

# Incidence of Citrobacter Urinary Tract Infection in Type 2 Diabetes and its Relationship to Glycemic Control

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## ABSTRACT

**Introduction:** *Citrobacter* species of the Enterobacteriaceae family, are gram negative bacilli that are commonly found in the intestinal tract. This study aimed to determine the incidence of *Citrobacter* Urinary tract infection in type 2 Diabetes

**Material and methods:** A retrospective analytical study was carried out in 221 diabetic patients with culture positive urinary tract infection (UTI) from January 2015 to March 2016. Identification of isolates was done using standard microbiological techniques. Incidence of *Citrobacter* UTI was identified and its relationship to glycemic control was assessed.

**Results:** 37 patients with *Citrobacter* UTI were identified. 79 percent of these patients had elevated fasting plasma glucose and HbA1C. *Citrobacter* species was found to be third most common organism causing UTI in diabetic patients after *Escherichia coli* and *Klebsiella* accounting for 14.1% of all isolates. *C. koseri* (82.1%) was the predominant organism among the two *Citrobacter* species.

**Conclusions:** Though not very common, *Citrobacter* causes urinary tract infections in diabetic patients. The incidence is more common in diabetes with deteriorating glycemic control.

**Keywords:** *Citrobacter*, Diabetes, glycemic control

## INTRODUCTION

There is high predisposition for urinary tract infection (UTI) to develop in diabetes mellitus. The longer the duration and greater the severity of diabetes, more is the chance to develop UTI.<sup>1-5</sup> The decrease in host immunity and high urinary glucose predispose to infection.<sup>6,7</sup> Hyperglycemia causes neutrophil dysfunction by increasing intracellular calcium levels and interfering with actin and, thus, diapedesis and phagocytosis.<sup>8,9</sup> Local causes like decreased blood supply and candidiasis of the vagina may predispose to development of recurrent UTI.

An association between the use of SGLT 2 inhibitors and development of an increased susceptibility to UTI has been noted in uncontrolled diabetes. The use of SGLT2 inhibitors never produced severe infections and the infections responded to a course of oral antibiotics.<sup>10-14</sup>

Over a period of time, long standing diabetes may develop cystopathy, nephropathy, and renal papillary necrosis, that predispose them to UTI.<sup>15,16</sup>

*Citrobacter* are rare opportunistic nosocomial pathogens.<sup>17</sup> The usual infections caused by *Citrobacter* include urinary tract infections, blood stream infections, intra abdominal sepsis, brain abscesses, and pneumonia and neonatal infections.

*Citrobacter* is usually part of the normal intestinal flora and hence a commensal. Neonates, diabetic, immunocompromised, elderly or debilitated patients are at increased risk of infection. *Citrobacter* may be spread by direct contact or through ingestion of environmental sources (fecal-oral route). The aim of this study was to define the incidence of *Citrobacter* causing

Urinary tract infection in type 2 Diabetes

## MATERIAL AND METHODS

The study was conducted as a retrospective analysis in 221 diabetic patients with urinary tract infection (UTI) who were culture positive. The patients were admitted in internal medicine department of various hospitals in South Kerala from January 2015 to March 2016. The study was conducted as a case control study. Non diabetic patients having UTI were taken as controls.

We studied the impact of hyperglycaemia on the incidence of *Citrobacter* UTI in these patients irrespective of other complications. Long term and short term glycemic control was assessed by HbA1C and Fasting plasma glucose respectively.

Isolates were identified using standard microbiological techniques. Patients with *Citrobacter* infection were identified and confirmed by culture.

*Citrobacter* species grows in various culture medium. *Citrobacter* ferment glucose with production of gas. The organisms are motile and utilize citrate. Different species were differentiated by biochemical tests. Incidence of *Citrobacter* UTI was identified and its relationship to glycemic control was assessed.

## STATISTICAL ANALYSIS

Microsoft office 2007 was used for statistical analysis. Mean and percentages were used to interpret the data.

## RESULTS

37 patients with *Citrobacter* UTI were identified in the diabetic group when compare with 12 in the control group (figure 1). 79 percent of these patients had elevated fasting plasma glucose and HbA1C. *Citrobacter* infection was significantly more common in uncontrolled diabetes (p<0.001).

*Citrobacter* species was found to be third most common organism causing UTI in diabetic patients after *Escherichia coli* and *Klebsiella* accounting for 14.1% of all isolates (figure 2).

*C. koseri* (82.1%) was the predominant organism among the two *Citrobacter* species.

## DISCUSSION

*Citrobacter* is grouped under Gram-negative coliform bacteria in the *Enterobacteriaceae* family. Citrate as a sole carbon source

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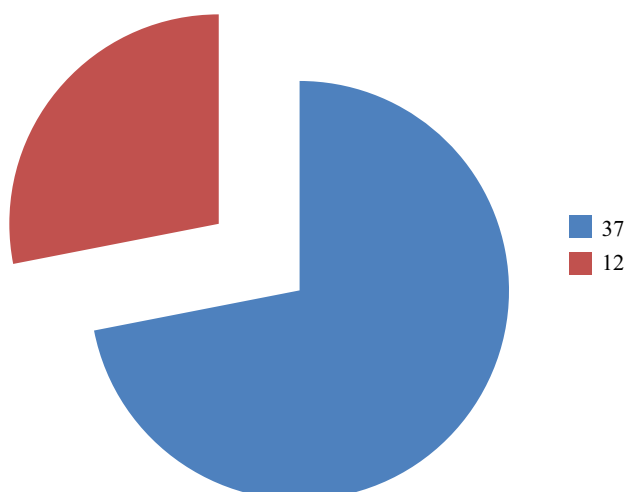


Figure-1: Prevalence of *Citrobacter*

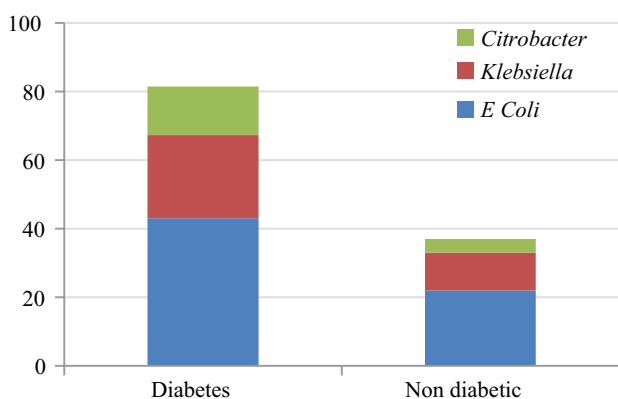


Figure-2: Different species in both the groups.

by the species *C. amalonaticus*, *C. koseri*, and *C. freundii*. *Citrobacter* species is usually differentiated by their ability to convert tryptophan to indole (*C. koseri* is the only *Citrobacter* to be commonly indole-positive), ferment lactose (*C. koseri* is a non-lactose fermentor), and use malonate.<sup>2,11,12</sup> *Citrobacter* has the ability to accumulate uranium by building phosphate complexes.<sup>3</sup>

*Citrobacter* is usually found in the environment in soil, water, waste water etc. They may sometimes be found in the human intestine. They usually produce infections of the urinary tract, infant meningitis and sepsis.<sup>4,5</sup>

*C. freundii* strains become resistant to ampicillin and first-generation cephalosporins by using inducible amp C genes encoding resistance. *Citrobacter* may also be resistant to other antibiotics by virtue of plasmid-encoded resistance genes.<sup>18,19</sup>

## CONCLUSION

UTI is very common among patients with type 2 diabetes mellitus. In these patients, UTI is more severe, caused by more resistant lesser known pathogens, and is associated with worse outcomes than in patients without diabetes.

Although it is uncommon, *Citrobacter* can cause urinary tract infections in the diabetic population, its incidence is more common in diabetes with deteriorating glycemic control.

Treatment should be tailored and patient centric according to severity of infection and culture results. More studies are needed in this direction to improve the treatment of patients with *Citrobacter* UTI.

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