Routine Preoperative Coagulation Tests in Children Undergoing Elective Surgery or Invasive Procedures: Are They Still Necessary?

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Azzah Alzahrani[1], Nada Othman[1], Tahani Bin-Ali[1], Huda Elfaraidi[1], Eman Al Mussaed[2], Fahad Alabbas[1], Qanita Sedick[3], Fatma Albatniji[1], Ziyad Alshahrani[1], Mohammed Asiri[3], Omar Alsuhaibani[3] and Ghaleb Elyamany[3]

[1]Department of Pediatric Hematology/Oncology, Prince Sultan Military Medical City, Riyadh, Saudi Arabia. [2]Department of Basic Sciences, College of Medicine, Princess Nourah Bint Abdulrahman University, Riyadh, Saudi Arabia. [3]Department of Central Military Laboratory and Blood Bank, Prince Sultan Military Medical City, Riyadh, Saudi Arabia.

ABSTRACT

INTRODUCTION: Preoperative coagulation screening tests in pediatric patients was once routine clinical practice globally and still used as standard practice in some countries before surgical procedures to assess of perioperative bleeding risk.

OBJECTIVE: The study aimed to evaluate unselected routine preoperative coagulation testing in children undergoing elective or invasive surgery to predict abnormal perioperative bleeding. The study also aimed to provide a rational approach of determining bleeding and family history of coagulation disorders as a predictive risk for bleeding.

METHODS: This retrospective study conducted between 2014 and 2015 (1 year) on normal healthy children aged under 15 years admitted to the hospitals for elective mild to intermediate surgery or invasive procedures. We reviewed and collected the details of the clinical history, previous surgery, trauma, family history, detail of anti-thrombotic medication and coagulation tests performed (prothrombin time (PT), the activated partial prothrombin time (APTT), and international normalized ratio (INR)) at the time of admission.

RESULTS: Among 2078 cases, 1940 cases had normal coagulation tests (93.4%), 77 cases had abnormal coagulation results (3.7%), and 61 patients underwent surgery without preoperative coagulation screening (2.9%). In 15 of 77 patients, coagulation tests were normal on repeat testing. A total of 52 were confirmed to have abnormal screening testing. Among these 52 cases, 45 had normal factors assay; where seven patients had abnormal factors assay. Postoperative bleeding occurred only in three cases (0.14%), two cases due to surgical procedures with normal preoperative testing and one due to hemophilia A which was detected postoperatively as no preoperative testing was performed.

CONCLUSIONS: Routine coagulation screening before surgery or invasive procedures to predict perioperative bleeding in unselected patients is not recommended. Our study emphasizes that selective preoperative testing is more appropriate. Selective criteria for consideration of the latter includes physical examination, type of surgery, family and bleeding history, and concomitant use of antiplatelet and anti-thrombotic therapy.

KEYWORDS: coagulation screening, APTT, PT, bleeding, preoperative surgery

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CORRESPONDING AUTHOR: Ghaleb Elyamany, Department of Central Military Laboratory and Blood Bank, Prince Sultan Military Medical City, Makkah Al Mukaramah Road, As Sulaymaniya 11564, Riyadh, Saudi Arabia.
Email: ghalebelyamany@psmmc.med.sa

Introduction

Coagulation screens usually include the prothrombin time (PT), the activated partial prothrombin time (APTT), and international normalized ratio (INR). Preoperative coagulation screening tests in pediatric patients is still routine practice in many centers before surgical procedures to assess perioperative bleeding risk, despite many controversies about the need of such testing and its value in predicting risk of perioperative bleeding.[1]

The PT is used to evaluate the extrinsic pathway of coagulation which consists of tissue factor and factor VII, whereas the APTT is used to evaluate the integrity of the intrinsic coagulation pathway (prekallikrein, high molecular weight kininogen, factors XII, XI, IX, VIII). Both PT and APTT are used to assess the final common pathway of coagulation cascade (factors II, V, X, and fibrinogen).[2]

As recommended by some of early literatures,[3,4] PT, APTT, and INR are employed widely before invasive procedure and surgery.[3,5] Current evidence does not support the routine unselected coagulation testing because it has limited impact on perioperative outcome.[4,6] It also may delay surgery and cause unwarranted anxiety and stress for the patient. In addition, hospital resources including hospital admissions and visitations are increased.[7]

Many studies concluded that if the clinical history and physical examination do not predict an increased risk of bleeding, perioperative bleeding is unlikely and no further coagulation testing would be required.[8–11] However, this routine testing is still practiced in some countries including Saudi Arabia where there is a higher incidence of consanguinity causing concerns about increased rates of inherited bleeding disorders.

This study evaluated the use of unselected routine preoperative coagulation testing at our institute in children undergoing elective surgery or invasive procedures to determine abnormal perioperative bleeding.

The study also aimed to provide a more rational and cost-effective approach to using other tools such as bleeding and family history to reduce unnecessary testing.

Material and Methods

Patients

This retrospective study was conducted at Prince Sultan Military Medical City (PSMMC), a tertiary care hospital in Riyadh, Saudi Arabia from 2014 to 2015 (1 year). We included all normal healthy children aged less than or equal to 15 years admitted to the hospitals for elective mild to intermediate surgery or invasive procedures using the American Society of Anesthesiologists (ASA) classification system. Complex surgical cases and patients with specific comorbidities such as cardiovascular, renal, respiratory conditions, diabetes, and obesity were excluded from the study. Patients having cardiothoracic procedures or neurosurgery and patients with known bleeding disorders were excluded as well.

The medical records of children admitted to the surgical ward for elective surgery was reviewed. We collected details of the clinical history, patient age, sex, weight, previous surgery, trauma, family history, diagnosis, operation, service unit, grade of surgery, detail of anti-thrombotic medication, and coagulation tests performed (PT, APTT, and INR) at the time of admission. The data extracted included abnormal tests, positive bleeding history, platelet count, perioperative hemorrhagic complications, and change in management as a result of coagulation screening.

After admission to the hospital, informed consent was taken from the parents/guardians. This study was approved by the Institutional Review Board at Prince Sultan Military Medical City (PSMMC-IRB: 607).

Statistical analysis

Descriptive statistics was use to analyze demographic data using mean and standard deviation (SD). A *t*-test was used for comparison. A *P*-value of $<.05$ was considered significant.

Coagulation tests

The first-line coagulation tests commonly used are APTT and PT. These were measured using fully automated analyzers, Stago's STA-R Evolution® (the STA-R Evolution).

The laboratory upper limit for normal was 40 seconds for APTT and 11 seconds for PT for children more than 6 months. Neonates and infants had an upper limit of 43 seconds for APTT and 12.4 seconds for PT. If the coagulation screen is abnormal, we perform a mixing study. A PT and APTT which corrects to normal limits suggest a coagulation factor deficiency. If the coagulation tests failed to correct after mixing, the presence of an inhibitor such as heparin is suspected. Other coagulation studies (factor or inhibitor assay) were performed according to mixing study results. A prolonged PTT which corrects after a mixing study (mix 50% patients plasma with 50% normal pooled plasma) is followed by the appropriate factor assay (FXII, FXI, FIX, FVIII, and von Willebrand factor (vWF)). A prolonged PT which corrects post-mixing studies is followed by assays for factor FVII. If both PT and PTT are prolonged, assays for factors X, V, II and fibrinogen are performed.

Type of operations and invasive procedures

This study included healthy children with mild and intermediate surgery who were scheduled for elective surgery. Mild surgery include circumcision, excising skin lesion, draining abscess, dental procedures, trigger thumb, tongue tie, removal of facial scar or navus, lid repair surgery where intermediate included tonsillectomy or adenotonsillectomy, inguinal hernia repair, excision of varicose veins in the leg, and so on. Patients requiring surgery for trauma, cancer, major or complex surgery associated with a higher risk of bleeding complications, for example, intracranial, neurosurgical or major ophthamological surgery, were excluded.

Results

Table 1 presents patient characteristics and clinical data including age, sex, and grade and type of surgery. Among 2078 cases, 1940 cases had normal coagulation tests (93.4%), 77 cases had abnormal coagulation results (3.7%) and 61 patients underwent surgery without preoperative coagulation screening (2.9%). In 15 of 77 patients with abnormal coagulation results, coagulation tests were normal on repeated testing, where 52 were confirmed to have abnormal screening testing. Among these 52 cases, 45 had normal factors assay, where 7 patients had abnormal results. Two patients had low levels of vWF, two had decreased factor XII, one patient had factor XI deficiency, and two patients had lupus anticoagulants (LA). Postoperative bleeding occurred only in three cases (0.14%), two cases due to surgical procedures whose preoperative screening was normal, and one case due to

Table 1. Demographic and clinical data.

CHARACTERISTIC	
Age	
0-1	300 (14.4%)
2-8	1228 (59%)
9-15	550 (26.4%)
Mean (years)	5.9
Median (years)	5.0
Male	1332 (64.2%)
Female	746 (35.9%)
Grade of surgery	
Mild	1178 (56.7%)
Moderate	900 (43.3%)
Type of surgery	
• ENT (Ear, Nose, Throat)	727
• General surgery	243
• Urogenital	272
• Dental	370
• Orthopedics	95
• Plastic	130
• Eye	149
• Endoscopy	31
• Other procedures	55

hemophilia A in unscreened group, this patient had positive family history of bleeding (Figure 1).

Discussion

Routine preoperative testing is expensive, labor intensive, and rarely identifies significant abnormalities and did not benefit the patients. Abnormal coagulation profiles are not commonly associated with perioperative complications or abnormal laboratory results.[2,12,13]

Indiscriminate coagulation testing in emergency surgical patients leads to inappropriate routine testing.[14]

Systematic review of guidelines regarding postoperative bleeding risks does not recommend using indiscrimate coagulation screening before surgical or invasive procedures.[11] In our institute, the current hospital policy is to do routine coagulation screen on all pediatric patients, in addition to structured questionnaire used to elicit bleeding history.

In our study, none of the patients with an abnormal coagulation test had an adverse outcome during surgery. On the contrary, unscreened patients with normal coagulation tests had adverse outcomes, supporting recent guidelines.[11]

In our study 77 patients (77/2078, 3.7%) had abnormal coagulation screening tests, only seven patients confirmed to have abnormal bleeding disorders according to age-based reference values (7/2078, 0.3%), and postoperative bleeding occurred only in three cases (0.14%), two cases due to surgical procedures, and one case due to hemophilia A.

This patient had positive family history of bleeding when careful family and details history was taken after surgery but the family denied that in preoperative assessment. The very low incidence of postoperative bleeding due to bleeding disorders in our study (1/2078, 0.05%) support the current evidence that routine coagulation testing has limited impact on the perioperative outcome.[2,11,15] Defects of coagulation detected preoperatively have poor correlations with postoperative bleeding risks and volume of blood loss or transfusion requirement.[16]

In our study only three patients benefited from screening (two patients with von Willebrand disease (vWD) and one patient with FXI deficiency). FXII deficiency and LA which is known to prolong the PTT are clinically irrelevant and is not usually associated with bleeding.

Case with vWD that received von Willebrand factor/factor VIII (vWF/FVIII) concentrates before surgery and proceed to surgery and had no bleeding during or postoperative, whereas patient with FXI deficiency received replacement therapy had no operative or postoperative bleeding as well.

Factor XII deficiency is a common cause for prolongation of the APTT, being present in 2% in some cases.[17] Lupus anticoagulant is another common cause for prolonged PTT and usually has no clinical significance.[18,19]

Our study emphasizes that preoperative testing should be performed based on physical examination, type of surgery, bleeding history including family history of coagulation disorders, previous abnormal bleeding and the use of any medications affecting coagulation.[4,20]

There are specific limitations to each test such as technical variability and detection of disorders not associated with bleeding, like FXII deficiency, LA, prekallikrein and high molecular weight kininogen, which delay surgery due to patients being subjected to further unnecessary, time-consuming, and expensive tests.[4,19]

One possible explanation of why physicians continue to do preoperative coagulation screening despite evidence which contradicts its usefulness in management, is the fear of malpractise accusations.

Conclusions

Routine preoperative testing is expensive, labor intensive and is unlikely to identify significant abnormalities. Abnormal coagulation test results preoperatively have no impact on surgical or anesthetic procedures or on postoperative complications. Preoperative testing is most beneficial when based on physical examination, type of surgical procedure, bleeding and family history of coagulation abnormalities, previous history of postoperative bleed, and

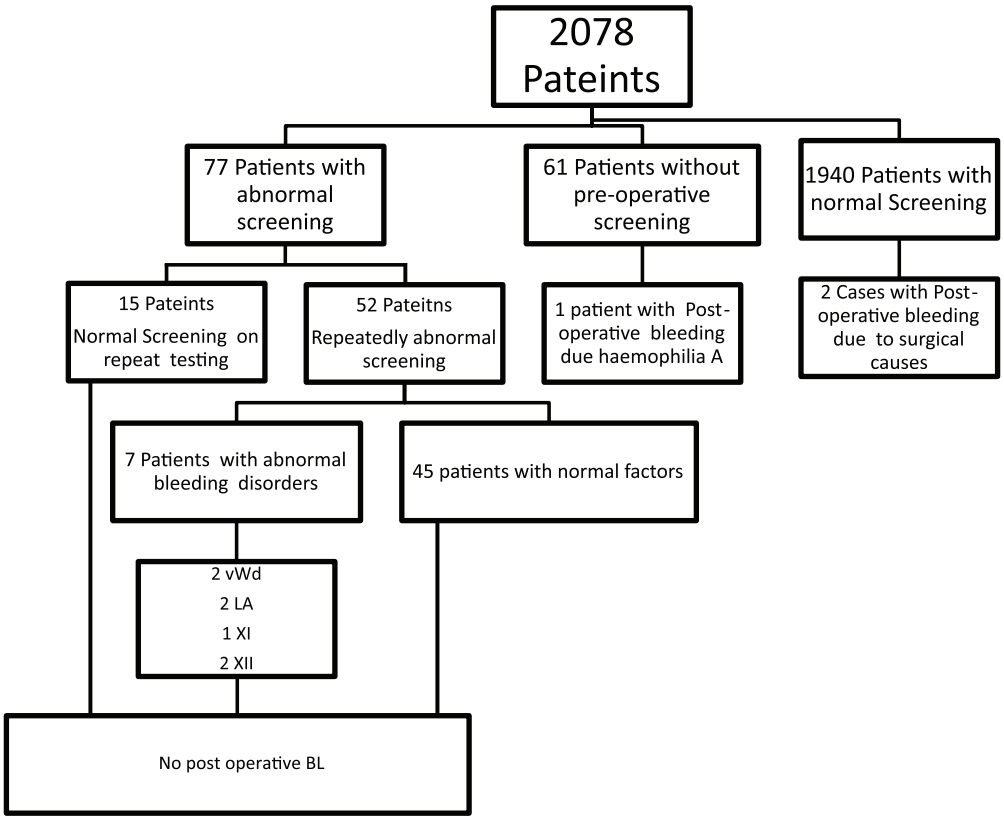

Figure 1. Coagulation results.

concurrent anti-thrombotic medication usage. Further studies evaluating physician practice with regard to guideline adherence is required to reduce unnecessary work up costs.

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Author Contributions

Analyzed the data: AA, GE , QS, NO. Wrote first draft GE, AA, QS, NO, ZA. Contributed to writing of the manuscript TA, HE, EA, FA, FAL, MA, OA. Agree with manuscript results and conclusions: All authors. Made critical revisions and approved final version: GE, AA, EM, HE. All authors reviewed and approved of the final manuscript.

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