Original Article

Utilization of Coagulation Studies in Emergency Department: A Chart Review

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Abstract

Aim: This study aimed to determine the prevalence of abnormal coagulation studies in emergency department (ED) patients with and to investigate the relationship among chief complaints, past medical history or drug history, and abnormal results of coagulation studies.

Materials and Methods: In this retrospective chart review study, ED records of patients who had undergone coagulation studies were obtained. Patient data, including demographics, chief complaints, past medical history, drug history, and clinical impression, were reviewed. Descriptive and statistical analyses were performed.

Results: A total of 322 charts were reviewed. Thirteen patients (4.04%) had an abnormal international normalized ratio (INR), of which six (46.2%) were on warfarin therapy. Although chest pain was the most prevalent chief complaint (10.4%), no statistically significant relationship was found between chief complaints and INR levels. Patients with past medical history of thromboembolic risk were likely to have an abnormal INR [likelihood ratio (LR): 8.8]. Patients on warfarin therapy had a statistically significant likelihood of having abnormal INR (LR: 32.8) (p=0.000). Coagulation profiling was repeated in 4.35% of the patients, with a request gap mean of 6 days.

Conclusion: Chief complaints upon presentation to the ED are not good predictors of INR abnormalities. However, warfarin therapy and past medical history of thromboembolic events demonstrated robust association with abnormal INR levels. Routine coagulation studies are not indicated in all patients presenting to the ED.

Keywords: Coagulation, emergency department, utilization

Introduction

Emergency departments (EDs) use coagulation tests as part of their patients' evaluation. This would include a wide range of clinical scenarios where there is an anticipated possibility of performing an invasive procedure or initiating an anticoagulant or thrombolytic therapy. This is obviously done as a screening test for an unrecognized bleeding disorder or hypercoagulable state i.e. a baseline value.

Cost-effectiveness and patient satisfaction are two important factors that play a big role in health care management, particularly in the ED where waiting time and resources utilization are of a huge impact on the services provided. These two factors should be modified for the institutional benefit, patient care, and quality improvement. Proper utilization of certain laboratory tests plays a determinantal role in these factors. In our ED, 45,000 annual visits, the total number of coagulation profile requested in a single year was 8,695. This represents 18.5% of total hematology tests and 7.2% of total laboratory investigations ordered throughout the same year.

The operational cost of the coagulation profile in the Kingdom of Saudi Arabia ranges from 18 to 37 US dollars.

Many studies showed a clear relationship between the patient length of stay in the ED, and laboratory performance and the number of tests requested per patient. Reduction in turnaround time affects emergency staff satisfaction as well (1,2). Laboratory turn-around time for hematology requests from our department

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was ranging from 12 minutes to 665 minutes per sample. The average turn-around time was 75 minutes.

Many studies have evaluated the efficacy of routine coagulation studies, most of them in the surgical and anesthesia literature as preoperative screening tests (3). Additional studies evaluated their utility prior to angiographic tests, on admission to the general medicine ward, and one study evaluated their importance in patients with a probable diagnosis of deep vein thrombosis (4-6). None of these studies found any justification for routine administration of the tests in any of the above-mentioned conditions. On the other hand, other studies showed the importance of Coagulation Profile as a prognostic factor in certain conditions e.g. polytrauma, head injuries, Systemic Inflammatory Response Syndrome, and Gastrointestinal bleeding (7-20).

Materials and Methods

Leaders of ED noticed that coagulation studies are being overutilized. A thorough literature review was done to find out that there are multiple studies that address the overutilization of the coagulation profile in other settings in the hospital.

The purpose of this study was to determine the prevalence of abnormal international normalized ratio (INR) levels in patients presenting to the ED and if there is a correlation between the INR levels and patients' chief complaints and other clinical data. The study was also quantifying the relevance and utilization of coagulation tests and its financial burden to the institution as well as the length of stay of patients in the ED, hence inconveniencing both the department and the patients.

In this retrospective chart review, we selected the month of August to apply our study to as it had the highest number of coagulation tests being requested throughout the year. The total number of ED visits during August was 3,579 patients.

We identified those patients who had a coagulation study done for, who were 801 patients. We postulated our margin of error to be <5% which gave as a sample size of at least 260. Using simple random sampling, we reviewed 322 charts of ED visits.

Data were entered through electronic sheets. Data collected were demographics, chief complaint, drug history "specifically aspirin, plavix, warfarin, and low molecular weight heparin (LMWH)", past medical history, clinical impression, and repeated tests if any. Some patients had more than one chief complaint; each chief complaint was counted as a separate entry. For statistical purposes, relevant chief complaints were grouped together and analyzed as one entity. All charts were included No patients were excluded from the study. For charts with missing "chief complaint" field, they were included in the "no history" category.

Other missing data were left blank during data entry. Past Medical History was categorized into groups of possible disease risk. These are; 1. Atherosclerotic Risk [diabetes mellitus (DM), hypertension (HTN), ischemic heart disease (IHD), cerebrovascular accidents (CVA) and dyslipidemias]; 2. Thrombo-embolic Risk [pulmonary embolism (PE), deep vein thrombosis (DVT), oncology patients]; 3. Respiratory Risk [chronic obstructive pulmonary diseases (COPD), bronchial asthma (BA), other pulmonary conditions]; 4. Other past medical histories. INR results were classified as normal and abnormal. Abnormal INR was defined as any INR >1.5.

Statistical Analysis

Linear Regression analysis of data was done using SPSS program version 15.0. This included descriptive data analysis and statistical data analysis for each variant versus INR. The study was done in accordance with the methods/methodical section of the Ethical Principles for Medical Research amended in October 2013. Statistical significance was defined at the 5% (p<0.05).

Results

Descriptive data analysis showed a wide range of Chief complaints for which coagulation studies are being requested (Table 1). The commonest chief complaint among patients who had a coagulation study requested was chest pain, followed by

Table 1. Frequency of chief complaints		
Chief complaint	n	%
Chest pain	41	10.4%
Abdominal pain	38	9.7%
Shortness of breath	31	7.9%
Other central nervous system complaints	29	7.4%
Other gastrointestinal complaints	24	6.1%
Vomiting	23	5.9%
Musculoskeletal pain	23	5.9%
Fever	23	5.9%
Obstetrics and gynecology	23	5.9%
Other complaints	23	5.9%
Limb(s) weakness	17	4.3%
No history	16	4.1%
Other cardiopulmonary complaints	16	4.1%
Dizziness	15	3.8%
Other abdominal pains	14	3.6%
Epigastric pain	12	3.1%
Motor vehicle accident	10	2.5%
Renal pain	8	2.0%
Head, eye, ear, nose or throat pain	7	1.8%
n: Number		

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abdominal pain and shortness of breath (10.4%, 9.7%, 7.9%). Out of 322 INR results, 13 patient (4.04%) had abnormal INR level, ranging from 1.6 to 5.6 with a mean of 2.7. These patients had different presenting chief complaints to the ED and variable past medical history (Tables 2 and 3). Among the patients with high INR levels, six patients were on warfarin (46.2%), one of them was on aspirin as well. None of them was on plavix nor heparin/ LMWH (Table 4). One of the patients with abnormal INR had an INR level measured three days earlier. The first time showed a normal INR "1.2" while three days later it showed a high INR of 2.6. This patient was on Warfarin in both visits.

Table 2. INR levels and their frequencies		
INR	Frequency	Percentage
<1.5	309	96.0%
>1.5	13	4.0%
Total	322	100.0%
INR: International normalized ratio		

Table 3. Frequency of past medical history		
Past medical history	n	%
Hypertension	80	25.7%
Diabetes mellitus	74	23.8%
Ischemic heart disease	45	14.5%
Oncology	30	9.6%
Chronic obstructive pulmonary disease	10	3.2%
Cerebrovascular accident	9	2.9%
Bronchial asthma	9	2.9%
Other lung diseases	6	1.9%
Chronic liver disease	6	1.9%
Patient on active chemotherapy	6	1.9%
Thyroid disease	6	1.9%
Chronic renal failure	5	1.6%
Epilepsy	5	1.6%
Dyslipidemia	4	1.3%
Organ transplant	4	1.3%
Deep vein thrombosis	3	1.0%
Sickle cell anemia	2	0.6%
Psychiatric Illness	2	0.6%
Pulmonary embolism	1	0.3%
Pregnancy	1	0.3%
Other blood diseases	1	0.3%
Valvular heart disease	1	0.3%
Atrial fibrillation	1	0.3%
Total	311	100.0%
n: Number		

Coagulation studies were repeated for 14 patients on different presentations to the ED. Each patient had a repeated test twice with an interval ranging from 1 to 23 days, and a mean of 6 days. Table 5 is showing the INR values, chief complaints, and impression on each visit "if available". This is followed by the past medical history of the patient and his current medication.

No statistically significant relationship was found between any of the chief complaints and INR level (Table 6). Furthermore, no statistically significant relationship was found between past medical risk factors and INR levels (Table 5). On the other hand, there is a high statistical association between the use of warfarin and INR level (Table 7).

Discussion

The ED receives a wide range of clinical presentations. The situations in which patients present to the ED might influence the clinical course of the patient including history taking, physical examination, laboratory investigations, Interventions, type of medications, and patient disposition. Another practical obstacle is patient with difficult intravenous access e.g. children and IV drug abusers.

The initial chief complaint upon presenting to the ED might not be the complaint of concern to the attending physician e.g. a patient who comes with leg pain who is found to be on warfarin therapy for DVT and having an associated dyspnea.

Table 4. Clinical data of patients with abnormal INR level			
INR	Chief complaint	Past medical history	Warfarin
5.6	Generalized body weakness	PE, oncology	Yes
4.2	Dizziness	IHD	Yes and ASA
3.7	Palpitation, fever	HTN, IHD, COPD	Yes
3.1	Chest pain, shortness of breath	DM, HTN, IHD, BA	Yes
2.6	Chest pain	DM, HTN, IHD	Yes
2.4	Ear discharge, fever	No	No
2.4	Sore throat	DM, HTN, DVT	Yes
2.1	Right sided weakness	DM, HTN	No
2.0	Decreased urine output	DM, HTN	No
1.9	Left leg pain	DVT	No
1.8	Chest pain	DM, HTN, IHD	No
1.7	Motor vehicle accident	No	No
1.6	Shortness of breath	Oncology	No
INR: International normalized ratio, PE: Pulmonary embolism, IHD: Ischemic heart disease, HTN: Hypertension, COPD: Chronic obstructive pulmonary disease, DM: Diabetes mellitus, BA: Bronchial asthma, DVT: Deep vein thrombosis, ASA: American Society of Anesthesiologists			

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Table 5. The likelihood ratio of abnormal INR vs historical risk factors

Risk factors	Likelihood ratio (p value)
Atherosclerosis	7.0 (0.07)
Thromboembolic	8.8 (0.01)
Lung	4.7 (0.10)
Other	3.4 (0.06)
INR: International normalized ratio	

Table 6. Odds and likelihood ratios of abnormal INR vs chief complaints

Chief complaint	Odds ratio (95% CI)	Likelihood ratio (p value)
Musculoskeletal pain	1.09 (0.14-8.75)	0.01 (0.94)
Other complaints	1.14 (0.14-9.22)	0.02 (0.90)
Limb(s) weakness	1.53 (0.19-12.48)	0.14 (0.71)
Shortness of breath	1.76 (0.37-8.31)	0.45 (0.50)
Dizziness	1.76 (0.21-14.47)	0.24 (0.63)
Chest pain	2.14 (0.56-8.12)	1.10 (0.30)
Fever	2.49 (0.52-11.99)	1.08 (0.30)
Motor vehicle accident	2.78 (0.33-23.73)	0.69 (0.41)
Renal pain	3.60 (0.41-31.59)	1.01 (0.32)
Cardiac complaint	6.83 (1.68-27.83)	5.39 (0.02)
Head, eye, ear, nose and throat complaint	11.06 (1.93-63.40)	5.13 (0.02)
Abdominal pain	N/A*	3.34 (0.07)
Vomiting	N/A*	1.97 (0.16)
Other gastrointestinal complaints	N/A*	1.88 (0.17)
Other abdominal pain	N/A*	1.18 (0.28)
Obstetrics and gynecological complaint	N/A*	1.97 (0.16)
No history	N/A*	1.35 (0.25)
Epigastric pain	N/A*	1.01 (0.32)
Central nervous system	N/A*	2.51 (0.11)
*N/A indicates no abnormal INR in the category		
N/A: Not available, CI: Confidence interval, INR: International normalized ratio		

Table 7. Odds and likelihood ratios of abnormal INR vs drug history

Rx	Odds ratio (95 %CI)	LR (p value)
Warfarin	131.6 (22.5-770.1)	32.8 (0)
ASA	1.4 (0.2-11.7)	0.1 (0.8)
Plavix	N/A	0.7 (0.4)
INR: International normalized ratio, LR: Likelihood ratio, CI: Confidence interval, ASA: American Society of Anesthesiologists, N/A: Not available		

Another point worth mentioning is, "pricking the patient a second time". Many physicians would do a coagulation profile to keep it "stand by" or "if needed" rather than a second prick. This is understandable as many patients in ED would have a disposition diagnosis different from their provisional diagnosis. The ethical and cost-effectiveness aspects should be balanced to reach an answer to the question "Prick again or not?". Further studies should evaluate these aspects and how to implement it.

Study Limitations

Our study had the limitations of small sample size, limited financial resources, time limitation.

Despite the major downside of our study i.e. sample size, our study is enforced by the similar results found in the literature.

Conclusion

EDs should develop protocols, guidelines or recommendations to improve the utilization of coagulation profile. This was found cost-effective (21-25). These guidelines should be flexible to adopt a wide range of clinical presentations to ED. Other studies have shown that obtaining a history of previous bleeding, liver disease or therapy with anticoagulants is a better predictor of abnormal coagulation profile or significant bleeding tendency (26-31).

Other authors recommend initiation of thrombolytic therapy in ischemic stroke or ST-elevation myocardial infarction, without waiting for coagulation studies results. In these studies, abnormal levels were predictable by history alone (3,32,33). Invasive procedures in the ED can be done without a baseline INR, provided that clinical information ruled out the possibility of bleeding tendency (34-36).

Ethics

Ethics Committee Approval: Since this retrospective study conducted before January 2020, and ethics committee approval was not necessary in that time, ethics committee approval was not obtained.

Informed Consent: Retrospective study.

Peer-review: Externally peer-reviewed.

Authorship Contributions

Concept: A.W., A.T., Design: A.W., A.T., Data Collection or Processing: A.W., A.T., Analysis or Interpretation: A.W., A.T., Literature Search: A.W., A.T., Writing: A.W., A.T.

Conflict of Interest: No conflict of interest was declared by the authors.

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