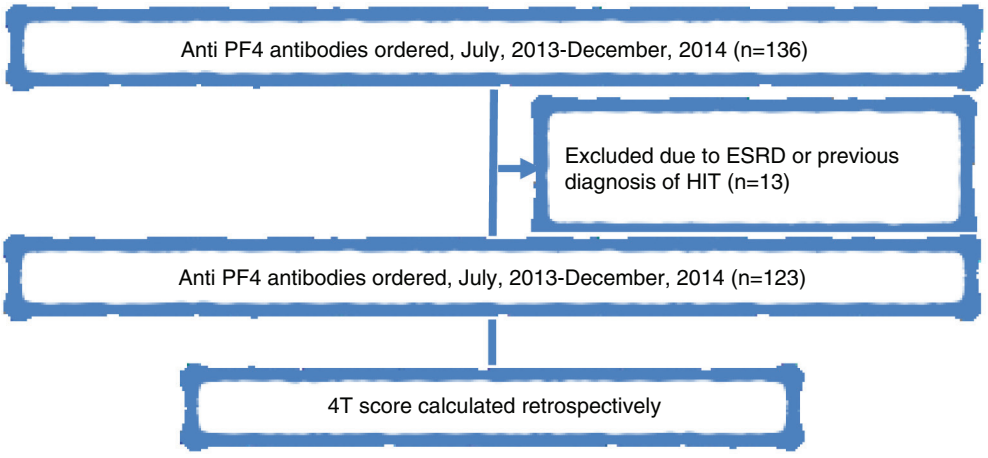

Fig. 1. Data overview.

determined, and no further testing is required. If the score is more than 3, then anti-PF4/heparin ELISA should be ordered, and all heparin products should be stopped.

While the negative predictive value of a low probability 4T score is 99.8%, it has a low positive predictive value (14–64%). So, a low probability 4T score appears to be a robust means of excluding HIT. Patients with intermediate and high probability scores require further evaluation (5).

The purpose of this study was to evaluate the utilization of 4T score before ordering anti-PF4/heparin antibodies at Rochester Regional Health-Unity Hospital.

Methods

After the institutional review board (IRB) approval, we did a retrospective chart review for patients who are 18 years or older, admitted to Unity Hospital between July 1, 2013, and December 31, 2014, and had anti-PF4/heparin antibodies ordered. Patients who had a prior HIT diagnosis or had end-stage renal disease (ESRD) on hemodialysis were excluded as dialysis patients have high false-positive rate.

The following parameters were assessed: age, sex, timing of platelets drop, thrombosis, other possible causes of thrombocytopenia, documentation of 4T score, anti-PF4/heparin antibodies result, and treatment. All subjects included were assigned a study ID. Their names, date of birth, and medical record number were listed with the study ID in one spreadsheet. A second spreadsheet included study ID and clinical variables. This is to protect against inadvertent HIPAA (Health Insurance Portability and Accountability Act) disclosures. All data were stored on a Unity Hospital–provided encrypted thumb drive.

Minitab 16 was used for calculating the proportion of patients who had 4T score documented prior to ELISA testing and the proportion of ELISA tests which were not indicated due to a 4T score less than or equal to 3 based on a retrospective calculation.

Results

There were 136 anti-PF4/heparin antibodies ordered in the time period specified in the protocol. Thirteen patients were excluded because of either previous history of HIT or being on hemodialysis (Fig. 1). Review of the remaining 123 patients, with average age of 69.4 years, 65 males and 58 females, showed that testing was indicated in 18 patients (14.6%) (Table 1). Six subjects had positive results, and testing was indicated in all of them. 4T score was documented in three patients only (2.4%) (Table 2).

Heparin products were stopped in 72 patients (58.5%). Alternate anticoagulant was started in 65 patients (52.8%), including all the six patients who had positive results.

This quality improvement study showed that 4T score documentation rate at Unity Hospital is 2.4%. Of note, this may not reflect the rate of 4T score use. Some patients with thrombocytopenia may not have the test ordered due to low 4T score and would not be in our sampling frame.

Table 1. 4Ts score and Elisa test results

	Positive test	Negative test	Total
Test indicated	6	12	18
Test not indicated	0	105	105
Total	6	117	123

Table 2. Documentation of 4Ts score

	4T score documented	4T score not documented	Total
Test indicated	1	17	18
Test not indicated	2	103	105
Total	3	120	123

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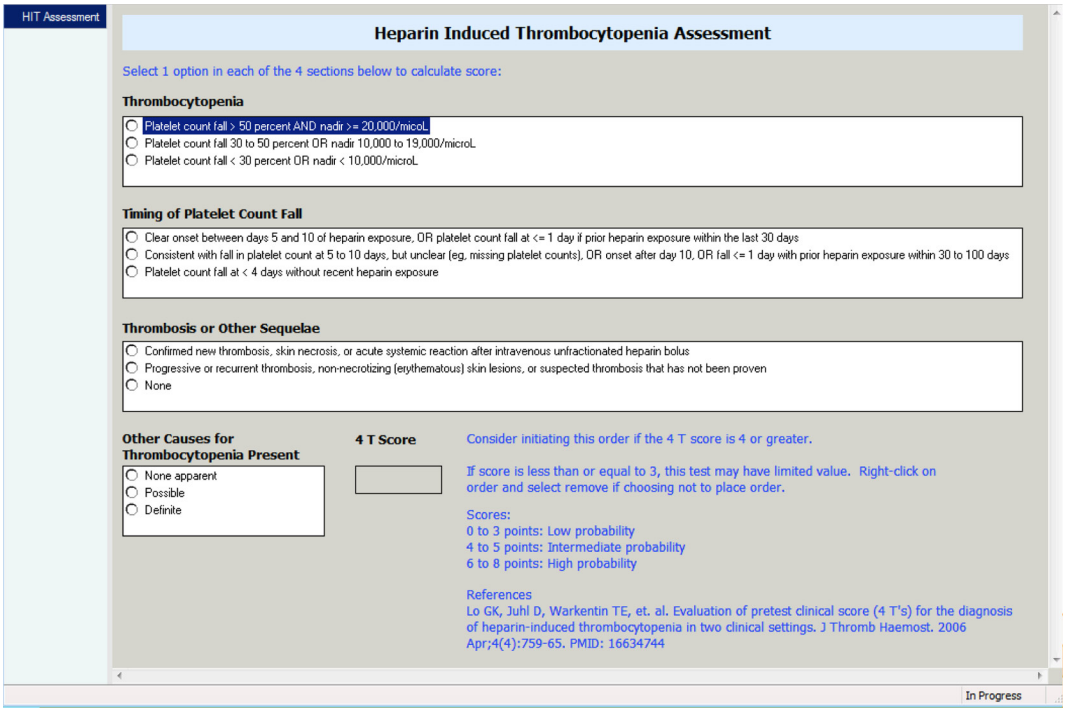

Fig. 2. 4Ts score calculator.

Anti-PF4/heparin antibody testing was indicated in 14.6%. This test is being overused in thrombocytopenia work up at Unity Hospital, with the fact that 85.4% of tests in this study were not indicated, costing $9,345. The topic was reviewed for residents in conferences and grand rounds. A prompt and calculator for 4T score (Fig. 2) were added to electronic medical records (EMRs) before ordering the test as a step to improve high value care and reduce unnecessary healthcare cost. A follow-up study will be done 1 year after EMR modification to evaluate the effect of our intervention.

Authors' contributions

YS, MT, RK, and TW have fulfilled the three criteria for authorship, all of them have made substantial contributions to the conception and design, or acquisition of data, or analysis, and interpretation of data and have been involved in drafting the manuscript or revising it critically for important intellectual content and have given final approval of the version to be published.

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Conflict of interest and funding

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