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Preoperative Coagulation Screening in Elective Surgery: Prevalence and Spectrum of Hemostatic Abnormalities in Diyala Governorate

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Abstract Preoperative screening tests are important for recognizing medical conditions that may mark surgical or anesthetic outcomes. This study evaluated the usefulness of routine coagulation screening in detecting bleeding risks prior to elective surgery. Over one year (January 2023–January 2024), 500 patients referred for preoperative assessment at Al-Shams Medical Laboratory in Diyala Governorate were studied (220 males, 280 females; age range 2–76 years). All patients underwent basic coagulation tests, including PT, APTT, TT, fibrinogen level, and platelet count. Patients with abnormal results were referred for advanced diagnostic investigations. Coagulation abnormalities were detected in 20 patients (4%), pre-analytic errors being the most common reasons for these abnormalities, followed by immune thrombocytopenic purpura, Glanzmann's thrombasthenia, VWF deficiency, factor VII, IX, and XIII deficiencies, Hypofibrinogenemia, and disseminated intravascular coagulation. Most of those patients were asymptomatic and had no prior history of bleeding, Therefore, coagulation secerning tests is vital preoperative to detect undiagnosed coagulation abnormalities and avoid bleeding and complications through operative.

Key Words: Preoperative Screening, Platelets, Coagulation Disorders, Thrombocytopenia, Elective Surgery

INTRODUCTION

Pre-operative clinical and laboratory assessment is usually performing as an essential step before any surgical procedures, one of these laboratory tests is the hemostatic screening tests which done and designed to: detects any abnormalities in haemostasis that may increase the risk of intra-operative or post-operative bleeding and or thrombotic complication, to evaluate a patient's overall health and to identify conditions that may influence surgical or anesthetic outcomes. Bleeding complication is one of the most detectable surgical complication which may occurs due to coagulation abnormalities, bleeding can results in increased morbidity, increased mortality, increased need for blood transfusion, reoperation , for all these reasons , Detection of these abnormality will allow appropriate preventive measures before surgery and reduce these complication [1–3]. Hemostasis is a complex physiological processes involving many factors which includes blood vessels integrity, blood platelets, coagulation factors, coagulation factors inhibitors & fibrinolytic systems. Any defect in each of these mention factors may predispose patients to abnormal bleeding and or thrombosis.

The assessment of hemostasis typically includes physical examination, laboratory investigations, and imaging studies. Blood coagulation screening test includes, complete blood count (CBC) looking for platelets count and coagulation profiles [1,3,4,5,6]. Standard coagulation screening profiles usually includes Prothrombin Time (PT) and Activated Partial Thromboplastin Time (APTT), which assess the extrinsic and intrinsic coagulation pathways, respectively, Thrombin time, fibrinogen assay and bleeding time to asses' platelet's functions [7]. These test are widely a variable, relatively not costly and easily to perform, for that reasons they are routinely used as a screening tests in many healthcare setting and used particularly in identifying asymptomatic patients with underlying hemostatic abnormalities that may otherwise remain undetected.

Aim of the Study

To determine the frequency of abnormality in routine preoperative coagulation screening tests results in patient prepare for elective surgical procedures.

METHODS

Study Population

This cross-sectional study was conducted over one year (January 2023–January 2024). A total of 500 patients attending Al-Shams Medical Laboratory in Diyala Governorate were included. All patients were prepared for different types of elective surgical procedures so they referred to the laboratory from different surgeon and gynecologist for routine preoperative coagulation assessment. The study population consisted of 220 males (44%) and 280 females (56%), aged between 2 and 76 years. A control group of 100 healthy, age- and sex-matched individuals (40 males and 60 females) was also included.

All patients who had undergone various surgical procedures and had no prior history of coagulation disorders were selected and underwent coagulation testing prior to the operation.

One hundred healthy individuals with no history of coagulation abnormalities were selected to comparation their results with those of the study members.

Laboratory Investigations

All patients underwent basic hemostatic screening tests, including:

- Platelet count
- Prothrombin Time (PT)
- Activated Partial Thromboplastin Time (APTT)
- Thrombin Time (TT)
- Plasma fibrinogen level

And according to results of above coagulation screenings test, further specific test are ordered to identify their underlying cause of theses abnormality, these test include specific coagulation factors assay and platelets function test.

Platelet counts were measured using a Sysmex N-350 automated hematology analyzer. Normal platelet reference range was 150–400 $\times 10^9$/L.

Coagulation screenings tests and Fibrinogen levels estimation were measures using Start Max coagulation auto-analyzer with its kits supply from Stago Company. Pooled plasma from at least five healthy individuals was prepared daily and used as control.

RESULTS

The following results were obtained from a coagulation screening test which was done for 500 patients scheduled for elective different type's surgical procedures, there were 220 men's (45.6%) and 280 women's (55.4%). With an age range of 2-76 years for men's and 2-67 years for women's. The frequency distribution of age and sex in healthy controls and patient cases are shown in Table 1 below.

Pre-Operative Coagulation Screening Test Results

Analysis of coagulation test results in the 500 studied patients revealed, Normal coagulation profiles was detected in 480 patients (96%), coagulation abnormalities detected in at least one coagulation perform tests was detected only in 20 patients (4%). The most frequently detected abnormality was pre-analytic errors, identified in 10 patients (50%), followed by immune thrombocytopenia, identified in three patients (15 %). The remaining seven cases included one patient (5%) each with Glanzmann's thrombasthenia, von Willebrand factor deficiency, factor XIII deficiency, factor IX deficiency, factor VII deficiency, Hypofibrinogenemia, and disseminated intravascular coagulation, as summarized in Table 2. Comprehensive clinical histories were obtained prior to testing. Only five patients (25 %) reported a bleeding tendency, while the remaining patients with abnormal coagulation findings were completely asymptomatic and had no associated clinical conditions.

Table 1: General Characterization of Patients

Characters patients N = 500			
Age (year)	Range (2-76) Mean (19.96)		
	Men (2-76) Mean (20.08)		
	Women (2-67) Mean (19.92)		
Sex	Men	N= 220	(44 %)
	Women	N= 280	(56 %)

Table 2: The Distribution of Surgical Procedures of Patients Included in Study was as following

Types of Surgery	Numbers	Percentage
General surgery	200	50
Ophthalmology surgery	50	10
Orthopedics surgery	75	15
ENT surgery	25	5
Gynecological surgery	75	15
Urology surgery	25	5
Other types of surgery	50	10

Table 3: Types of Coagulation Disorders

N = 20 patients (4%) from the total Patients			
Pre-analytic Errors	Men	N= 6	(30%)
	Women	N= 4	(20%)
I.T.P	Men	N= 3	(15%)
	Women	N= 0	(0%)
Glanzmann's thromboasthenia	Men	N= 0	(0%)
	Women	N= 1	(5%)
Factor VII deficiency	Men	N= 1	(5%)
	Women	N= 0	(0%)
Factor IX Deficiency	Men	N=0	(0%)
	Women	N=1	(5%)
FXIII deficiency	Men	N= 1	(5%)
	Women	N= 0	(0 %)
VWF deficiency	Men	N= 1	(5 %)
	Women	N= 0	(0 %)
Hypofibrinogenemia	Men	N= 0	(0%)
	Women	N= 1	(5%)
D.I.C	Men	N= 0	(0%)
	Women	N= 1	(5%)

Result of Coagulation Screening Tests of Control Group

The results of coagulation screening tests in the control group are presented in Table 4. The mean platelet count was 260.7 $\times 10^9$/L (range: 210–300 $\times 10^9$/L). The mean prothrombin time was 12.9 seconds (range: 12–15 seconds), while the mean activated partial thromboplastin time was 35.1 seconds (range: 32–39 seconds). The mean thrombin time was 14.4 seconds (range: 13–17 seconds). The mean plasma fibrinogen level was 3.0 g/L (range: 2.52–3.64 g/L).

Table 4: The results of the Coagulation Test of Healthy Controls

Coagulation Tests	Healthy controls
Platelets count (x 109/L)	
Range	(210-300)
Mean±SE	260.7±7.96
PT (sec.)	
Range	(12-15)
Mean±SE	12.9±0.27
PTT (sec.)	
Range	(32-39)
Mean±SE	35.1±0.56
TT (sec.)	
Range	(13-17)
Mean±SE	14.4±0.39
Fibrinogen (g/L)	
Range	(2.52-3.64)
Mean±SE	3±0.08

Table 5: Result of Patient with Coagulation Abnormality

N	PT Sec	PTT Sec	Fibrinogen g/L	TT Sec	Platelet's count	Diagnosis
Control	12	33	3.2	10	150-400	Healthy
Patients1-10	45	32	2.9	11	10	Re-sampling normalized the results
Patients11	12	30	4.0	12	60	I.T.P diagnosed by BM Examination
Patients 12	12	33	2.8	13	30	I.T.P diagnosed by BM Examination
Patients13	12	30	4.0	12	60	I.T.P diagnosed by BM Examination
Patients14	12	33	2.7	10	310	Glanzman's thrombasthen diagnosed platelet's function assay
Patients15	55	31	2.9	11	280	Factor VII Deficiency Diagnosed by FVII Clotting assay
Patients 16	12	99	2.8	11	267	Factor IX Deficiency diagnosed by FIX Clotting assay
Patients17	13	110	3.0	12	330	FXIII Deficiency Diagnosed by FXIII Clotting assay
Patients18	12	85	3.7	12	400	VWF Deficiency diagnosed by VWF- Ag Assay
Patients19	10	33	0.8	10	370	Hypofibrinogenemia
Patients20	90	130	0.4	22	20	D.I.C

Result of Coagulation Screening Test of Patient Group

Table 5 summarizes the coagulation screening test results in patients with abnormal findings.

Abnormalities in all coagulation test results were detected in 10 patients (2%) without any bleeding history or any clinical evidences suggested hemostatic abnormalities in those patients this make us think of pre-analytic sample errors, so re-sampling with application of good patient preparation and using standard operating technique for sample collection and coagulation test performance, re-testing give completely normal test results. Thrombocytopenia (platelet count <150 ×10⁹/L) was detected in three patients (15%) and represented the most common hemostatic abnormality. All three patients had normal results in other coagulation tests and were referred for bone marrow examination, which confirmed immune thrombocytopenic purpura (ITP).One patient (5%) presented with bleeding manifestations, including skin purpura and epistaxis, despite normal routine coagulation screening results. Platelet function testing revealed Glanzmann's thrombasthenia.

Isolated prolongation of prothrombin time was observed in one patient (5%), with a PT value of 55 seconds and otherwise normal coagulation results, indicating an extrinsic pathway defect. Subsequent factor assay confirmed factor VII deficiency.

Three patients (15%) showed isolated prolongation of activated partial thromboplastin time (APTT values: 99, 110, and 85 seconds) with normal remaining screening tests, suggesting intrinsic pathway abnormalities. Specific factor assays for those three patients identified factor IX deficiency, factor XIII deficiency , and von Willebrand factor deficiency respectively .

One patient (5%) demonstrated isolated Hypofibrinogenemia, with a fibrinogen level of 0.8 g/L and normal other coagulation parameters, leading to a diagnosis of Hypofibrinogenemia.

Finally, one patient (5%) exhibited abnormalities in all coagulation screening tests, including prolonged PT, APTT, and TT, thrombocytopenia, and Hypofibrinogenemia. This patient had clinical bleeding manifestations, and combined laboratory findings and peripheral blood film examination confirmed disseminated intravascular coagulation (DIC).

DISCUSSION

The coagulation screening tests are routinely performed to prepared patient for any surgery to identify patients at risk to developed bleeding and or thrombosis during surgery. Hemostatic abnormalities are frequently encountered in clinical practice and may remain clinically silent especially in mild deficiency, until unmasked by physiological stress such as surgery or trauma. These abnormalities may involve any component of the hemostatic system, including platelets, coagulation factors, fibrinogen, or fibrinolytic pathways [8,9]. The present study demonstrates that routine preoperative coagulation screening can identify a spectrum

of clinically significant bleeding disorders even in asymptomatic patients, emphasizing its value in perioperative bleeding risk assessment.

Our current study show, Pre-analytic errors in coagulation screening tests are the most frequently detected cause of abnormalities in coagulation test results and represent a significant contributes to abnormal results especially in asymptomatic patients. In current study which detected in 10 patients, this can frequently if unsolved will cause delayed in peri-operative decision making. The cause of these pre-analytic errors may be due to inadequate patient's preparation, physiological conditions, errors during sampling, errors in specimens handling or transports, sample processing errors, patient's identification and documentations error. The diagnosis of this errors is essential to prevent misdiagnosis and unnecessary post-ponding surgical procedures and further unnecessary tests.

The findings of the present study demonstrate that pre-analytical errors in coagulation screening tests represent a major contributor to abnormal coagulation results, particularly among asymptomatic patients. In our cohort, abnormalities linked to pre-analytical issues were detected in ten patients and were associated with delayed peri-operative decision-making. These data confirm earlier literature reports of the fact that pre-analytical variables account for 60–70% of all laboratory testing errors, especially having a strong effect on coagulation assays (PT, aPTT, INR and other screening tests), due to their high sensitivity to specimen quality [10,11].

A number of different pre-analytical factors were involved in the observed laboratory anomalies. They include improper patient preparation, physiological factors, sampling errors, specimen handling and transport errors, delays in processing and patient identification/documentation mistakes. These factors have already been widely acknowledged in the literature as the major determinants of erroneous coagulation profiles [12-14]. Thus, incorrect blood-to-citrate ratio, hemolysis, delayed centrifugation, or partial clot formation may cause a prolongation of clotting time falsely and mimic coagulopathy in healthy patients [15,16].

One of the most important clinical implications of our observations is the possibility of misinterpreting coagulation abnormalities in surgical patients without any bleeding symptoms or history. Unnoticed pre-analytical problems may lead to unnecessary delays in the performance of surgery, additional and unnecessary investigations, and in some cases, even unnecessary transfusions of fresh frozen plasma or factor concentrates. This exposes patients to risks and increases health care expenses [17,18]. Previous studies on peri-operative hematology have shown that abnormal PT/aPTT in asymptomatic patients most often are the reflection of non-clinical problems and do not correlate with any clinically meaningful coagulation disorders [19].

Our data emphasize the necessity of systematic efforts to detect and prevent pre-analytical variability. Interventions that include proper patient preparation, venipuncture and tube filling education, improved transport logistics, temperature and time control, and strict implementation of patient identification check-lists were suggested as effective strategies [20-22]. Implementation of such strategies into laboratory quality management system is necessary to ensure that abnormal screening tests indicate genuine hemostatic abnormalities and not artifacts.

Thus, the current investigation supports the increasing body of evidence about the role of pre-analytical errors as a source of inaccuracy in diagnostics in coagulation testing. Correcting such errors is essential to improve diagnostic validity, prevent misclassification of patients, and avoid unnecessary peri-operative delays. Future research with bigger sample size and multi-center collaboration is needed to quantify the prevalence and clinical significance of certain pre-analytical variables in different settings.

Thrombocytopenia was the second most frequently detected laboratory abnormality accounting for the majority of abnormal findings. This data coincides with other literature sources describing thrombocytopenia as a frequent incidental laboratory finding in preoperative workup [10,11]. Not only the prevalence of this finding, but also its unpredictability due to the lack of correlation between the severity of bleeding and platelet count makes this diagnosis clinically important. Mild or moderate thrombocytopenia may be entirely asymptomatic, yet predispose patients to the risk of excessive bleeding intra- and postoperatively, especially during invasive procedures. Therefore, platelet count remains an important part of preoperative screening [23-26].

Platelet function disorders represent a special problem of diagnostics, since such patients may have normal platelet count and regular results of coagulation tests. In the current study, Glanzmann's thrombasthenia was detected in a patient with a history of bleeding, but with normal screening findings. This observation emphasizes the importance of taking detailed clinical history in preoperative setting. Earlier literature reports have stressed that mucocutaneous bleeding, epistaxis, easy bruising or prolonged bleeding after minor trauma should be considered as indicators of qualitative platelet disorders, which require specialized platelet function testing [27,28]. Failure to recognize such disorders preoperatively may cause serious peri-operative bleeding complications.

Isolated prolongation of PT or APTT was useful in detecting rare coagulation factor disorders in this investigation, including deficiencies of factor VII, IX, XIII, and von Willebrand factor. These disorders are usually inherited and may present with variable severity depending on factor activity level [26-29]. It should be mentioned that many patients with mild factor deficiencies do not manifest any symptoms throughout life and are accidentally detected during routine preoperative testing. Even though these abnormalities do not present any symptoms, they may cause unexpected bleeding during surgery if they are not detected and managed properly. This stresses the importance of analyzing separate anomalies in coagulation screening tests and not considering them as laboratory artifacts.

Von Willebrand factor deficiency deserves special attention because of relatively high prevalence among other inherited bleeding disorders and tendency for underdiagnosis. VWF plays two important roles in hemostasis – it promotes platelets adhesion and stabilizes factor VIII. Mild VWF deficiency may remain asymptomatic until the development of complications in surgical or obstetric setting. Detection of VWF deficiency in the current study corresponds with previous epidemiological findings that the proportion of undetected VWF abnormalities is large unless specific screening is performed [30].

The detection of Hypofibrinogenemia in an asymptomatic patient emphasizes the importance of fibrinogen testing in routine preoperative screening. Congenital fibrinogen disorders are rare, yet clinically significant, since fibrinogen plays an important role in clot formation and stabilization. Even small defect of this protein may increase the risk of bleeding during surgery, delay of wound healing, or postoperative bleeding [20]. Early detection enables appropriate peri-operative management and diminishes surgical risks.

The detection of disseminated intravascular coagulation (DIC) in a patient with pre-existing cancer stresses the necessity of thorough coagulation testing in patients with systemic diseases. Disseminated intravascular coagulation is a complex acquired disorder characterized by widespread activation of coagulation, consumption of clotting factors and platelets and subsequent fibrinolysis [31,32,33]. In the postoperative period, unrecognized DIC may lead to severe hemorrhagic or thrombotic complications. Malignancy-associated disseminated intravascular coagulation (DIC) as was revealed in this study is well documented and stresses the need for increased vigilance in the assessment of patients with known or suspected malignancy [34,35].

The results of this investigation support the necessity of routine preoperative coagulation screening especially in combination with thorough clinical history and physical examination. Even though the prevalence of discovered anomalies was not high, the clinical significance of missed diagnoses can be serious. Early detection of hemostatic abnormalities allows for the individual approach to perioperative management and includes operation delay, hematology consultation, or prophylactic therapy.

CONCLUSION

Coagulation screening tests are vital for any patients who are candidates for elective surgical procedures. Pre-analytical mistakes are the most common cause of abnormality in coagulation tests especially when it comes to asymptomatic patients. Hemostasis disorders could be observed in patients without having any symptom of bleeding. It is very important to conduct routine preoperative screening to detect various bleeding problems that may occur genetically and/or acquired.

Recommendations

Preoperative screening for coagulation is recommended for all the patients undergoing different types of elective surgeries.

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