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Impact of desflurane versus sevoflurane on coagulation in radical cystectomy patients: A randomized clinical study

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***Abstract*---**Background: Hypercoagulability in patients with cancer is difficult to detect through standard coagulation tests unless the platelet count and fibrinogen concentration is markedly increased. Reaching haemostasis during major surgical procedures is one of the most difficult problems which face anaesthesiologists. Objective: The

aim of this study is to investigate the impact of desflurane in comparison to sevoflurane on coagulation detected by ROTEM to find out which of them is more suitable in reducing blood loss and better patient outcome after major surgery in the study population of patients. Patients and Methods: This study was conducted on thirty-six patients of both sexes having cancer bladder were admitted to Theodore Bilharz Research Institute (TBRI). They were randomly allocated into 2 groups (18 patients each). Group (S) received sevoflurane, while group (D) received desflurane as an inhalational anesthetic for Radical Cystectomy surgery. Six venous blood samples were collected for assessment of thromboelastometric parameters with INTEM, EXTEM, FIBTEM analysis which were CT (clotting time), CFT (clot formation time), α angle and MCF (maximum clot firmness). Laboratory coagulation testing included International normalized ratio (INR), Prothrombin time (PT), Activated partial thrombin time (aPTT), Platelet count and Fibrinogen level. All tests were performed immediately preoperative (after insertion of IV access) (T0), at the end of surgery (as soon as closure of the inhalational agent) (T1), 24 hours postoperative (T2). Measurement of CFT was done by ROTEM. Also, we assessed the total blood loss, patient outcome, postoperative coagulopathy, liver and kidney functions. Results: CFT in both EXTEM and INTEM were increased intraoperatively then decreased 24 hours postoperative close to base line in each of the study groups. Conclusion: Under either sevoflurane or desflurane radical cystectomy surgery showed negligible effect on the coagulation parameter investigated by ROTEM and less effect on other coagulation parameter and liver and kidney function detected. We consider the use of rotational thromboelastometry (ROTEM) as one of the coagulation monitoring devices for point-of-care (POC) is crucial.

***Keywords*---**Desflurane, Sevoflurane, Coagulation, Radical Cystectomy, Thromboelastometry.

Introduction

Hypercoagulability in patients with cancer is difficult to detect through standard coagulation tests unless the platelet count and fibrinogen concentration is markedly increased[(1)]. Perioperative haemostasis management is a complex task. Anaesthesia plays a critical role in the decision making on transfusion and/or haemostatic therapy during surgery in order to decrease the morbidity incidence from cerebro-vascular, coronary artery disease or pulmonary embolism. Also it is found that some anesthetic drugs may protect against intravascular thrombosis during the operation[(2)].

Reaching haemostasis during major surgical procedures is one of the most difficult problems which face anaesthesiologists. Preoperative coagulation disturbances because of underlying disease or antithrombotic medications are not uncommon, which are further worsened by intraoperative bleeding and fluid replacement. The coagulation reactions between blood cells, proteins, and

vasculature, are standing in sharp contrast to rather simple treatment options which are transfusion of platelets, plasma, and cryoprecipitate[3].

Perioperative coagulation monitoring must start with the assessment of individual bleeding risk by a standardized bleeding history before the surgery. Laboratory testing is done if abnormal history or perioperative bleeding is expected. So it is important to identify those who are at risk of bleeding, and so minimize that risk, without costly and time-consuming population testing[4]. The most important benefits of Rotational thromboelastometry (ROTEM) technology include the rapid availability of test results, less susceptibility to mechanical stress, movement and vibration, as well as providing enhanced reproducibility[5]. The data are also continuous, digital, and retrievable for further calculations[6].

ROTEM technology provides a rapid and dynamic assessment of haemostasis in vitro. It is a valuable analytic tool for clinicians in making an early diagnosis of a specific coagulopathy and a decision for the most appropriate treatment. Diagnosis and treatment algorithms incorporating ROTEM analysis for bleeding patients in varied clinical settings have been developed. ROTEM also measures hypercoagulability in various clinical scenarios where it is not detected by routine coagulation tests. Further developments in ROTEM-based transfusion strategies may also reduce transfusion requirements and improve clinical outcomes by optimizing the administration of blood components. Besides, ROTEM studies and treatment guidelines should be expanded to various fields such as neurosurgery, orthopedics, urology, gastrointestinal surgery, sepsis, renal transplantation, vasculitis, and many other haematological disorders as well as the assessment of the influence of anti-thrombotic, anti-platelet, and anti-fibrinolytic drugs[7].

The aim of this study was to investigate the impact of desflurane in comparison to sevoflurane on coagulation detected by ROTEM to find out which of them is more suitable in reducing blood loss and better patient outcome after major surgery in the study population of patients.

Materials and Methods

After obtaining approval from the Ethical Committee of Theodore Bilharz Research Institute (TBRI) and Research Ethical Committee of the Faculty of Medicine, Cairo University,and informed written consent from patients, this study was conducted on thirty-six patients of both sexes having cancer bladder were admitted to Theodore Bilharz Research Institute (TBRI). They were randomly allocated into 2 groups (18 patients each). Group (S) received sevoflurane, while group (D) received desflurane as an inhalational anesthetic for Radical Cystectomy surgery. We included patients undergoing elective radical cystectomy surgery, aged 40 to 80years old of both sexes with BMI <35kg/m^2 and ASA Class II& III. Exclusion criteria were as follows: Age: <40and >80years, BMI >35kg/m^2, patients suffering from coagulation disorders(INR > 1.2 and platelets count< 100 ×109), unstable angina pectoris, myocardial infarction within the last six months and general anesthesia within the last three months to avoid the possible incidence of hepatitis from repeated exposure. Patients with sever chronic liver disease with coagulopathy (INR> 1.2) or suffering from alcohol or drug addiction were also excluded. Regarding general anesthesia, all patients received midazolam 0.05

mg/kg under close monitoring for all vital parameters. After preoxygenation, anesthesia was induced with 1.5-2 mg/kg propofol, 2 µg/kgfentanyl andatracurium(as neuromuscular blockade (NMB)) 0.5 mg/kg followed by tracheal intubation. Both central venous and urinary catheters, as well as, radial arterial cannula, were inserted. Anesthesia was maintained with desflurane or sevoflurane administered in fresh gas flow (oxygen in air) 30-40% at a rate of 3L/min. Anesthesia was maintained to keep the end-tidal anesthetic concentrations at one minimum alveolar concentration (MAC) for both desflurane and sevoflurane groups. BIS monitoring was used to assess the depth of anesthesia. Six venous blood samples (6ml each) were collected for assessment of thromboelastometric parameterswith INTEM, EXTEM, FIBTEM analysis including clotting time (CT), clot formation time (CFT), α angle and maximum clot firmness (MCF) measurement. Laboratory coagulation testing included International normalized ratio (INR), Prothrombin time (PT), Activated partial thrombin time (aPTT), Platelet count and Fibrinogen level.All tests were performed immediately preoperative (after insertion of IV access) (T0), at the end of surgery (as soon as closure of the inhalational agent) (T1), 24 hours postoperative (T2). Measurement of CFT, CT, MCF and α angle were done by ROTEM. Also, we assessed the total blood loss, patient outcome, postoperative coagulopathy in the form of INR, PT, aPTT, platelet count and fibrinogen level. Evaluation of liver functions was done as ALT (alanine amino-transferase) and AST (aspartate amino-transferase) and kidney function test as urea and creatinine 24 hour post operative.

Statistical Analysis

Data collected throughout history, basic clinical examination, laboratory investigations and outcome measures coded, entered and analyzed using Microsoft Excel software. Data were then imported into Statistical Package for the Social Sciences (SPSS version 20.0), (Statistical Package for the Social Sciences) software for analysis. According to the type of data qualitative represent as number and percentage, quantitative continues group represent by mean ± SD, the following tests were used to test differences for significance; difference and association of qualitative variable by Chi square test (X2). Differences between quantitative independent groups by pairedT test. P value was set at <0.05 for significant results & <0.001 for high significant result.

Results

Thirty-six patients of both sexes having cancer bladder were included in the study. They were randomly allocated into 2 groups (18 patients each). Group (S) received sevoflurane, while group (D) received desflurane as aninhalational anesthetic for radical cystectomy surgery. Demographic data of patients in both studied groups included: Age, Sex, BMI & ASA, they were all comparable among both groups (Table 1). Also the operative data including: blood loss, surgical time and fluid replacement were comparable among both studied groups (Table 2). INTEM; CFT in both studied groups, was comparable among both groups at different times (Table 3). EXTEM; CFT in both studied groups, was comparable between both group in different times, (Table 3). INTEM parameters in both studied groups included; CT, α angle and MCF. They were all comparable among both groups at different times (Table 4). EXTEM parameters in both studied

groups, included: CT, α angle and MCF, they were all comparable between both groups in different times (Table 5). FIBTEM MCF in both studied groups; they were comparable among both groups in different times. Within the same group, in sevoflurane group FIBTEM MCF showed statistically significant decrease in T1 compared to both T0 and T2 (with p <0.001) and also T2 showed statistically significant increase compared toT0 (with p <0.001). In desflurane group FIBTEM MCF showed statistically significant increase in T2 compared to both T0 and T1 (with p <0.001& 0.013) respectively (Table 6). Laboratory coagulation parameters in both studied groups, included: PT, INR, aPTT, and fibrinogen level, they were all comparable among both groups in different times (Table 7). Platelet and Hemoglobin values were all comparable among both studied groups at different times (Table 8). Liver function tests and Kidney function testswere comparable among both groups at different times (Table 9, 10) respectively. Hemodynamic changes of patients in both studied groups included mean blood pressure (MBP) and heart rate (HR). They were all comparable among both groups at different times (Table 11).

Table (1): Demographic data between both studied groups

Demographic data		Group S (n= 18)	Group D (n = 18)	P value, between groups (< 0.05*)
Age		64.06 ± 10.25	65.56 ± 9.87	0.6404
BMI		30.27 ± 4.23	28.01 ± 4.54	0.1192
Sex	Male	17	16	1.000
	Female	1	2	
ASA	II	12	13	1.000
	III	6	5	

Table (2): Operative data between both studied groups

Operative data	Group S (n= 18)	Group D (n= 18)	P value, between groups (< 0.05*)
Blood loss(ml)	1067 ± 295.6	1000 ± 247.6	0.4632
Surgical time(Hours)	7.681 ± 1.23	7.611 ± 1.39	0.868
Fluid replacement(ml)	2194 ± 594.6	2231 ± 578.6	0.8484

Data are expressed as mean ±standard deviation. group S=sevoflurane group, group D =desflurane group. P value (< 0.05*)= significance.

Table (3): INTEM and EXTEM clot formation time (CFT) between both studied groups

		Group S (n= 18)	Group D (n= 18)	P value, between groups (< 0.05*)
INTEM CFT(sec)	T_0	57.67 ± 20.02	64.61 ± 21.1	0.3137
	T_1	72.50 ± 20.14●	73.06 ± 22.3●	0.936
	T_2	58.72 ± 23.01#,^	64.50 ± 21.8#	0.408
EXTEM CFT(sec)	T_0	87.44 ± 28.74	89.89 ± 28.58	0.828
	T_1	110.8 ± 27.89●	97.61 ± 26.54●	0.2357
	T_2	86.83 ± 28.21#	87.78 ± 27.85#	0.9339

Data are expressed as mean ± standard deviation. group S =sevoflurane group, group D=desflurane group. T_0= baseline, T_1= at the end of the surgery, T_2= 24 hours postoperative. INTEM CFT; reference value 40-100 second, EXTEM CFT; reference value 46-148 second. P value (< 0.05*) = significance in between groups, ●= P value < 0.05= significance compared T_0 to T_1. #= P value < 0.05= significance compared T_1 to T_2. ^= P value < 0.05= significance compared T_2 to T_0.

Table (4): INTEM parameters values in both studied groups at different times

INTEM parameters		Group S (n= 18)	Group D (n= 18)	P value, between groups (< 0.05*)
CT(sec)	T_0	154.0 ± 29.7	153.9 ± 28.1	0.9909
	T_1	182.5 ± 32.7●	164.1 ± 30.2●	0.085
	T_2	155.0 ± 30.87#	155.6 ± 27.45#,^	0.954
Alpha angle	T_0	74.8 ± 3.74	75.0 ± 3.81	0.8936
	T_1	73.3 ± 4.87●	73.17 ± 4.95	0.9069
	T_2	75.67 ± 4.77#	75.83 ± 4.78#,^	0.8936
MCF(mm)	T_0	63.5 ± 6.41	63.8 ± 5.89	0.8923
	T_1	60.8 ± 6.97●	61.83 ± 6.81	0.743
	T_2	61.78 ± 6.87#,^	63.06 ± 5.74#	0.5473

Data are expressed as mean ± standard deviation. group S= sevoflurane group, group D=desflurane group. T_0=baseline, T_1 = at the end of the surgery, T_2= 24 hours postoperative. CT; reference value 137-246 seconds, MCF; reference value 52-72 mm, and α angle; reference value 71-82 degree. P value (< 0.05*) = significance in between groups,●=P value < 0.05= significance compared T_0 to T_1. #=P value < 0.05= significance compared T_1 to T_2.^= P value < 0.05= significance compared T_2 to T_0.

Table (5): EXTEM parameters values in both studied groups at different times

EXTEM parameters		Group S (n= 18)	Group D (n= 18)	P value, between groups (< 0.05*)
CT(sec)	T_0	57.22 ± 12.11	58.11 ± 12.54	0.8269
	T_1	68.56 ± 11.87●	67.11 ± 13.58●	0.7187
	T_2	57.44 ± 13.66#	59.00 ± 13.85#	0.7142
	T_0	71.11 ± 6.31	72.00 ± 6.12	0.6542

Alpha angle	T_1	71.11 ± 6.98	70.72 ± 5.98●	0.8609
	T_2	72.61 ± 6.21^	73.00 ± 6.01#,^	0.843
MCF(mm)	T_0	63.94 ±5.88	62.78 ± 6.38	0.5513
	T_1	62.50 ± 5.74●	61.39 ± 5.87●	0.5721
	T_2	65.44 ± 5.79#,^	63.83 ± 6.18#,^	0.4131

Data are expressed as mean ± standard deviation. Group S =sevoflurane group, group D= desflurane group.T_0= baseline. T_1= at the end of the surgery. T_2= 24 hours postoperative. CT; reference value 42-74 seconds, MCF; reference value 49-71 mm, α angle; reference value 63-81 degree. P value (< 0.05*)= significance in between groups, ●= P value < 0.05= significance compared T_0 to T_1. #= P value < 0.05= significance compared T_1 to T_2.^= P value < 0.05= significance compared T_2 to T_0.

Table (6): FIBTEM maximum clot firmness (MCF) values in both studied groups at different times

Timing	Group S (n= 18)	Group D (n= 18)	P value , between groups (< 0.05*)
T_0	16.78 ± 3.84	17.11 ± 4.16	0.805
T_1	14.89 ± 3.83●	15.72 ± 4.29	0.537
T_2	18.22 ± 3.82#,^	18.56 ± 3.99#,^	0.799

Data are expressed as mean ± standard deviation. group S=sevoflurane group, group D=desflurane group. T_0= baseline. T_1= at the end of the surgery. T_2= 24 hours postoperative. MCF; reference value 9-25 mm. P value (< 0.05*)=significance, #=Pvalue< 0.05 = significance compared to T_1.^= P value < 0.05= significance compared T_2 to T_0.

Table (7): Laboratory coagulation parameters in both studied groups at different times

Coagulation parameters		Group S (n= 18) n= 18	Group D (n= 18) n= 18	P value , between groups (< 0.05*) Between groups (< 0.05*)
PT(sec)	T_0	13.01 ± 0.183	13.06 ± 0.78	0.838
	T_1	13.73 ± 0.107●	13.68 ± 0.59●	0.795
	T_2	13.14 ± 0.19#	13.19 ± 0.88#,^	0.848
INR	T_0	1.01 ± 0.078	1.014 ± 0.068	0.8785
	T_1	1.082 ± 0.047●	1.078 ± 0.051●	0.8835
	T_2	1.024 ± 0.081#	1.028 ± 0.073#,^	0.8285
aPTT(sec)	T_0	28.99 ± 2.75	29.10 ± 2.56	0.8991
	T_1	29.50 ± 2.39●	29.58 ± 2.41●	0.9235
	T_2	29.22 ± 2.48#,^	29.34 ± 2.49#,^	0.894
Fibrinogen(mg\dl)	T_0	263.2 ± 47.81	290.8 ± 52.58	0.1045
	T_1	286.6 ± 48.67●	286.0 ± 51.34	0.9668
	T_2	281.8 ± 41.58^	274.9 ± 52.67#,^	0.6637

Data are expressed as mean ± standard deviation. Group S= sevoflurane group, group D=desflurane group. T_0= baseline. T_1 = at the end of the surgery. T_2= 24 hours postoperative.PT; reference value 11 - 14 seconds. INR; reference value 0.8-1.1. aPTT; reference value 30- 40 seconds. Fibrinogen; reference value 150-400 mg/dl. P value (< 0.05*)= significance.*P value (< 0.05*)= significance compared to T_0. #P value (< 0.05*)= significance compared to T_1.^= P value < 0.05= significance compared T_2 to T_0.

Table (8): Platelet and Hemoglobin values in both studied groups at different times

		Group S (n= 18)	Group D (n= 18)	P value , between groups (< 0.05*)
Platelet(ml)	T_0	312.7 ± 74.58	314.9 ±95.25	0.9372
	T_1	299.8 ± 75.21●	304.7±97.5●	0.8653
	T_2	292.2 ± 73.12#,^	295±92.3#,^	0.9193
Hemoglobin (g/dl)	T_0	13.92 ± 1.55	14.12 ± 1.24	0.5902
	T_1	13.32 ± 1.23●	13.52±1.31●	0.5812
	T_2	13.24 ± 1.22#,^	13.45 ±1.41#,^	0.5869

Data are expressed as mean ± standard deviation. group S = sevoflurane group, group D =desflurane group. T_0= baseline. T_1= at the end of the surgery. T_2= 24 hours postoperative. P value (< 0.05*)= significance. Platelet; reference value 150000- 450000/ml. Hemoglobin; reference value 12- 16 g/dl. P value (< 0.05*)= significance.*P value (< 0.05*)= significance compared to T_0. #P value (< 0.05*)= significance compared to T_1.^= P value < 0.05= significance compared T_2 to T_0.

Table (9): Liver function tests in both studied groups at different times

Liver function test		Group S (n= 18)	Group D (n= 18)	P value between groups (< 0.05*)
ALT(U\L)	Preoperative	29.17 ± 9.18	29.28 ± 9.28	0.9739
	24 hours Postoperative	36.28 ± 11.87[a]	32.6 ± 10.28[a]	0.2707
AST(U\L)	Preoperative	28.83 ± 10.58	29.11 ± 9.74	0.933
	24 hours Postoperative	30.78 ± 9.99 [a]	30.8 ± 10.02a	0.9757

Data are expressed as mean ± standard deviation. group S =sevoflurane group, group D =desflurane group. ALT; reference value 7- 56 U\L. AST; reference value 10- 40 U\L. P value (< 0.05*)= significance. **a**= P value < 0.05 = significance compared to preoperative.

Table (10): Kidney function tests in both studied groups at different times

kidney function test		Group S (n= 18)	Group D (n= 18)	P value, between groups (< 0.05*)
Urea (mg\dl)	Preoperative	27.94 ± 8.64	28.61 ± 8.74	0.7935
	24 hours Postoperative	30.11 ± 9.12[a]	30.2 ± 9.75[a]	0.9689
Creatinine (mg\dl)	Preoperative	0.91 ± 0.18	0.95 ± 0.14	0.4716
	24 hours Postoperative	1.009 ± 0.14[a]	0.99 ± 0.09	0.7606

Data are expressed as mean ± standard deviation. group S=sevoflurane group, group D =desflurane group. Urea; reference value 7-20mg/dl, and Creatinine; reference value 7-1.3 mg/dl. P value (< 0.05*) = significance. **a**= P value < 0.05 = significance compared to preoperative.

Table (11): Haemodynamic changes in both studied groups at different times

Haemodynamic changes		Group S (n= 18)	Group D (n= 18)	P value. , between groups (< 0.05*)
MBP (mmHg)	Preoperative(baseline)	76.83 ± 9.58	73.72 ± 8.45	0.2837
	Intraoperative	75.78 ± 9.25●	75.28 ± 7.85●	0.8624
	Postoperative	71.94 ± 10.25#	70.06 ± 8.21#	0.5128
HR (Bpm)	Preoperative(baseline)	76.78 ± 9.19	79.34 ± 13.12	0.765
	Intraoperative	77.28 ± 9.22●	77.11 ± 11.25●	0.9199
	Postoperative	74.00 ± 9.1#	77.89 ± 10.98^	0.2087

Data are expressed as mean ± standard deviation. Group S=sevoflurane group, group D=desflurane group. Bpm;beat per minute. P value (< 0.05*) = significance in between groups,● = P value < 0.05= significance compared preoperative to intraoperative. #= P value < 0.05= significance compared intraoperative to postoperative ^= P value < 0.05=significance compared postoperative to preoperative.

Discussion

This study was designed to compare the perioperative effects of inhalational anesthesia (desflurane) and (sevoflurane) on haemostasis in patients undergoing radical cystectomy, guided by the (ROTEM) and routine screening coagulation tests (namely; PT, aPTT, INR and platelet count).The main finding of this study is that the, CFT in both EXTEM and INTEM were increased intraoperatively then decreased 24 hours postoperative close to base line in each of the study groups. Although these changes were more prominent in group S, all were within the normal reference range. Similarly, the CT showed the same results as the CFT in both groups. Both α angle and MCF in both INTEM and EXTEM showed intraoperative decrease compared to the baseline then increase in the 24 hours postoperative. Changes were minor in each group and within the normal reference range. The same changes were observed in FIBTEMMCF, as it was decreased compared to the baseline then increase in the 24 hours postoperative. There was

no significant correlation between both groups in fibrinogen level and FIBTEM MCF. INR, PT and aPTT levels showed significant immediate postoperative increase which returned to near base line 24 hours postoperative in both groups. Intraand postoperatively significant decreases in Hb levels in both groups compared to preoperative levels were observed. This might be due to either intraoperative hemodilution or blood loss, but these changes were within the clinically acceptable rangewith no significant differences between the twogroups. Concerning the platelet counts showed insignificant decrease of postoperative count within each group when compared to preoperative level. In the sevoflurane group, both serum urea and creatinine showed a statistically significant increase in postoperative values compared to preoperative values, but only serum urea showed a statistically significant increase in postoperative values compared to preoperative values in the desflurane group. This change was within the normal laboratory range. ALT and AST showed statistically significant increase in postoperative values compared to preoperative values in both sevoflurane and desflurane groups. In line with our study, Khafagy et al.[8] investigated the effect of desflurane versus propofol with total intravenous anesthesia (TIVA) on coagulation parametersmonitored by ROTEM and laboratory coagulation tests in patient suffering from liver cirrhosis. They found both (INTEM) & (EXTEM) CFT increased postoperative and decreased 24 h later reaching near baseline but this change not significant by (INTEM), and significant by (EXTEM), (INTEM) & (EXTEM) CT, were also increased significantly immediately postoperative, then significantly decreased to near baseline 24 hours postoperative by (EXTEM) and insignificant decrease by (INTEM). Regarding α angle by (INTEM) & (EXTEM) minimal insignificant change was detected. MCF by (EXTEM) alsoshowed no significant change both immediate postoperative and 24 hours postoperativeconcerning the MCFby (INTEM) & (FIBTEM) their study showed significant decrease immediate postoperative with significant increase 24h postoperative by (INTEM) and insignificant increase by (FIBTEM) were detected. Both studies, ours and Khafagy, the changes detected were all within the normal reference range. Their study also showed that PT & INR, were increased immediate postoperative then decreased 24 hours postoperative. This was found to be consistent with our study. Concerning fibrinogen level and platelet count, their study showed increased values immediate postoperative, then further increased 24 hours postoperative. On the contrary, in our study, both fibrinogen and platelets decreased immediate postoperative, then further decreased 24 hours postoperative. The difference between Khafagy's study and ours may be due to differences in the type of patient as Khafagy et al.[8], did their in patients with livercirrhosis who were being scheduled for splenectomy, which may explain the postoperative increase in platelet counts. Khafagy et al.[8] detected immediate postoperative reduction of hemoglobin, followed by a further 24-hour postoperative decrease. Both anesthetics were therefore considered safe in those patients with a high incidence of coagulopathy. Another study done by Koo et al.[9], compared the coagulation effect of TIVA (propofol) with sevoflurane in patients scheduled for ophthalmic surgery by ROTEM and coagulation testing. They were only examined one hour after surgery. The postoperative ROTEM values showed no significant changes, compared to the preoperative values. In addition to PT, PTT & INR also showed no significant difference and variations within the standard reference range. This slight variations in results may be due to the fact that Koo et al.[9] investigated the coagulation status in patients with

mild surgical trauma; and those scheduled for optical surgery (ASA I and ASA II patients). Topraket al.[10] found that, significant elevation of postoperative AST, ALT, and INR using desflurane compared to isoflurane at the equivalent dose of 1 MAC in living donors undergoing right hepatectomy. In our study desflurane group showed significant increases of AST, ALT, and INR both postoperative and 24 h postoperative but still within the normal reference range. Elsarraf et al.[11] observed insignificant decrease in the platelet count in the sevoflurane and isoflurane groups and within the group. PT, INR, and PTT groups showed no significant increase in both groups. The same trend occurred in our study, but was significant increase for sevoflurane. Elsarraf et al.[11] investigated bleeding time, factor V and factor VII in addition to other coagulation parameters, and they concluded that the use of thromboelstography or platelet aggregometry would have given more insight into their study. Ko et al.[12] studied the effect of both desflurane and sevoflurane on liver function, renal function, haemoglobin (Hb) and platelet count (PLT), PT and INR in living donor hepatectomy. PT and INR showing similar trends between the two groups as non-significant postoperative increases and 24 h. The values of Hb and PLT were similar between the two groups. However, the AST in the sevoflurane group was significantly higher on day of operation and postoperative day 1 , 2 and 3 compared to the Desflurane group. The ALT values in the sevoflurane group were significantly increased on postoperative days 1 and 3. Renal function test results, including BUN and creatinine, have been maintained and similar postoperative trends have been observed in both groups. Although postoperative creatinine was consistently higher in the sevoflurane group with significantly higher values on postoperative days 3 and 30, these values were within normal ranges. Elrashidy et al.[13] showed no significant impact of sevoflurane on parameters of coagulation including platelet count, PT and PTT. These findings were obviously different from ours. Again, the different population as well as the different nature of the study may explain this disparity. Elrashidy et al.[13] concluded that sevoflurane had a significant inhibitory effect on intraoperative platelet aggregation, whereas isoflurane had no effect. Therefore isoflurane may be used as an inhalation agent for general anesthesia maintenance in patients at increased risk of intraoperative and postoperative bleeding. Elrashidy et al.[13] also detected that, red blood cells (RBCs) count and Hb values were insignificantly changed postoperatively from the preoperative level with no significant difference between patients anesthetized by either sevoflurane or isoflurane during ophthalmic surgery. This finding is clearly different from our results. However, this difference could be justified by the different type of surgery as well as the different bloody lengthy operation.

Conclusion

Under either sevoflurane or desflurane radical cystectomy surgery showedn egligible effect on the coagulation parameter investigated by ROTEM and less effect on other coagulation parameter and liver and kidney function detected. We consider the use of rotational thromboelastometry (ROTEM) as one of the coagulation monitoring devices for point-of-care (POC) is crucial. As it is detecting the viscoelastic properties of the whole blood and preventing the delay waiting for the result of the test. This delay can increase the incidence of coagulopathy, bleeding, requirements for blood products, surgery duration and subsequent morbidity and mortality. Future studies are considered necessary to evaluate the

effect of desflurane anesthesia using thermoelastometry (ROTEM) in pediatric congenital cardiac schedules for open cardiac surgery.

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