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ORIGINAL ARTICLE

Incidence of Infectious Diseases in Patients Suffering from Renal Diseases

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ABSTRACT

Background: Infection is an invasion of an organism's body tissues by disease-causing agents, their multiplication, and the reaction of host tissues to the infectious agents and the toxins they produce. Patients with renal compromised states are more susceptible to infection than normal individuals. In the pre-dialysis era, about 45% of patients with the renal compromised state suffering from infection required hospitalization, while a total of about 78% of the enrolled subjects needed hospitalization. It was assumed that the debility caused by the uremic state increased the risk of infection, and the reversal of uremia would reduce the risk of infection.

Aim: The main aim of the study is to report the incidence of infectious diseases in patients with renal compromised state and appropriate measures to be considered to control infectious conditions.

Materials and Methods: The study was carried out as prospective and cross-sectional studies. During the study period, a total of 195 subjects were examined with the renal compromised state, of which 108 subjects were suffering from infectious co-morbidity, and were enrolled based on inclusion and exclusion criteria, which includes in-patients, out-patients, and patients on regular dialysis.

Results: This shows the percentage prevalence of infections in patients with the renal compromised state is 55.38. Patients were found to show various infectious states.

Conclusion: The conclusion shows the probability of encountering a subject with renal compromised state along with co-morbid infection is 0.55. Evidence-based international guidelines are of great value and are instrumental in helping reduce health-care-associated infections.

Keywords: Incidence of infectious diseases, Renal compromised state, Renal disease.

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INTRODUCTION

Renal disease or renal compromised state is the condition when a patient's kidneys begin to show a gradual or drastic decline in the glomerular filtration rate (GFR) value and thereby kidneys lose their ability to filter wastes from the blood.

During this study, the various renal compromised states included were acute and chronic kidney disease, nephritis, nephropathy, nephrotic syndrome, and subjects undergoing dialysis. The prime co-morbidities which include infections caused by bacteria, viruses, or fungi were considered in this study.

Febrile conditions (temperature ≥100° F) that developed during dialysis or in the span of about 48 h post-dialysis were also considered during this study; however, the patient may develop fever state due to non-infectious causes as well, which includes broader variation in temperature between dialyzing fluid and body fluid, increased/decreased rate of filtration and flow by dialyzing machine, continuous/prolonged use of dialysis machine/ dialysate membrane, cooler temperature maintained in rooms where dialysis is being carried, using of ethylene oxide gas for sterilization of dialysis machine, tubes or

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dialysis room may lead to fever and anaphylactic shock in certain population group allergic to it. Therefore, the confirmation of the infectious state relied on laboratory findings of the subject.

According to one of the recent study conducted by Aakanksha B. (September 2018), the number of Indians that suffer from chronic kidney ailments has doubled in the past decade and about 8–10% of the adult population suffers from some or the other form of kidney diseases. Furthermore, it is believed that patients suffering from renal compromised states are more easily prone to acquire infectious diseases than normal person. Hence, this study was conducted to determine the incidence of infectious diseases in patients suffering from renal compromised state.[1-10]

MATERIALS AND METHODS

All relevant and necessary data for this study were collected from patient case notes, treatment charts, dialysis notes, laboratory reports, interviewing patient/patient caretaker, and interviewing healthcare professionals. The data collection for this study was done in the following hospitals:

- Hyderabad Kidney and Laparoscopy Centre, Malakpet, Telangana
- Malla Reddy Health City, Suraram, Telangana
- Malla Reddy Narayana Multispeciality Hospital, Suraram, Telangana.

A prospective and cross-sectional study was carried out in the various wards of hospitals. The patients suffering from renal compromised state and having infectious co-morbid conditions were identified during ward rounds by regular case record reviews during the study period. The enrolled patients were taken follow-up from the day of admission till the day of discharge and the relevant study data including laboratory investigations, recent medical history of the patient (not more than 1 month) from the case record of the patient, and medical history interview was documented in case record form.

Study Criteria

Inclusion criteria

Patient population showing either of the following:

- Kidney disease state – CKD, AKI, nephropathy, nephritis, and obstruction to solitary kidney function.
- Patients on dialysis.
- Patients with congenital kidney malfunctioning state.
- Patients with altered kidney functioning (altered GFR, altered clearance of metabolites).
- Patients having specific infection as co-morbidity.

Exclusion criteria

The following criteria were excluded from the study:

- Patients with recent surgical procedures other than those related to the kidney.
- In clinically indicated for the patient to have LFT as a part of pre-assessment for the surgery and this screening ALT or ASP is above 3 times the upper limit of normal values.
- Pregnant and lactating women.
- Infants.

Study Duration

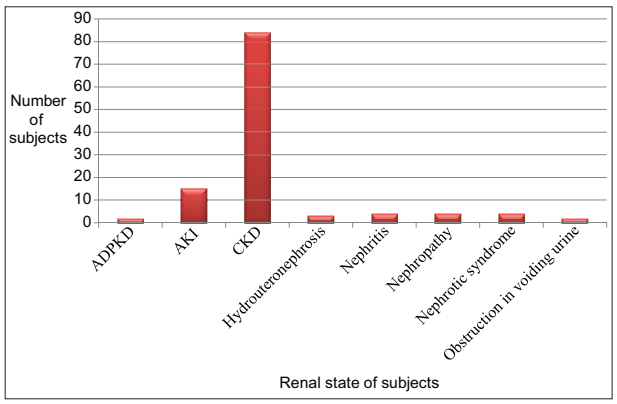
The study was conducted for a span of 11 months, starting from the month of April 2018 till the end of February 2019.[11-20]

RESULTS AND DISCUSSION

A total of 195 subjects were analyzed to have renal compromised state during the study period. Of these, 120 subjects were suffering infectious co-morbidity, of which 108 subjects were enrolled based on inclusion and exclusion criteria, which includes in-patients, out-patients, and regular dialysis patients. Of the total of 108 enrolled subjects, there were 67 male and 41 female subjects, with a mean age value of 54.57 years.

Renal State of Enrolled Subjects

The enrolled 108 subjects based on their renal state were classed and analyzed. It was seen that 84 subjects were suffering from CKD; 15 subjects from AKI; 4 subjects from each of nephritis, nephrotic syndrome, nephropathy; 3 subjects from hydroureteronephrosis; and 2 subjects from each of obstruction in voiding urine and ADPKD. In certain cases, subjects were known to exhibit multiple renal compromised states [Graph 1 and Table 1].



Graph 1: Graphical representation of renal state of subjects enrolled

Infectious Co-morbid State

The percentage incidence of various infection diagnosed in the subject during the study duration was found to be: Hepatitis C-virus infection (0.94), septicemia (1.88), pulmonary tuberculosis (1.88), upper respiratory tract infections (2.83), pleural effusion (6.6), septic shock (6.6), urosepsis (8.49), pneumonia (10.37), lower respiratory tract infection (LRTI) (16.98), sepsis (20.75), and urinary tract infection (22.64) [Graph 2 and Table 2].

The percentage prevalence of septicemia was found to be 1.88 during this study, which was closer to 2.2, the study results conducted by Allareddy *et al*. (2017). The summative total percentage prevalence of sepsis, septic shock, septicemia, and urosepsis was found to be 37.72, which was closer to 35% as in the study result which was conducted by Dalrymple and Go (2008).

The study has shown that the percentage prevalence of pulmonary TB was found to be 1.88, which was closer to 2.27 found in the study results conducted by Lui e*t al.* (2001). The percentage prevalence of LRTI and pneumonia during this study was found to be 16.98 and 10.37, respectively, which were similar to the study results conducted by McDonald *et al*. (2015) which were 15.58 and 10.3 for the incidence of LRTI and pneumonia, respectively.

In this study, the percentage prevalence of hepatitis C virus infection was found to be 0.94, which lies in the study range (0.2–3.5) conducted by Cavolia *et al.* (2011).

Table 1: Renal state of subjects enrolled

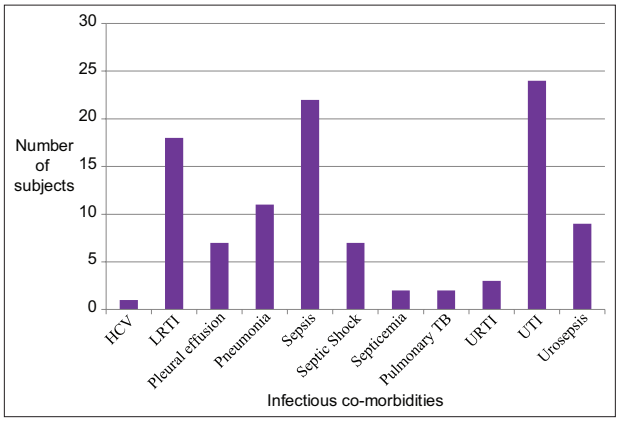
Renal state	*Number of subjects*
ADPKD	2
AKI	15
CKD	84
Hydroureteronephrosis	3
Nephritis	4
Nephropathy	4
Nephrotic syndrome	4
Obstruction in voiding urine	2

Table 2: Incidence of infectious co-morbid state

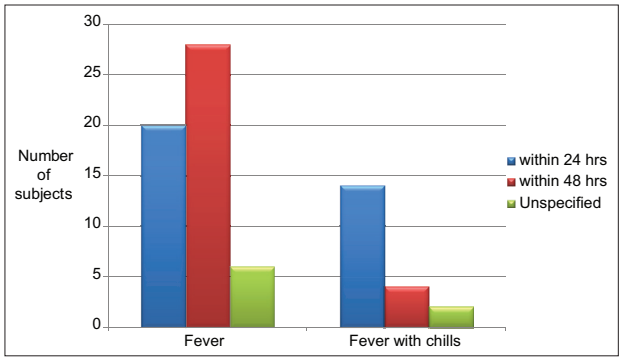
Infectious disease	*Number of subjects*	*Percentage incidence*
HCV	1	0.94
Lower respiratory tract infections	18	16.98
Pleural effusion	7	6.6
Pneumonia	11	10.37
Sepsis	22	20.75
Septic shock	7	6.6
Septicemia	2	1.88
Pulmonary TB	2	1.88
Upper respiratory tract infections	3	2.83
Urinary tract infections	24	22.64
Urosepsis	9	8.49

Fever State

The state of fever, considering as temperature ≥100° F, among the enrolled subjects, was seen in 80 subjects of 108 subjects (74.07%). Of the 80 subjects, it was found that 54 subjects suffered from fever, while 26 subjects suffered from fever with chills. The data were classed further as fever/fever with chills- within 24 h of dialysis, within 48 h of dialysis and unspecified period of time [Graph 3 and Table 3].



Graph 2: Graphical representation of subjects suffering from infectious co-morbid diseases



Graph 3: Graphical representation of different fever conditions in subjects

During the study period, 74 subjects (68.51%) were confirmed to develop a fever as a post-dialysis outcome. According to a study conducted by Kanda (2014), patients on hemodialysis may develop a fever as an allergic reaction after blood comes into contact with a dialysis device as an artificial material. When patients develop an allergic symptom such as anaphylactic shock within a few minutes after the start of dialysis (type A), substances from the dialyzer or bacterial contaminants are considered as a cause of the symptom. The symptoms of patients with immunoglobulin E antibodies against ethylene oxide gas may become serious. Drugs administered to dialysis patients, such as anticoagulants, acetate, and erythropoietin, may also induce a fever. Mild allergic symptoms that occur approximately 30 min after the start of dialysis are of type B, which occurs later than type A. Type B allergic reactions are considered to result from the activation of the complement system after blood comes in contact with the dialysis membrane. For example, regenerated cellulose membranes used for dialysis tend to activate this complement system. Thus, the material quality of dialysis membranes has been improved and synthetic polymer membranes have been manufactured. In addition to the above-mentioned allergic reactions, the temperature of the dialysate incorporated into dialysis machines may also cause a fever when it is set high.

Contaminants in the dialysate such as endotoxins and bacterial components (peptidoglycan) may be absorbed into the patient's body through inverse diffusion or inverse filtration through the dialysis membrane and cause a fever. Therefore, regular monitoring of the quality of the dialysate and the appropriate purification of the dialysate is indispensable. Sterilization using ethylene oxide gas more frequently induces allergic reactions than γ-ray and autoclave sterilizations and requires careful checking.

When the cause of fever is clear, the appropriate treatment strategy can be promptly taken. When the cause of fever is unclear, however, the diagnosis should be started based on the urgency of treatment and Durack and Street's FUO classification. First, the patient's clinical history should be carefully examined. For example, the onset time and time course of fever, the place of cause of fever (inside or outside the hospital), the use of artificial materials (catheters and artificial blood vessels), possible factors for the decrease in neutrophil count, and the risk of HIV infection should be examined. It is also useful to interview the patients about their travel history, living environment, the presence or absence of persons they are in close contact with a similar symptom, regular medication, and pet ownership.

Table 3: Fever condition in enrolled subjects

Type of fever	*Number of subjects*		
	Within 24 h of dialysis	*Within 48 h of dialysis*	*Unspecified time*
Fever	20	28	6
Fever with chills	14	4	8
No fever		28	

Urine Culture Reports

Urine culture report was prescribed for 29 subjects of 31 subjects suffering from urosepsis and UTI, during the study period to possibly identify the microbial pathogen. The data were recorded and analyzed [Graph 4 and Table 4].

During this study, the percentage prevalence of various pathogens was found to be: *Candida* species (3.4), *Pseudomonas* species (13.7), *Staphylococcus* species (13.7), *Pneumonia* species (17.2), *Klebsiella* species (24.1), and *Escherichia coli* (27.5).

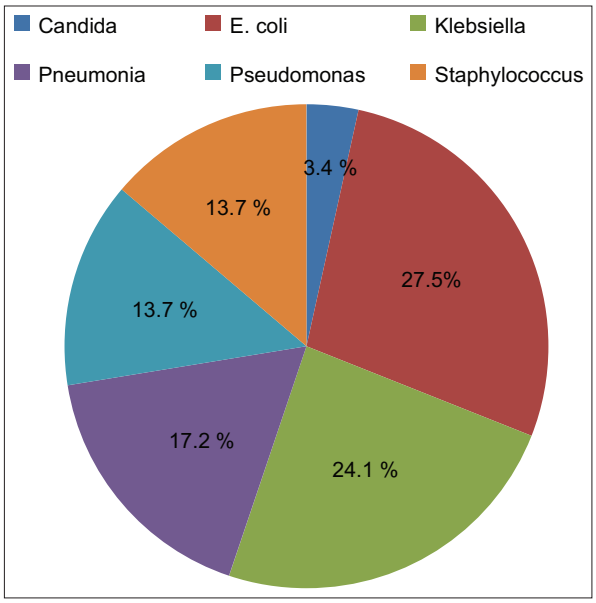
The percentage prevalence of *Pseudomonas* species (13.7) found in the study was similar to the study conducted by Ponce *et al.* (2007) which was reported to be 13.3%. The percentage prevalence of *E. coli* and *Klebsiella* species was found to be 27.4 and 24.1, respectively, during this study, which was closer to 24.4% and 22.2% prevalence, as found in the study conducted by AbouDagher *et al*. (2015).

Leukocytes

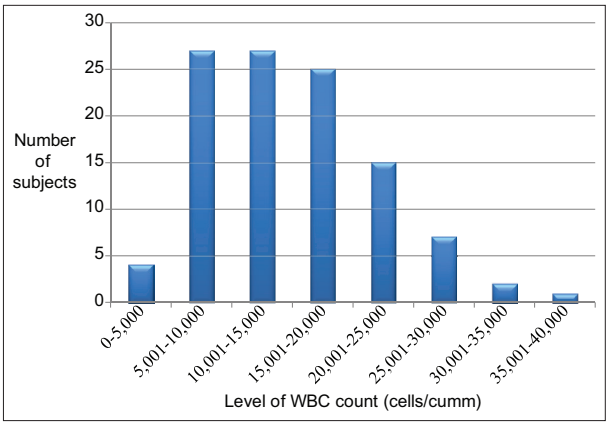
White blood cells (WBC), also referred to as leukocytes, are components of blood, which serves by providing immunity against pathogens. High WBC count may indicate the presence of certain pathogens and that the immune system is working to destroy infection, while

Table 4: Susceptibility of various pathogens in subjects prescribed with a urine culture

Culture organism	*Number of subjects*	*Percentage incidence*
Candida species	1	3.4
Escherichia coli	8	27.5
Klebsiella species	7	24.1
Pneumonia species	5	17.2
Pseudomonas species	4	13.7
Staphylococcus species	4	13.7



Graph 4: Pie-graph representation of microbial pathogens in urine culture



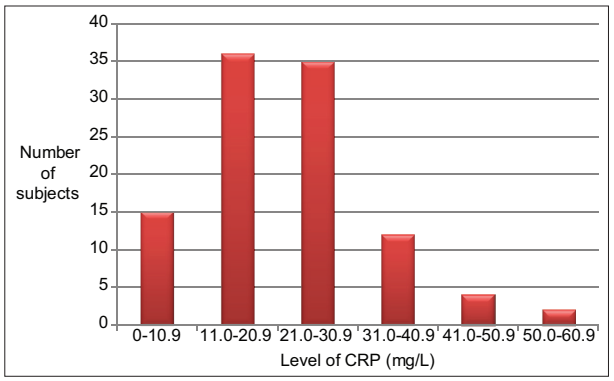
Graph 5: Graphical representation of white blood cells count in prescribed subjects

low WBC count signals that an injury or condition is destroying cells faster than they are being produced.

Normal count of WBC in a healthy individual ranges from 4000 to 11,000 cells/cumm. During this study, the WBC count was examined as part of regular CBP check-up in all the subjects [Graph 5 and Table 5].

C-reactive Protein (CRP)

CRP is an acute-phase reactant, a protein made by the liver and released in the blood within a few hours after tissue injury, the start of an infection, or other causes of inflammation. The normal range of CRP is 0–10 mg/L. During this study, 104 of 108 subjects were prescribed



Graph 6: Graphical representation of the level of C-reactive protein in prescribed subjects

Table 5: Leukocyte (WBC) count in prescribed subjects

WBC count (cells/cumm)	*Number of subjects*
0–5000	4
5001–10,000	27
10,001–15,000	27
15,001–20,000	25
20,001–25,000	15
25,001–30,000	7
30,001–35,000	2
35,001–40,000	1

WBC: White blood cells

Table 6: Levels of CRP in prescribed subjects

Level of CRP (mg/L)	*Number of subjects*
0–10.9	15
11.0–20.9	36
21.0–30.9	35
31.0–40.9	12
41.0-50.9	4
50.0–60.9	2

CRP: C-reactive protein

for CRP [Graph 6 and Table 6]. It was seen that majority of subjects had CRP levels ranging from 11.0 to 30.9 mg/L.[21-30]

CONCLUSION

This prospective and cross-sectional study revealed that the incidence of infectious diseases in patients suffering from renal compromised state exists and the probability of encountering a subject with renal compromised state along with co-morbid infection is 0.55.

The study has shown that male subjects developed co-morbid infectious conditions with a prevalence rate of about 62.03%, while it was 37.97% in the case of females, which reveals that male subjects could attain infectious co-morbid state 1.6 times more than the females.

It was seen that of the various subjects that developed a fever during the study period, the majority belonged to the post-dialysis group (82.5%), which shows possibility at contaminants in the dialysate such as endotoxins and bacterial components (peptidoglycan) may be absorbed into the patient's body through inverse diffusion or inverse filtration through the dialysis membrane and cause fever, apart from patient's specific reasons.

Evidence-based international guidelines are of great value and are instrumental in helping reduce health-care-associated infections. The cornerstone toward risk reduction is to be aware and abreast of the latest guidelines and be keen on implementing them reliably and consistently, as well as being conscientious and alert/active in engaging in quality improvement projects. The decision to follow any guideline statement must be made individually by each HD unit at different locations with varying conditions, according to the incidence and prevalence of any type of infection. However, the patient's safety and well-being deserve top priority in whatever decision is to be made.[31-34]

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