Introduction

Zimskind, in 1967, was the first who prescribed endoscopic stent placement to relieve ureteral obstruction [1]. This early era was plagued with frequent stent migration and device expulsion. It was not until the year 1976; when the revolutionary development of the Double J and pigtail stents independently by Finney and Hepperten and colleagues (1978) [2], that the use of ureteral stents witnessed widespread status [3]. Since then ureteral stents became a fundamental tool in today’s urologic armamentarium and are prescribed for number of indications including obstruction relief, prophylaxis against obstruction or ureteral injury and is used as a ureteral splint. Stents are often inserted to relieve either extrinsic (tumor, retroperitoneal fibrosis) or intrinsic ureteral obstruction (stones, tumors, strictures), as a temporary measure while definitive treatment is instituted, or as permanent tool when no corrective treatment is possible. Indications for pre-ESWL stenting are stone burden greater than 2 cm, when bilateral ESWL is recommended to be undertaken (at least one renal unit) and in solitary kidney’s treatment [4,5].

All stents may cause morbidity such as flank pain, dysuria, hematuria, infection, migration and encrustation. We reviewed the literature on the subject of the encrusted stents; discussed the risk factors for encrustation, and methods of preventing thereof. We could identify variety of factors that contribute in determining the occurrence rate of this process, the material of the stent, urine composition and duration of using thereof. We noticed that risk of stent encrustation is increased in patient with a history of urolithiasis and at progressively longer indwelling time [6]. Selective medical therapy for nephrolithiasis is highly effective in preventing new stone formation. Citrate efficacy for the management of hyper uricosuric calcium nephrolithiasis may stem from inhibitory activity of citrate with respect to calcium and oxalate crystallization. We evaluated the clinical efficacy of long-term preventive treatment of stent encrustation with alkaline citrate medication. The annual and cumulative rates of stents encrustation were compared before and during the treatment.

Material and Methods

We compared two groups of patients in a retrospective study. First group from June 2003 to June 2004, 82 patients were selected among 923 patients with urolithiasis who underwent extracorporeal shock waves lithotripsy (ESWL) and needed previously double J (J-J) insertion because of what are the burden of stone >2cm or treating obstructive anuria due to urolithiasis or after open surgery on the kidney and ureter for lithiasis when needed. The second group from June 2010 to June 2011 who have taken preventive alkaline K and Na citrate therapy to prevent stent encrustation in addition to ESWL, this second group consisted of 130 patients who underwent ESWL therapy and they needed (J-J) insertion because of similar reasons of the first group. Patient age ranged from 6 years to 73 years (mean age 42 years) in the first group. But in the second group patient age ranged from 2 years to 80 years (mean age 37 years). Ratio male to female was identical in both groups and was 59%; 41%.

Results: Stent encrustation was quantified by visual analog score 0 (none) to 4 (heavy).

Group 1: The mean stenting time was 6.2 months.
   a) Score (0 and 1) none encrusted: 55 patients (67%).
   b) Score (2, 3 and 4) encrusted: 27 patients (33%).

Group 2: The mean stenting time was 8.6 months.
   a) Score (0-1) none encrusted: 121 patients (93%).
   b) Score (2, 3 and 4) encrusted: 9 patients (7%).

Conclusion: Alkaline medication, potassium and sodium citrate is effective in preventing and reducing stent encrustation.

Keywords: Stent; Encrustation; Urolithiasis; Citrate

Abbreviations

ESWL: Extracorporeal Shock Wave Lithotripsy; J-J Double J Stent U/S: Ultrasound; CT: Computerized Tomography IVU: Intravenous Urography; PCNL: percutaneous nephrolithotripsy
selected among 923 patients with urolithiasis who underwent ESWL therapy and needed previously J-J insertion because of whatever the burden of stone > 2cm or treating obstructive anuria because of stone formation or after open surgery on the kidney and ureter due to stones when needed. The second group from June 2010 to June 2011 who has taken preventive alkaline K and Na citrate therapy to prevent stent encrustation in addition to ESWL this second group consisted of 130 patients who were chosen from 1182 patients who underwent ESWL therapy and they needed J-J insertion because of similar reasons of the first group. Material of Stents in both groups was polyurethane which shares characteristics common to both silicone and polyethylene the first plastic polymer used in stents and the two companies of stents we used to use were B. Brown from USA and Coloplast from France. Patient age ranged from 6 years to 73 years (mean age 42 years) in the first group. But in the second group patient age ranged from 2 years to 80 years (mean age 37 years). Ratio male to female was identical in both groups and was 59%: 41%. Patients were evaluated monthly by KUB film; U/S, blood urea and serum creatinine, urine analysis for each patient. Urine culture, IVU, and coronal CT scan were done when indicated. The administration of Uralyt-U granules (potassium sodium hydrogen citrate) started at the first week of insertion of J-J. Patients were instructed to take 1-4 spoons of granules (2.5 - 10gr) daily according to the pH of their fresh urine examined by test strip of indicator paper daily in the early morning.

**Results**

Stent encrustation was quantified by visual analog score 0 (none) to 4 (heavy)

**Group I:** The mean stenting time was 6.2 months

- a) Score (0 and 1) none encrusted: 55 patients (67%). (Figure 1)
- b) Score (2, 3 and 4) encrusted: 27 patients (33%). (Figure 2-5)

**Group II:** The mean stenting time was 8.6 months.

- a) Score (0-1) none encrusted: 121 patients (93%). (Figure 1)
- b) Score (2, 3 and 4) encrusted: 9 patients (7%) (Among them those patients who did not comply the treatment or had forgotten the stent).

No complications were recorded in our patients. Alkaline medication, potassium and sodium citrate (group two) about 3-fold (Odd- 2.8) significantly effective in prevention and reducing stent encrustation compared with group one (Considered significant when P-value < 0.05).

**Discussion**

The ideal stent material should be biocompatible and radiopaque, relieve intraluminal and extra luminal obstruction, resist encrustation and infection, cause little discomfort to the patient, and should be widely available at reasonable cost.
Citrice inhibits agglomeration and sedentation of calcium oxalate crystals [15, 16] as well as growth of calcium oxalate and calcium phosphate crystals. Ultimately, normal urinary citrate levels can enhance the inhibitors effect of Tamm-Horsfall glycoproteine [17]. And as we know hypocitraturia is an important and correctable abnormality associated with nephrolithiasis that exists as an isolated abnormality in up to 10% of calcium stome formers and is associated with other abnormalities in 20% to 60% [18, 19] and we may correct this underlying cause of lithiasis by using alkaline therapy to prevent encrustation as stated hereinabove. An interesting observation deserves mentioning herein, is that not all stents become encrusted, even after long indwell times. In a series of patients who had an indwelling stent for more than 1 year (mean 36 months), Park and colleagues (2004) found this occurred in only 33% of the stents [20].

In our series, in the first stented group treated by ESWL only, the rate of encrusted stent was 33% (27 patients) is identical to the reported series ratio. Regarding to the second group treated by ESWL and citrate medication, the rate of encrusted stent was 7% (9 patients), among them those patients who did not comply the alkaline treatment or had forgotten the stent with calcification all over the stent, which also were treated by ESWL and citrate medication, and in this group the removal of stent was easier because of mild encrustation seen on it. Management of the retained encrusted ureteral stent may require multiple procedures; many options include chemolysis, ESWL, endoscopic lithotripsy, PCNL, open lithotomy and nephrectomy. In our series we did not need in the second group any further treatment than ESWL and citrate. We have taken a policy in our hospital to add a new indication for alkaline citrate medication which is reducing of ureteral stent encrustation in addition to lithotripsy.

**Conclusion**

Stent encrustation and management challenges even experienced urologist. The key to prevent this problem is to

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**Table 1:** Demographic baseline and treated patients characteristics:

<table>
<thead>
<tr>
<th>Demographic data</th>
<th>First group</th>
<th>Second group</th>
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<tbody>
<tr>
<td>Gender Male N. (%)</td>
<td>48 (59%)</td>
<td>77 (59%)</td>
</tr>
<tr>
<td>Female N. (%)</td>
<td>33 (41%)</td>
<td>53 (41%)</td>
</tr>
<tr>
<td>Total N.</td>
<td>82 patients</td>
<td>130 patients</td>
</tr>
<tr>
<td>Age, years, median, range</td>
<td>42 years (6-73y)</td>
<td>37 years (2-80y)</td>
</tr>
<tr>
<td>Rt. Side N. (%)</td>
<td>-48%</td>
<td>-45%</td>
</tr>
<tr>
<td>Lt. Side N. (%)</td>
<td>-38%</td>
<td>-37%</td>
</tr>
<tr>
<td>Bil. N. (%)</td>
<td>-14%</td>
<td>-18%</td>
</tr>
<tr>
<td>Stenting time, mean, range</td>
<td>6.2 months (2-8.9 months)</td>
<td>8.9 months (2-48 months)</td>
</tr>
<tr>
<td>Non-encrusted stent N (%)</td>
<td>55 (67%)</td>
<td>121 (93%)</td>
</tr>
<tr>
<td>Encrusted stent N. (%)</td>
<td>27 (33%)</td>
<td>9 (7%)</td>
</tr>
</tbody>
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**Statistical Analysis:** First Group; 55 (67%), 27 (33%)

Second Group: 121 (93%), 9 (7%)

Chi Square (χ²) = 24.12 P-value < 0.0001

Relative Risk = 2.8

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give preventive alkaline medication, potassium and sodium citrate, they are equally effective in preventing uric acid stone formation because of their ability to increase both urinary pH and its inhibitor effect on spontaneous nucleation of Ca oxalate and growth of Ca phosphate crystals interrupting stone formation, stent encrustation and decrease stent blockage in the long run.

References