Objective: To study the possibility of creating mucosal valve mechanism at ureteric orifice without obstructing the urine outflow but preventing the urine backflow into the ureters.

Materials and Methods: Ethical waiver was obtained from the institutional ethical committee. Prospective experimental study was conducted on the post-mortem specimen of intact bladder with urethra and bilateral ureters retrieved from the already slaughtered lamb available in the meat market. Feeding tube inserted via urethral opening into the bladder lumen and bladder inflated with saline demonstrated no reflux of urine via transverse cut opening of ureters. Bladder lumen opened, ureteric orifices incised backwards to eliminate the obliquity. After closing the bladder opening, saline inflation test demonstrated bilateral reflux of saline via cut openings of bilateral ureters. Bladder was re-opened. The upper limb of horizontal U started 10 mm lateral and 8 mm above the refluxing ureteric orifice. Distal most curvature of horizontal U was kept 5 mm medial to ureteric orifice continuing along the lower limb of horizontal U terminating 10 mm lateral and 8 mm below the refluxing ureteric orifice, mucosal flaps from superior and inferior incision mobilized and edges joined to cover the ureteric orifice creating a flap valve mechanism. Influx of saline via cut end of ureters demonstrated no obstruction. Bladder was closed. Saline inflation test and contrast study demonstrated abolition of reflux on flap side and persistence of reflux on another side.

Results: Five such experiments were conducted. On the side where the valve was created, Vesicoureteral reflux was abolished in four but in one minimal reflux still persisted.

Conclusion: Creating a mucosal flap valve around the ureteric orifice can prevent reflux in 80% of cases without obstruction and without the necessity of ureteric mobilization or creating submucosal tunnel.

Keywords: Antireflux mechanism, mucosal flap valve, vesicoureteric reflux

INTRODUCTION

Various techniques of surgical correction of vesicoureteric reflux have been described.[1-12] The described techniques necessitate mobilization of ureters and its advancement either submucosal or extramucosal to create intravesical oblique course with detrusor backup for effectivity of Paquin’s rule.[3] In some techniques for correction of vesicoureteral reflux like endoscopic injection of dextranomer hyaluronic acid at the ureteric orifice[8] or extravesical ureteric
reimplantation\textsuperscript{[4,5]}, ureteric mobilization is not necessary. In several circumstances such as surgery of classic bladder extrophy, the task of the ureteric mobilization may have its own complications. The purpose of this communication is to report a new concept of creating a flap valve at the ureteric orifice with bladder mucosa without obstructing the urine flow and creating unidirectional urine flow mechanism eliminating reflux.

**Materials and Methods**

**Study design**

This is a prospective experimental study performed on fresh post mortem specimens of urinary bladder with the intact urethra and ureters retrieved from a slaughtered lamb available in the market. Ethical waiver was obtained from the institutional ethical committee. The study was conducted in the experimental surgery laboratory.

**Experimental technique**

A specimen of bladder and bilateral intact ureters with kidney was placed on table [Figure 1a]. Upper one third of ureters with kidneys was cut away, leaving the end of the distal two third of ureters open [Figure 1b]. Through urethral opening feeding tube was passed in bladder and peritubal saline leak was prevented by securing the feeding tube with purse string sutures around bladder neck. Bladder was inflated with 20 ml of saline through feeding tube. Saline inflation test demonstrated no reflux of saline via cut end of ureters. Bladder was opened. Bilateral ureteric orifices were located [Figure 1c]. Keeping one blade of Reynolds scissors in ureteric orifice and other blade on the bladder mucosa back cut was made to eliminate the obliquity of intravesical course of ureters. After occluding the anterior bladder wall opening with clamp, saline inflation test demonstrated bilateral vesicoureteral reflux [Figure 1d], on table contrast study also demonstrated bilateral reflux.

The mucosal flap valve was created in following manner. A horizontal U shape mucosal incision was marked. The upper limb of horizontal U started 10 mm lateral and 8 mm above the refluxing ureteric orifice. Distal most curvature of horizontal U was kept 5 mm medial to ureteric orifice continuing along the lower limb of horizontal U terminating 10 mm medial and 8 mm below the refluxing ureteric orifice [Figure 2a]. Starting from above towards ureteric orifice, bladder mucosa flap was raised, similar flap was raised from below [Figure 2b], edges of superior and inferior flaps sutured with each other creating a flap valve over the ureteric orifice [Figure 2c]. Infusion of saline was performed from superior cut end of ureteric orifice to eliminate the possibility of obstruction created by flap valve and no obstruction was found. After occluding opening of anterior bladder wall, saline infusion test and contrast study again performed to see the abolition or persistence of reflux. Five such experiments were conducted.

**Outcome measurements**

1. Abolition/persistence of reflux on the side of the creation of the flap valve
2. Maintenance of nonobstructive outflow on the side of the creation of the flap valve
3. Any operative complication or difficulty in raising mucosal flap or creating flap valve.

**Results**

In all five experiments conducted on the specimens of the bladder and ureters of a lamb, intact natural antireflux mechanism was demonstrated. In all five specimens, after destroying the obliquity of transvesical course of the ureters, vesicoureteric reflux was uniformly demonstrated.

In all experiments, destruction of antireflux mechanism was performed on both sides but flap valve was created only on unilateral side to demonstrate creation of effective antireflux mechanism without causing any obstruction to outflow of saline from ureters into the bladder.

The flap valve thus created was effective to eliminate reflux on the side of valve in four out of five. In one out of five, reflux persisted but severity was reduced [Figure 3].

For raising the mucosal flap, the magnification was required in all the cases.

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**Figure 1:** (a) Specimen of the bladder with B/L ureter and kidney. (b) Kidney and upper ureter cut away. (c) B/L ureteric orifices seen through the open bladder. (d) Saline inflation test with leak of urine from the cut end of the ureters.
In one case, mucosal flap tear was noted, and in the same case, incomplete abolition of reflux was also noted.

**Discussion**

Vesicoureteric reflux has been prevented by nature itself to prevent the backflow of urine into ureters pelvis and kidney, thus protecting against injury to nephrons.

The mechanism of prevention of vesicoureteric reflux involves several factors related to physiology of ureters, anatomical design of ureterovesical junction, and functional dynamics of bladder reservoir. The normal ureteric physiology contributes by active propagation of urine bolus in antegrade manner.\(^{[13]}\)

Contraction of ureteral smooth muscle leads to shortening of distance between intravesical and extravesical ureteric hiatus that results in widening of hiatus and reduction of obliquity, this help propulsion of urine from ureters to bladder. During the filling phase, when bladder is relaxed, the submucosal tunnel is lengthened and acts like a compression valve over the ureters because the pressure is transmitted through the bladder wall anteriorly and posterior wall of the ureters lies against the detrusor backing, thus the valve mechanism is effective.

There are numerous surgical techniques described for correction of vesico-ureteric reflux. All these techniques involve restoration of a flap valve mechanism by creating a submucosal tunnel with adequate detrusor muscle backing so that Paquin’s rule come into force for prevention of reflux. Various surgical techniques described by Hutch\(^{[1]}\), Cohen\(^{[14]}\), Leadbetter Politano\(^{[2]}\), Gregoir\(^{[5]}\), Glenn \(^{[6]}\), Gil-Vernet\(^{[7]}\), O Donnel et al\(^{[8]}\), Gupta et al\(^{[11]}\), Sunil et al.\(^{[12]}\)

In all these techniques there has been a need to mobilize the ureter and gain intravesical length for creation of valve mechanism. Mobilization of ureter itself can be associated with complications like injury to ureteric walls, injury to microscopic vasculature thereby altering the peristalsis and injury to periureteric vesical detrusor muscle. There are several occasions where ureteric mobilization is difficult and in these cases, creation of effective antireflux mechanism is desired without ureteric mobilization and without creating obstruction at ureteric orifice. This experimental study we have demonstrated that with creation of flap valve using the described technique it is possible to eliminate vesico-ureteric reflux without obstructing outflow of urine and without the necessity to mobilize the ureter.

The limitation of this study is that this experimental study was conducted on postmortem bladder specimen of a lamb, which fails to demonstrate the long-term survival of the flap valve with intact vascularity. Moreover, destruction or tear of valve with urine flow has also not been demonstrated.

**Conclusion**

Creating a mucosal flap valve around the ureteric orifice with adherence to technical protocol as described can prevent reflux in 80% of cases without obstruction and without necessity of ureteric mobilization or creating submucosal tunnel.

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Nil.

**Conflicts of interest**

There are no conflicts of interest.
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