Global Academic Journal of Medical Sciences

Available online at www.gajrc.com
DOI: 10.36348/gajms.2022.v04i06.001

OPEN ACCESS

ISSN: 2706-9036 (P)
ISSN: 2707-2533 (O)

Original Research Article

To Evaluate the Effect between Normal Saline and Heparin Solution in Arterial Line Flushing on Platelet Count – A Cross Sectional Study

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Article History
Received: 17.10.2022
Accepted: 23.11.2022
Published: 27.11.2022

Abstract: ***Introduction:*** Arterial catheters are widely used in intensive care units for continuous blood pressure monitoring and blood sampling. The patency of these lines is maintained by continuous flushing, usually with the addition of the anticoagulant heparin to the flushing solution. Normal saline solution can maintain patency of arterial and central venous pressure monitoring catheters. ***Aim of the Study:*** The aim of this study was to evaluate the effect between normal saline and heparin solution in arterial line flushing on platelet count. ***Methods:*** This was a prospective cross- sectional study conducted in the Department of Cardiac surgery of National Institute of Cardiovascular Disease (NICVD), Sher-E-Bangla Nagar, Dhaka, Bangladesh during the period from July 2016 to June 2017. This study included sixty patients who underwent single valve replacement surgery and shifted to the ICU with arterial line catheter. The patients who fulfilled the inclusion criteria were divided into two groups- Group A (with heparin solution) and Group B (with normal saline). ***Result:*** In total 60 patients from both the groups completed the study. In our study we found the mean ± SD of age among group A & B was (36.3±6.7) & (35.7±10.3) respectively. We found the mean± SD of platelet count at 1st POD was (206530±64441) & (212543±48768); at 3rd POD was (226517±60185) & (245957±52826); at 7th POD was (240517±57379) & (257713±53655); at 14th POD was (245850±52680) & (244337±56796) in Group A & B respectively**.** ***Conclusion:*** In our study we didn't find any statistically significant difference regarding the patients' demographic characteristics and there were no statistically significant difference of platelet counts between Group A and Group B at preoperative period, post pump, 1st POD, 2nd POD, 3rd POD, 4th POD, 7th POD and 14th POD.

Keywords: Arterial catheters, anticoagulant, heparin.

INTRODUCTION

Arterial lines are widely used in intensive care unit for continuous hemodynamic monitoring and frequent assessment of arterial blood gas analysis. Arterial catheters include radial, brachial, femoral, dorsalis pedis and axillary artery are used in the intensive care unit for continuous blood pressure monitoring, repeated blood sampling, and when there is inability to measure indirect blood pressure [1]; invasive arterial blood pressure measurements are more accurate [2]. Flush system is used to maintain patency of arterial catheter. For

this purpose, heparinized solution or normal saline should be used. Heparinized saline solution is used to prevent occlusion in the arterial catheters and central venous pressure monitoring catheters. Even at low dose, heparin administration can be associated with serious complications [3]. Heparin is an anticoagulant drug used to prevent and treat thrombosis [4]. Unfractionated heparin is a standard anticoagulant that affects multiple sites of internal and external coagulatory system and inhibits blood clotting [5]. Heparin administration can be associated with serious complications. It has a number of drug interactions, as well as potentially serious side effects. Heparin, even with low dose, can cause thrombocytopenia and bleeding [6]. The absolute risk of heparin-induced thrombocytopenia (HIT) with unfractionated heparin is 1%-5% [7]. Normal or isotonic saline has sodium and chloride concentrations of 154 mEq/L [8]. Normal saline solution can maintain patency of arterial and central venous pressure monitoring catheters. Heparinized solutions had no effect on prolonging patency and improving function of catheters and even caused changes in activated partial thromboplastin time (APTT) while the normal saline solution increases accuracy of coagulatory tests. Use of normal saline solution prevents patient exposure to the risks associated with heparinized solution and thus increases patient safety [3, 9]. Normal saline should be used as an alternative to heparin in arterial line and central-venous catheters. Low-dose heparin (1U/ml) should be added to the infusion set to maintain patency of arterial catheters. Extra precautionary measures must be taken when heparin therapy in instituted. Nurses and other healthcare professionals need to be reeducated on the side effects and complications of heparin therapy in order to prevent unnecessary complications and to provide safe and effective [10]. Thrombocytopenia define as a drop in platelet count by 30% to 50% from the patient's baseline platelet count.[11] Heparin induce thrombocytopenia is defined as a decrease in platelet count during or shortly following exposure to heparin [12]. HIT is the most important and most frequent drug-induced type of thrombocytopenia. It is associated with significant morbidity and mortality if unrecognized. Despite thrombocytopenia, bleeding is rare; rather HIT is strongly associated with thromboembolic complications involving both the arterial and venous system. The risk of HIT is high with prolonged use of heparin for post-operative thromboprophylaxis [13]. Arterial catheters are widely used in intensive care units for continuous blood pressure monitoring and blood sampling. The patency of these lines is maintained by continuous flushing, usually with the addition of the anticoagulant heparin to the flushing solution. Although various studies have compared the effects of heparinized and normal saline solutions on patency of arterial catheters, few studies have considered the effect of these heparinized solutions on platelet count [4, 14, 15]. We undertook a prospective randomized comparative clinical trial to find out any effect of heparin on platelet count and to see the efficacy of normal solution as flushing solution [16]. In this study we aimed to evaluate the effect between normal saline and heparin solution in arterial line flushing on platelet count.

OBJECTIVE OF THE STUDY

The main objective of the study was to evaluate the effect between normal saline and heparin solution in arterial line flushing on platelet count.

METHODOLOGY & MATERIALS

This was a prospective cross-sectional study and was conducted in the Department of Cardiac surgery of National Institute of Cardiovascular Disease (NICVD), Sher-E-Bangla Nagar, Dhaka, Bangladesh during the period from July 2016 to June 2017. This study included sixty patients who underwent single valve replacement surgery, either MVR or AVR and shifted to the intensive care unit (ICU) with arterial line catheter. These are the following criteria to be eligible for the enrollment as our study participants: a) Patients who got shifted in ICU with arterial line after single valve replacement surgery with normal platelet count; b) Patients who were aged between 18-60 years old; c) Patients time passed from the insertion of catheter less than 6 hours; d) Usage of arterial line extension catheters, 20 cm, 20 gauze ; e) PT (Prothrombin Time) of 11-12.5 seconds ; f) PTT (Partial Thromboplastin time) in the range of 35-45 seconds and p a) Patients with risk of bleeding; b) Patients with previous surgical history; c) Patients with known hypersensitivity to heparin; d) Patients who needed anticoagulants, thrombolytic therapy, platelet or whole blood transfusion; d) Patients require therapeutic heparin and TPN (Total Parenteral Nutrition); e) Patients with any history of chronic inflammatory pain (e.g., rheumatoid arthritis, ankylosing spondylitis, etc.) were excluded from our study.

The patients who fulfilled the inclusion criteria were divided into two groups- Group A (with heparin solution) and Group B (with normal saline) using random numbers generated by MS Excel software's RANDBETWEEN Function. Subjects were included after signing consent by themselves or their family.

Insertion of radial arterial line catheters were performed in OT prior to operation by an

anesthetist in aseptic condition in radial artery. In the heparinized group, heparin (ROTEXMEDICA, TRITTAU, GERMANY) with the product number of 40124 was be used. The solution was prepared by a 1000 IU of heparin added to a half liter of normal saline; hence each milliliter of the prepared solution contained 2 IU of heparin. 3 mL of the heparin solution was used for each flush. In normal saline group patients, 3 mL 0.9% sodium chloride will be used for each flush.

Arterial catheter was remained up to 72 hours. During the examination of catheters, all patients were lying on their backs. If flushing or taking blood sample from the catheter was not possible, it was considered non-functional and removed. Platelet count was measured manually preoperative, post pump and continuous for 4 days then on 7th and 14th days. The maximum time of study was 14th days and the collected data during the first 4 days were recorded every four hours in the previously prepared checklist. At the end of 1st week and 2nd week platelet count were recoded and whole data were analyzed by using IBM Statistical Package for Social Sciences version 23 (SPSS version 23.0) for windows 10.

In this study for describing the features of research units, descriptive statistics (mean, standard deviation and distribution frequency) was used. For analyzing the data, Kaplan Meier survival analysis, log rank test and Cox regression was performed and for comparing the ratios, the Chi-square test was used. ($p < 0.05$ was considered significant **$^{1}1^{1}111q11$**).

RESULT

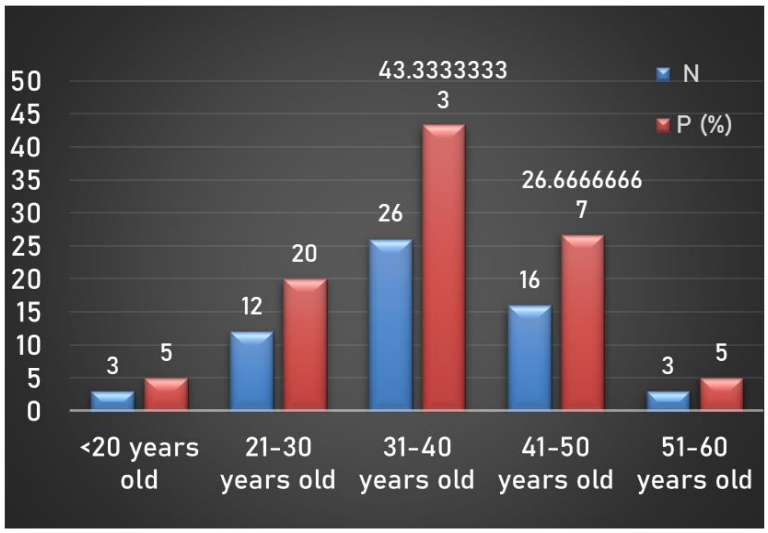

Figure 1: Age distribution among our study subjects

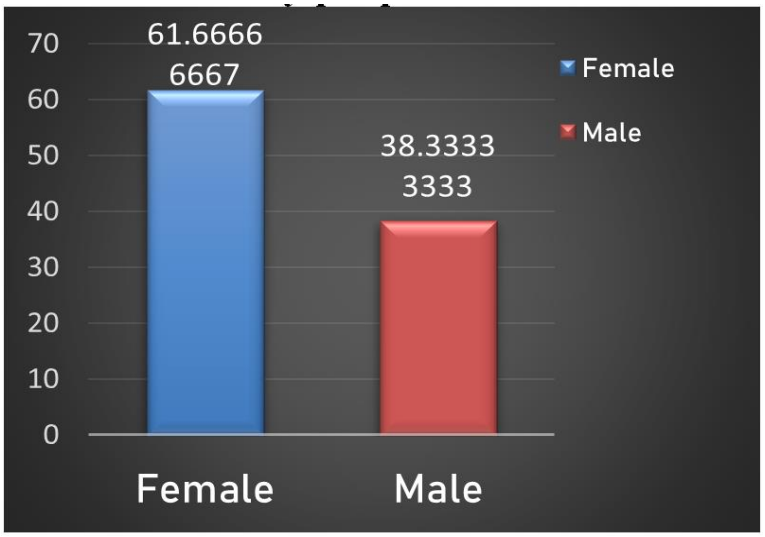

Figure 2: Gender description of the study people

Table-1: Demographic characteristics of study participants (n=60)

Demographic Characteristics	Group-A (n=30)		Group-B (n=30)		p value
Age (years)	**N**	**(%)**	**N**	**(%)**	
< 20	0	0	3	10%	
21-30	7	23.3%	5	16.7%	0.79
31-40	13	43.3%	13	43.3%	
41-50	10	33.3%	6	20%	
51-60	0	0	3	10%	
Mean±SD	**36.3±6.7**		**35.7±10.3**		**0.79**
Gender					
Male	12	40.0%	11	36.7%	0.79
Female	18	60.0%	19	63.3%	

Table -2: Types of Operation among study subjects

Name of operation	Group-A (n=30)		Group-B (n=30)		P-Value
	N	(%)	N	(%)	
MVR	22	73.3	17	56.7	0.175
AVR	8	26.7	13	43.3	
Total	30	100.0	30	100.0	

Table-3: Comparison of platelet count in two groups in different POD

Platelet Count	Group-A (n=30)	Group-B (n=30)	P value
	Mean±SD	**Mean±SD**	
Pletelet count pre-operative	247583±55675	235813±54708	0.412
Pletelet count post pump	215883±58210	222580±52422	0.633
Pletelet count 1st POD	206530±64441	212543±48768	0.685
Pletelet count 2nd POD	208363±58003	222177±55580	0.350
Pletelet count 3rd POD	226517±60185	245957±52826	0.188
Pletelet count 4th POD	241217±57558	258190±55012	0.247
Pletelet count 7th POD	240517±57379	257713±53655	0.236
Pletelet count 14th POD	245850±52680	244337±56796	0.915

In this study figure 1 showed the age distribution among study subjects where we found that majority (43%) of the patients were aged between 31-40 years old; 27% & 20% were aged 41-50 & 21-30 years old respectively. The least prevalence 5% was found among less than 20 years old and 51-60 years old. , figure 2 shows the gender description of our study people. Majority of our patients were female (62%) & male (38%).In table 1 we showed the demographic characteristics of study people. The highest prevalence (43.3%) was present in aged between 31-40 years old in both group A & B. Followed by (33.3% & 20%) was present in aged between 41-50 years old among group A & B respectively. (23.3% & 16.7%) was found aged between 21-30 years old among group A & B respectively. The lowest prevalence (10%) was found in group B. The mean ± SD of age among group A & B was (36.3±6.7) & (35.7±10.3) respectively. Majority of our patients was female in both group A (60%) and group B (63.3%). The prevalence of male was 40% & 36.7% in group A & B respectively. In table 2 shows that two types of operations were found among our study people. MVR was found 73.3% in group A and 56.7% in group B respectively. AVR was found (26.7% & 43.3%) among group A & B respectively. In table 3 we showed the comparison of platelet count between two groups. Platelet count preoperative was significantly higher in Group A than Group B. At post pump platelet count was significantly higher in Group B than Group A and it continued till 14th POD.

DISCUSSION

In our study we found the majority (43%) of our patients were aged between 31-40 years old; 27% & 20% were aged 41-50 & 21-30 years old respectively. The least prevalence 5% was found among less than 20 years old and 51-60 years old [Figure 1]. While in other study (Hall *et al.,*) found the majority of their patients aged between 51-60 years old [17]. In this present study majority of our patients were female (62%) & male (38%) [Figure 2]. Similarly other study (Hall *et al.,)* found the majority of their patients were female (n=33) and male was (n=32) [17]. In our study we found the highest prevalence (43.3%) in aged between 31-40 years old in both group A & B. Followed by (33.3% & 20%) was present in aged between 41-50 years old among group A & B respectively. (23.3% & 16.7%)

was found aged between 21-30 years old among group A & B respectively. The lowest prevalence (10%) was found in group B. The mean ± SD of age among group A & B was (36.3±6.7) & (35.7±10.3) respectively. Majority of our patients was female in both group A (60%) and group B (63.3%). The prevalence of male was 40% & 36.7% in group A & B respectively [Table 1]. In this study we did MVR and AVR operations on our study people. MVR was found 73.3% in group A and 56.7% in group B respectively. AVR was found (26.7% & 43.3%) among group A & B respectively [Table 2]. In here we showed the comparison of platelet count between two groups. Platelet count at preoperative period was significantly higher in Group A than Group B. At post pump, 1st POD, 2nd POD, 3rd POD, 4th POD, 7th POD and 14th POD, there was no statistically significant difference between Group A and Group B. Though at post pump period platelet count was significantly higher in Group B than Group A and it continued till 14th POD [Table 3]. The parallel study done by (Hall *et al.,*) comparing arterial catheter line in the two groups showed no difference at the 95% confidence interval using the central limit theorem. Sixty-five patients were recruited over 8 months: 35 in the normal saline group and 30 in the heparinized saline group. The mean platelet count was 256.6×109 /L for the heparinized saline group, compared with 234.6×109 /L for the normal saline group. Comparison of means with the central limit theorem showed there was no significant difference at the 95% confidence interval [17]. In 1991, Clifton conducted a double-blind, randomized study comparing the effects of heparin solutions (4 IU/mL) and normal saline solutions on patency of arterial catheters. They concluded that heparinized solutions were preferable for reducing the rate of catheter occlusions and other malfunctions and that they did not significantly alter platelet count [18]. Another study of 35 ICU patients compared use of either heparin (4 IU/mL) or 1.4% sodium citrate, both in 0.9% sodium chloride solution, as a continuous flush solution. Again, platelet counts were similar in the two groups [19].

Limitations of the Study

Our study was a single center study that conducted in the department of Cardiac surgery of National Institute of Cardiovascular Disease (NICVD). We could only observe the effect of heparin solution and normal saline after evaluating those patients for a 14th postoperative days follow-up and have not known other possible interference that may happen in the long term with these patients.

CONCLUSION AND RECOMMENDATIONS

In our study we didn't find any statistically significant difference regarding the patients' demographic characteristics such as age and gender between heparinized flush solution group and normal saline group. There was no statistically significant difference of platelet counts between Group A and Group B at preoperative period, post pump, 1st POD, 2nd POD, 3rd POD, 4th POD, 7th POD and 14th POD. We only evaluated the effects of normal saline and heparin solution in arterial line flushing on platelet count with 14th POD follow up. So, a further study with a prospective and longitudinal study design needs to be done to evaluate the efficacy of heparin solution and normal saline in arterial lines flushing among the patients of the department of Cardiac surgery of National Institute of Cardiovascular Disease (NICVD).

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