



Encrusted Double-J Stents: Risk Factors Analysis

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Abstract

Introduction Since its introduction by Finney and Hepperlen in 1978, the double-J (DJ) stent has become a common armament that every urologist uses every day. The use of the DJ stent cannot be separated from the morbidity or complications that might occur, including discomfort arising from the insertion of stents, forgotten to remove, urinary tract infections, biofilm formation, and even encrustation of the stent. This research aims to determine the correlation between the risk factors in the formation of encrustation in patients with urinary tract stones. **Materials & Methods** This is a cohort study using the chi-square analysis and odds ratio calculation. We evaluated urine metabolite, urine culture, time of removal of the DJ stent, and encrustation formation in the DJ stent. Sixty patients with urinary tract stone and 60 without urinary tract stone participated in this research. **Results** The presence of urine bacteria and neglected DJ stent in the stone group and abnormal urine levels of magnesium in the non-stone group had significant correlation with encrustation formation of the DJ stent ($P < 0.05$). **Conclusions** various factors lead to encrustation formation in the DJ stent, and patients with a history of stones have more risk factors for encrustation formation.

Keywords *DJ Stent, Bacteria, Urine Metabolite, Neglected, Encrustation.*

Introduction

Since its introduction by Finney and Hepperlen in 1978, the double-J (DJ) stent has become a common armament that every urologist uses every day. Over time, there have been advances and improvements in both designs and materials, to improve the efficacy of the stents themselves [1, 2]. In clinical practice, the DJ stent is mostly indicated for treatment of ureteral obstruction due to intrinsic or extrinsic causes [3].

Although the use of the DJ stent cannot be separated from the morbidity or complications that might occur, including discomfort arising from the insertion of stents, forgotten to remove, urinary tract infections, biofilm formation, and even encrustation of the stent.

The biofilm formation begins with bacterial colonization on the surface of the stent. Over time, this condition can promote urinary obstruction, urinary tract infection leading to urosepsis, and stent encrustation. The encrustation of the DJ Stent can occur in infected or sterile urine. In infected urine,

the urea splitting bacteria play the important role, whereas in sterile urine, the encrustation occurs due to accumulation of urine electrolytes. Calcium oxalate is the most common component found in the encrusted DJ stent [4, 6]. In patients with urinary tract stones, the risk of encrustation increases three times [7].

Subjects and Methods

This is a cohort study using the chi-square analysis and odds ratio calculation. We evaluated urine metabolite, urine culture, time of removal of the DJ stent, and encrustation formation in the DJ stent. Sixty patients with urinary tract stone and 60 without urinary tract stone participated in this research.

Results

The presence of urine bacteria and neglected DJ stent in the stone group and abnormal urine levels of magnesium in the non-stone group had significant correlation with encrustation formation of the DJ stent ($P < 0.05$). These results can be seen in Table 1.

Table 1: Analysis of risk factors in correlation with encrustation formation

		Encrustation		P Value	OR
		Yes	No		
• Stone Group					
Uric Acid	Normal	2	3	0.741	0.73
	Abnormal	18	37		
Magnesium	Normal	2	10	0.171	3
	Abnormal	18	30		
Calcium	Normal	17	36	0.57	0.748
	Abnormal	3	4		
Urinalysis	Normal	6	30	0.001	7
	Abnormal	14	10		
Urine Culture	Sterile	5	24	0.011	4.5
	Abnormal	15	16		
Time to Remove	On Time	7	30	0.003	5.571
	Forgotten	13	10		
• Non Stone Group					
Uric Acid	Normal	4	28	0.212	2.333
	Abnormal	7	21		
Magnesium	Normal	5	37	0.049	3.7
	Abnormal	6	12		
Calcium	Normal	10	49	0.333	0.169
	Abnormal	0	1		
Urinalysis	Normal	4	18	0.982	1.016
	Abnormal	7	31		
Urine Culture	Sterile	4	18	0.982	1.016
	Abnormal	7	31		
Time to Remove	On Time	3	23	0.234	2.359
	Forgotten	8	26		

*P Value < 0.05 is significant

Discussion

The usage of DJ stent cannot be separated from the associated complications that might occur. Encrusted stent is one of the complications, which causes a variety of problems. In our study, encrusted stents occurred in 33% of patients in the stone group and in 18% of those in the non-stone group. Multiple risk factors could cause encrustation on the DJ stent [1]. The presence of abnormality in urinalysis is more likely to change the condition of the DJ stent. It will be discoloured and more likely to develop encrustation [8]. In our study we found that patients with abnormal values in urinalysis are seven times more likely to develop DJ stent encrustation.

Fifty-two (52%) subjects in the stone group had positive bacteria in urine culture and it was significantly associated with encrustation formation. The risk calculated was four times. The presence of bacteria in the urine could lead to biofilm formation. Subsequently, it would attract other urine-forming compositions, which in the appropriate urine conditions can trigger attachment and further proliferation on the surface of the stent [9]. Eventually, encrustation will occur. The neglected DJ Stent can cause various problems [10]. The risk of encrustation in neglected stents is high.

The rate of formation of encrustation increased from 9.2% in less than 6 weeks to 47.5% in 6-12 weeks after the insertion of the DJ stent. This number increases to 76.3% if the stent is not retrieved for more than 12 weeks [11]. Takashi et al. also demonstrated a similar result in his study, the rate of encrustation in stents less than 6 weeks was 26.8%, 56.9% in stents that were left for 6-12 weeks, and 75.9% in stents that had been forgotten to be retrieved in more than 12 weeks [10]. In our study, we found 38% encrustation in the neglected DJ stent. This was statistically significant (P = 0.003) and had six times risk to develop it. One of the risk factors for developing encrustation was biofilm formation.

The mechanism of biofilm formation is the result of the union of organic components of urine with the surface of the biomaterial on the ureteric stent. In a longer time, it can trigger further bacterial growth, thus causing an increase in urease production, which can increase the pH level of urine. The increase in urinary pH will attract calcium and magnesium ions in the biofilm matrix, which can eventually cause crystallization [10]. In this study, abnormal urine metabolite levels of magnesium were found in 30% of the non-stone group and showed four times risk in the formation of encrustation. Magnesium is

one of the components that can cause encrustation, and the presence of this component on the surface of the stent indicates the presence of an encrustation process [5].

Conclusion

Various factors could lead to encrustation

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formation in the DJ Stent. Patients with history of stones have more risk factors for encrustation formation.

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