e-ISSN: 0975-1556, p-ISSN:2820-2643

Available online on www.ijpcr.com

International Journal of Pharmaceutical and Clinical Research 2022; 14(6); 510-519

Original Research Article

Role of Complete Blood Count, Coagulation, ABO Blood Group Parameters in Nephrolithiasis

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Received: 15-04-2022 / Revised: 20-05-2022 / Accepted: 15-06-2022
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Conflict of interest: Nil

Abstract

Background: Complete blood count (CBC), Coagulation & ABO blood group parameters may associate with multiple diseases. Urinary stone disease is common public problem. Predictive value of CBC, Coagulation & ABO blood group parameters may be associated with effects of Nephrolithiasis disease.

Objectives: To analyze the association between complete blood count (CBC), coagulation, ABO blood group parameters and Nephrolithiasis disease.

Methodology: This study was done on the patients who were admitted to the urology (Surgical OPD) outpatient clinic or diagnosed with Nephrolithiasis disease in the emergency services department. There were 36 patients & 30 controls included in the study, the patients were confirmed by Multi detector CT (MDCT) urinography. Both patients and control subjects were studied for CBC, coagulation, ABO blood group parameters. Data of patients were retrieved from the hospital database and statistical analysis was performed.

Results: An increase in Hb, MCH, MCHC, RDW, Neutrophiles, PT, WBC, Haematocrit, lymphocyte and decrease in RBC, MCV, Monocytes, Platelets, MPV, and PDW is statistically associated with urinary stone disease. In nephrolithiasis patients with B+ group is more affected.

Conclusions: It is important to remember that CBC, Coagulation & ABO blood group parameters may support urinary stone disease and considering CBC & Coagulation results may be useful in the diagnosis of nephrolithiasis.

Keywords: Nephrolithiasis, Kidney Stone, MDCT, Hb, MCH, MCHC, RDW, Neutrophiles, PT, WBC, Haematocrit, Lymphocyte, and ABO blood group.

Introduction

Nephrolithiasis may define as a history of renal calculi**,** kidney stones, kidney calculi, renal stones disease, urinary calculi, which varies with sex, age, and race. Nephrolithiasis is a common affliction of the human population with a variety of

geographical variations. Anthropological history provided evidence that urinary calculi existed before 5000 BC and perhaps more. Nephrolithiasis incidence varies in different countries depending upon the environmental conditions of the area. In India, the incidence of nephrolithiasis is lower in southern states, compared to that of northern states. Kidney stones are less frequently seen in winter or colder climates in comparison to during summer or warmer climate. The cause may be due to increased concentration of urine and dehydration, which is one of the causes of calculi formation. Consumption of Vegetables like tomato & spinach which are available easily and more rich sources of calcium leads to calculi formation. Many parts of people in India drink bore well water, which contains more minerals. there is a tendency for calculi formation over a period of years, different varieties of urinary calculi are recognized (Uric acid, Oxalate of lime, cystine, Calcium carbonate, Phosphate of lime, Ammonium magnesium phosphate, Fusible calculus consisting of later two substances). Nephrolithiasis is defined as crystals mixed with protein matrices with one or more aggregate stones, which are formed in the pelvis or calyces of the kidney or in the ureter. This may cause obstruction of urine flow in the renal collecting system, ureter, or urethra which causes severe pain; bleeding with pain, or local erosion of tissue in the kidney. It is an important health care problem worldwide. It is estimated that during the lifetime of 70 years it is about 3–20% of the overall population of the world has the tendency to form one urinary stone. [1] 12% of the people in India are estimated to have urinary stones. Also, nearly 15% of the people of northern India are affected by urinary stones out of which 50% may end up with renal damage or loss of kidneys. [2] Diagnosis and treatment of kidney stone disease is essential health care around the worldwide. The formation of stone is common with the lifetime with exceeding 12% chances in men and 6% chances in women. [3] This disorder results from one or more events such as genetic, biochemical, and epidemiological factors. About stone formation, there are multiple theories, but none of the mechanisms explains completely stone formation. Reactive oxygen radicals and oxidative stress are one of the important mechanisms related to calcium oxalate stones. [4]

A commonly performed lab test that can be used to detect or monitor many different health conditions is CBC (Complete Blood Count) to monitor a long-term (chronic) health problem that may change your blood count results, such as chronic kidney disease. [5]

Numerous investigators have carried out anatomical, metabolic, and physical studies, all of them were trying to identify factors that are associated with stone disease and many theories have been imposed, but none answer all questions. In all likelihood, an individual's stone diathesis will be found to result from an interdependence of numerous factors. [6]

A lot of work has been done on the understanding of the occurrence, recurrence, prevention, and treatment of nephrolithiasis in modern medicine. Hence the present study is aimed at studying the "Role of Complete Blood Count Coagulation, ABO blood group parameters in Nephrolithiasis". Therefore, the present study is undertaken in the Parul Institute of Medical Sciences & Research, Parul Sevashram Hospital, with a problem related to nephrolithiasis, were considered from IPD and OPD for further study with the following objective to assess whether there is any relation between complete Blood Count (CBC), Coagulation parameters, ABO blood group in nephrolithiasis.

Methodology:

2.1 Assessment of plan:

Patients coming to Department of Medicine and Department of Surgery IPD, OPD'S of, Parul Sevashram Hospital; were considered

for the study. The study was approved by IECHR and informed Consent was also obtained from all the participants. The Blood sample for CBC was collected in an EDTA tube for further process.

Ethical consideration

The protocol for this study was approved by the Institutional Ethics and Research Committee (IERC) in accordance with the ethical standards of the committee on human institutional experimentation and with the Helsinki Declaration of 1975 that was revised in 2000**.[Approval Number: PUIECHR/PIMSR/00/081734/4011].**

Methods

Blood was collected in the EDTA bulb for the CBC estimation & ABO blood grouping and inthe citrate bulb for the coagulation parameters. CBC parameters were analysed by MINDRAY BC 6200. Coagulation parameters were analysed by HEMOSTAR XF 1.0. ABO blood grouping was analysed by the agglutination method.

Statistical Analysis

The results obtained were statistically analysed by using Jamovi, with version 23.0. The variables were presented as mean with standard deviations and then compared between different groups of the study by applying the Independent's test. Then values were taken as significant when the probability ($p<0.001$) as a percentage of the observing values of 't' test at a particular degree of freedom.

Observation & Result

Table 1: CBC Parameters of Nephrolithiasis Patients and Control Groups

Parameters	Nephrolithiasis Patients	Control	P-Value
Age (Years)	49.2±15.7	22.5±2.7	
Sex (M/F)	31- M /5 F	21-M / 9F	
COMPLETE BLOOD COUNT (CBC)			
Hemoglobin(13-17 g/dl)	12.70±1.7	13.71 ± 1.1	0.001#
RBC (4.5 – 5.5 10^{12}/L)	5.08±0.88	5.08 ± 0.36	0.968
BLOOD INDICES			
Haematocrit (40-54 %)	40.40±5.25	42.17±1.55	0.047*
MCV(83-101fl)	80.50±9.95	81.25±12.40	0.428
MCH (27-32pg)	25.41±3.75	30.40±1.60	0.006#
MCHC(31.5 -34.5 g/dl)	31.45±1.19	32.85±1.20	0.005*
RDW (11.5% - 14%)	16.10±3.10	12.75±1.10	0.002*
TOTAL WBC COUNT			
WBC(4000-10000cmm)	10273.61±4100.5	8184.65±886.15	0.017#
DIFFERENTIAL WBC COUNT			
Neutrophils(50-62%)	65.95±12.95	55.97±3.95	0.005#
Lymphocyte (20-40%)	23.5±10.99	28.1±5.45	0.055#
Monocyte (0-10%)	6.80±1.52	6.05±2.75	0.309
Eosinophil(0-6%)	3.75±3.43	3.45±1.55	0.827
Basophils(0-2%)	0±0	0±0	
PLATELETS COUNT			
Platelet(150000-450000/µL)	333055.5±104184.4	319718.6±44060.0	0.059#
MPV (fl)	9.50±1.21	13.05±19.85	0.325
PDW (%)	15.99±0.35	16.02±0415	0.608

Values are expressed as Mean ±SD.

Student's t-test applied, P < 0.05*, P<0.001# is statistically significant

Abbreviations:

Hb =Haemoglobin

RBC = Red Blood Cell

MCV = Mean Corpuscular volume

MCH = Mean Corpuscular Haemoglobin

MCHC = Mean Corpuscular Haemoglobin Concentration

RDW = Red cell distribution width

WBC = White Blood Count

MPV = Mean Platelet volume

PDW = Platelet distribution width

The results of CBC analysis in the nephrolithiasis group and the control group are detailed in (table 1). There were no statistical differences by age and gender between the two groups Table 1. Between the Nephrolithiasis group and the control group Hb[P value 0.001#], MCH [P value0.006#], MCHC [P value 0.005*], RDW [P value0.002*], Neutrophils [P value 0.005#], WBC [P value 0.017#], Haematocrit [P value 0.047*]. Lymphocyte percentage and granulocyte percentage, statistically different& statistically associated in (Table 1). There is decrease in RBC [P value0.968], MCV[P value 0.42468], Monocytes[P value 0.30904], Platelets[P value 0.05952#], MPV[P value 0.325], and PDW[P value 0.608] is statistically associated with kidney stone disease (Table 1).

Table 2: Coagulation Parameters of Nephrolithiasis Patients and Control Groups

Parameters	Nephrolithiasis Patients	Control	P-Value
Activated Partial Thromboplastin Time (APTT) Seconds	34.78±5.65	32.1±0.38	0.007
Prothrombin Time (Seconds)	14.45±1.75	12.45±0.10	0.005*

Values are expressed as Mean ±SD

Student's t-test applied, P < 0.05*, P<0.001# is statistically significant Prothrombin Time(PT) showed a promising result than Activated Partial Thromboplastin Time (APTT) did not show any significance in our study, (Table 2).In Nephrolithiasis the coagulation studies showed rise in the Prothrombin Time [P values 0.005*] and decreased values subjects Partial Thromboplastin Time [P value0.007].

Table 3: Nephrolithiasis patient

	NEPHROLITHIASIS PATIENT			
BloodGroup Parameters	**A**	**B**	**AB**	**O**
RBC	**(6.21±0.38)↑↑**	**(5.92±0.23)↑↑**	**(5.90±0.18)↑↑**	**---**
RDW	**(15.55±1.00)↑↑**	**(16.46±3.29)↑↑**	**---**	**(16.16±1.21)↑↑**
Neutrophiles	**(72.14±7.08)↑↑**	**(70.88±7.11)↑↑**	**---**	**(74.66±9.30)↑↑**
WBC	**----**	**(1204.44+1581.79)↑↑**	**---**	**(12433.33±1498.55)↑↑**
Eosinophil	**----**	**---**	**(11.66±2.60)**	**---**

Values are expressed as Mean ±SD.

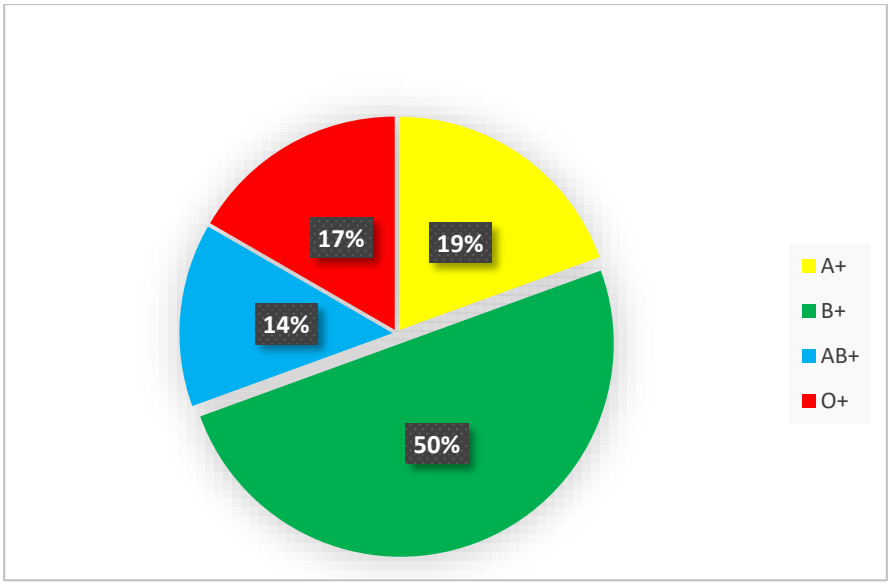
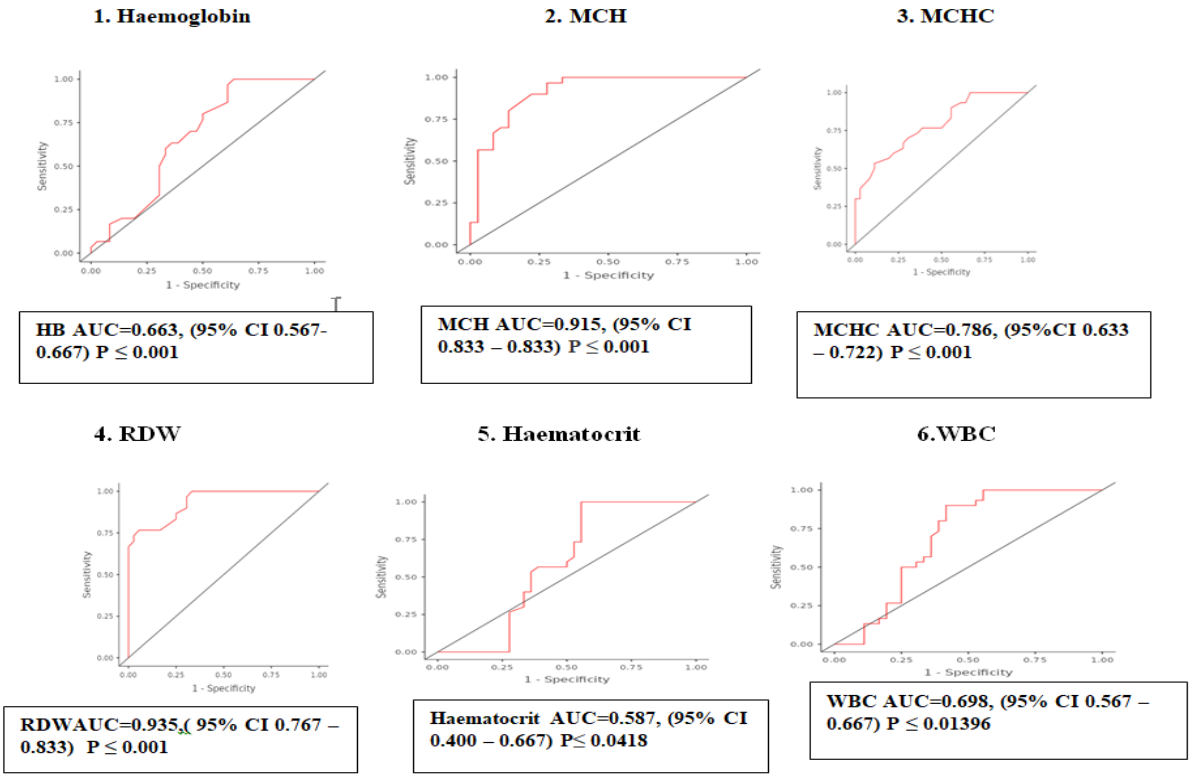


Figure 1: ABO blood group distribution in Nephrolithiasis Patients

The ABO blood group distribution in Nephrolithiasis Patients in our study(Fig:1)with high frequency of B^+ – blood group with significant of parameters RBC = (5.92±0.23)↑↑, RDW = (16.46±3.29)↑↑, WBC = 1204.44+1581.79)↑↑,Neutrophils = (70.88±7.11)↑↑,and A^+blood group with significant RBC = (6.21±0.38)↑↑,RDW = (15.55±1.00)↑↑, Neutrophils = (72.14±7. 08)↑↑, and O group RDW = (16.16± 1.21)↑↑, Neutrophils=(74.66±9.30)↑↑,W BC =(12433.33± 1498.55)↑↑, and AB + group RBC = (5.90±0.18)↑↑, Eosinophil = (11.66±2.60).



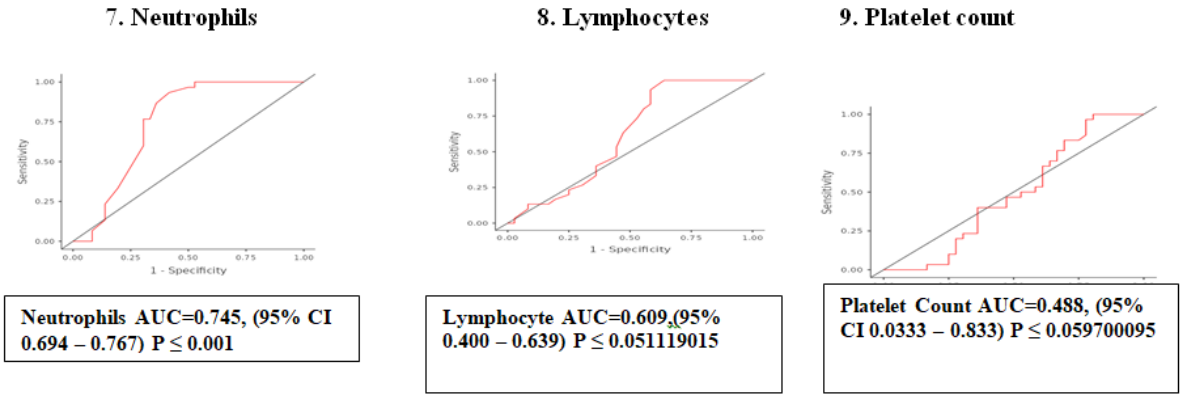


Figure 2: Roc Curves for Significant CBC Individual Parameters in Nephrolithiasis

Receiver Operating Characteristic (ROC) curves displays the specificity on X – axis and sensitivity on Y- axis for the test values. This generally plotted in a square box for convenience on both axis. The area under curve is an effective tool to combine the specificity and sensitivity of a test. The area under ROC curves (AUC) is predicting nephrolithiasis for CBC parameters is shown in (Fig:2). Between the nephrolithiasis and control group percentage are statically different for Hb, MCH, MCHC, RDW, Neutrophiles, PT, WBC, and Haematocrit, Lymphocyte. The area under the ROC (Fig:2)curve (AUC) is predicting urinary stones for CBC parameters are shown in fig 2.AUC values of Haemoglobin = 0.663 (95% CI 0.567-0.667), Haematocrit = 0.587(95% CI 0.400 – 0.667), MCH = 0.915(95% CI 0.833 – 0.833), MCHC = 0.786 (95%CI 0.633 – 0.722), RDW = 0.935(95% CI 0.767 – 0.833), WBC = 0.698(95% CI 0.567 – 0.667), Neutrophiles = 0.745(95% CI 0.694 – 0.767), Lymphocytes = 0.609 (95% 0.400 – 0.639), Platelet Count = 0.488(95% CI 0.0333 – 0.833).

Discussion

In this study, we analysed the association between CBC parameters in nephrolithiasis, we found that Hb, MCH, MCHC, RDW, Neutrophils, PT, WBC, Haematocrit. Lymphocyte, and Platelets percentage values were increased in nephrolithiasis patients, and percentage values RBC, MCV, Monocytes, MPV, and PDW were decreased.

In our study showed that there is a significant correlation between nephrolithiasis patients and hemoglobin with a significant value of (p = 0.001#).As of the results seen an increase RDW on increased production of a red blood cell. Some of the proteins like cytokines, interleukin-6, and tumour necrosis factor α, and interleukin - 1 β can raise the destruction of normal RBC and immature RBC. [7]

MCHC showed a significant correlation between nephrolithiasis patients &the Control Group with a significant value of (p= 0.006#), MCH showed a significant correlation between nephrolithiasis patients &the Control Group with a significant value of (p= 0.006#).Perkins SL et al (2009) suggested that both mean corpuscular haemoglobin concentration (MCHC), and mean corpuscular haemoglobin (MCH) reflect the average haemoglobin content of red blood cells in different ways. [8] Ryan DH et al (2010) concluded that MCHC and MCH, are parameters reflecting the size and haemoglobin content of red cells (parts of red cell indices) that have traditionally been used to aid in the differential diagnosis of anaemia. Although MCH can be used to determine if anaemia is hypo-, normal-, or hyperchromic, the mean corpuscular volume (MCV) has to be considered along

with the MCH since cell volume (MCV) affects the content of haemoglobin present per cell (MCH), and MCH can decrease or increase in parallel to the MCV. [9] Thus Perkins SL et al(2001), MCHC in the past has been thought to be a better parameter than MCH to determine hyperchromasia . [10]

Red blood cell distribution width (RDW) is a parameter that is calculated by dividing the standard deviation of red blood cell (RBC) volume by the mean corpuscular volume (MCV) multiplied by 100. The main usage of RDW is to differentiate the cause of anemia in nephrolithiasis patients. Besides differential diagnosis of anemia, recent studies have shown that elevated RDW values are also associated with a prognosis of sepsis, acute myocardial infarction, cardiac arrest, and heart failure. [11-15] The mechanism of this relationship is still unknown, but inflammation and oxidative stress are suggested for the increase in RDW. Also, recent reports have shown RDW is related to other inflammatory markers such as interleukin-6 and tumor necrosis factor. [16, 17] In inflammatory bowel disease, the activity of RDW is associated with a prognosis of sepsis in patients with a risk of the inflammation that can cause an increase in RDW. [18] Aktas et al, reported an increased RDW values in Hashimoto's disease. It was also suggested that an increase in the RDW could be an effect on the inflammation of the uroepithelium. Inflammation markers increased in kidney stone disease, our study was also compatible with other studies as per literature. [19] An increase of platelet count is expressed as a mediator for thrombosis and inflammation with other platelet markers activation such as β – thromoglobin and thromboxane. In pulmonary tuberculosis, the relationship ship between platelet count and the prognosis of bloodstream infection is shown in the literature [20]. High levels of RDW are also associated with estimated glomerular filtration rate, hemoglobin, and hematocrit and mean corpuscles associated with red blood cells counts. [21]

Neutrophils, showed a significant correlation between nephrolithiasis patients &the Control group with a significant value of (p=0.005#) and WBC showed a significant correlation between nephrolithiasis patients &the control group with a significant value of (p=0.017#). Stavros Sfoungaristos et al (2012) concluded that increased concentrations of neutrophils and WBCs at the time of the acute phase of a renal colic were associated with an increased likelihood of spontaneous passage. In the multivariate analyses, they found that neutrophils and WBC counts were the most important predictors of stone elimination. [22]

Haematocrit showed a significant correlation between nephrolithiasis patients &the control group with a significant value of (p= 0.047*).The increase of haematocrit and haemoglobin and platelets is due to the hemoconcentration of after haemodialysis. Metry et.al. suggest that a change in hemorheological profile leads to increased haematocrit significantly which causes blood viscosity. [23]

Lymphocyteshowed a significant correlation between nephrolithiasis patients &the Control Group with a significant value of (P = 0.055#). During the inflammation, the lymphocytes, neutrophils, and C- reactive protein (CRP) levels are changing. The lymphocytes can secrete cytokines such as necrosis factor – α and interferon – γ. The kidney stone formation is closely related to the inflammatory responses, a significant relation in CRP and self-reported t kidney stones. [24]

Platelet count is a marker of activation and function of platelet. It is a measured mean platelet count by using anticoagulant blood. Platelets activity increased on vascular disorders has been suggesting many studies. This activity can measure by mean platelet volume (MPV). Platelet activation

along with vascular endothelial cells and leukocytes and micro vascular dysfunction. Platelet activation and adhesion not only increase in thrombosis associated with inflammatory conditions. Platelets showed a significant correlation between nephrolithiasis patients &the Control Group with a significant value of (P = 0.059#). The platelets consider as mediators for blood coagulation, inflammation, and thrombosis. These platelets are activated by markers such as β – thromboglobulin and thromboxane. [25]

In the coagulation system Prothrombin (PT) and Activated Partial Thromboplastin (APTT) time have an important role in intrinsic and extrinsic pathways of blood coagulation. In the present study, coagulation findings show a significant increase in prothrombin time of nephrolithiasis patients when compared to the subjects. The increase may lead to atherosclerosis asa result of endothelial damage. Our significant Prothrombin value was($p \leq 0.005$*). The activated partial thromboplastin time and prothrombin time with an increase of hypertension which prolongs endothelial wall damage lead to decrease as anti-hypersensitive and interfere coagulation cascades. [26] Future studies are required on the role of coagulation analysis in patients with nephrolithiasis.

It has been observed that from the present study, nephrolithiasis is higher in blood group B+ compared to A, AB, &O blood groups. The frequency of the A+ and O+ groups are closely similar. In India nephrolithiasis, the association with the blood group is not responsible for the geographic difference in all parts of India. There are at least two influences that promote the cause of nephrolithiasis regarding to the ABO blood groups with relation A and B group and others are probability natural. Nephrolithiasis is afforded with blood group B+ which is the above-mentioned figure:1. Finally, analysis of data in can be concluded that the highest frequency of blood group B+ in the patients of nephrolithiasis might indicate that this group is more susceptible to this particular disease. [27] Hence future follow-up studies are desirable to collect more data to find out the association ABO blood group in nephrolithiasis. [28]

Conclusion

Our understanding of CBC parameters, such as that Hb, MCH, MCHC, RDW, Neutrophils, PT, WBC, Haematocrit. Lymphocyte values were increased in nephrolithiasis patients with the B+ group is more affected in our study promising results showed a rise in the prothrombin Time. The area under ROC curves (AUC) is predicting nephrolithiasis for the above CBC parameters.It confirmed in future follow–up studies this may provide a rationale to introduce theeasy follow-up studies in considering CBC and coagulation Parameters and ABO blood group results may be useful in the diagnosis of nephrolithiasis for prediction patients.

Acknowledgements

The authors would like to thanks to Department of Biochemistry, Parul Institute of Applied Sciences, Parul University, Department of Biochemistry, Parul Institute of Medical Sciences and Research, Parul University, and Central Labof diagnostics, PSH for sharing the patient's report

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