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Assessment of Wound Healing Following Collagen Urethral Stent Placement for Urethrotomy in Dogs

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ABSTRACT

Background: The present study was undertaken to evaluate the efficiency of collagen urethral stents on wound healing post-urethrotomy in dogs and to assess the uptake of collagen urethral stents through urethrography, ultrasonography and hematobiochemical analysis.

Methods: A total of 12 dogs presented to Madras Veterinary College Teaching Hospital with the history of urinary obstruction were chosen for the study and were randomly divided into 2 groups of 6 dogs in each. In group I, dogs were treated with conventional urethrotomy procedure and in group II, animals were treated with urethrotomy with collagen urethral stent placement. Hematobiochemical, plain and contrast radiography, ultrasonograhy were performed in both the groups.

Result: The study revealed that in comparison with group I, group II animals had a faster wound healing rates; reduction in urethral lumen diameter and urethral leakage post-operatively were not observed in both the groups. In the present study, ultrasound was used to identify and locate the calculi but also to check the collapse, migration and absorption of the collagen stent placed inside the urethra wherein no stent collapse or migration noticed. Partial collagen stent absorption was noticed on day 7 and a complete stent absorption was noticed on day 14. There was no significant difference in the pain scores between the groups indicating that the collagen stent does not elicit any extra pain as compared to normal urethrotomy procedure.

Key words: Collagen stent, Urethral stent, Urethral stricture, Urethrotomy, Urolithiasis.

INTRODUCTION

In male dogs, the most commom site for calculi in the urinary tract is the penile urethra, caudal to the os penis which blocks the urinary passage either partially or completely resulting in stranguria, hematuria or anuria. Depending on the size of the calculi, either retrohydropropulsion or urethrotomy is the preferred choice of treatment in dogs. Urethrotomy often results in formation of urethral stricture at the site of incision. To avoid the urethral stricture, usually a urinary catheter is placed *in situ* to maintain the urethral patency until the urethral incision heals. This may aid as a source of ascending infection into the urinary bladder. Hence to avoid the urethral strictures post-surgically as well as to prevent ascending infection into the bladder, a stent can be placed inside the urethra to maintain the urethral patency (Al-Aown *et al*., 2010). The collagen material which had been used in this study as a stent was less immunogenic due to its acellularity (Jia *et al*., 2015).

MATERIALS AND METHODS

Twelve male dogs brought to the Madras Veterinary College Teaching Hospital,TANUVAS with a history of urethral calculi along with less or absentia of cystolith and systemically uncompromised patients with absence of grave or poor pre-renal azotemic symptoms were randomly selected for the study during the period 2018-21. The dogs were presented with clinical symptoms of pollakiuria, stranguria, hematuria or dysuria. These cases were divided into 2 groups, with 6 animals in each group. Group I animals underwent conservative urethrotomy and a urinary catheter was placed insitu in each case. Group II animals underwent urethrotomy following which collagen stent were placed and sutured. Routine hematobiochemical profiles were performed pre-operatively and post-operatively. The serum values of calcium (mmol/dl) and phosphorus (mmol/dl) sodium (mmol/dl) and potassium (mmol/dl) were estimated. All the animals in both the groups were subjected to survey and positive contrast radiographic evaluation pre-operatively and on 3rd, 7th and 14th day post-operatively to check for any urethral extravasation or any urethral strictures. For a positive contrast urethrography, a urinary catheter of appropriate size was placed into the distal urethra with urethral tip closed

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2 ml of aqueous, sterile, iohexol was infused into the urinary catheter and a radiograph was taken with the same settings as survey radiograph to check for any urethral extravasation or any urethral strictures (Fig 1, 2). Ultrasonography of the urethra and the bladder was done for any calculi or any abnormality as described by Mannion (2009) and Sravanthi *et al*. (2014) pre-operatively and on 0, 3rd, 7th and 14th day post-operatively (Fig 3, 4). Urine samples were collected pre-operatively through cystocentesis and post-operatively on days 7 and 14 for routine urine analysis.

Surgical management

Catheterisation was attempted with hydropropulsion using an appropriate sized urinary catheter for each dog in both groups. After unsuccessful attempts of dislodging the urethral calculi to relieve the urethral obstruction, urethrotomy was decided in all dogs. Following retrieval of the calculi urethra was catherised and was sutured with PGA 3-0 in a continuous pattern with the catheter in place. The subcutis and the skin were closed as per standard protocol.

Collagen stent preparation and placement

Commercially available sterilised acellular collagen sheets (Nemigen) of bovine origin were tubularised into collagen stents. As opined by Weiss *et al*. (2006), the stent size diameter was made atleast 10% greater than the maximal luminal diameter of the urethra. The collagen sheet was then rolled over the catheter and the extra sheet of collagen was trimmed off and then the free edges of the collagen sheet were fastened with a few interrupted sutures using PGA 3-0 as demonstrated by De Filippo *et al*. (2002). The procedure was followed by Collagen Stent Placement**.**

A conservative urethrotomy was performed and the caliculi was removed following which urinary catheter was passed through the penile urethra and taken out through the urethral incision and then the prepared collagen stent was passed through the urinary catheter The collagen stent of appropriate length and diameter was pushed into the urethra and then the catheter was passed into the bladder. An interrupted suture with PGA 3-0 was made on the urethra including the collagen stent in the suture to prevent the stent migration post-operatively (Fig 5). The urethra was closed with PGA 3-0 in a continuous pattern.The urinary catheter was removed after the stent placement. The subcutis and the skin were apposed as per standard protocols.

Subjective evaluation of surgical wound was done based on colour, odour and exudates of the surgical wound on days 3, 7 and 14 post-operatively. The surgical wounds were assessed using a 4-point gross wound score (0- absence of swelling, crusting and discharge and dehiscence mild swelling; 1-mild crusting mild discharge and <1 mm of skin edge separation; 2-moderate swelling, moderate crusting moderate discharge and 1-2 mm of skin edge separation; 3-severe swelling, severe crusting, severe discharge and <2 mm of skin edge separation as per (Hodshon *et al*., 2013) and a subjective evaluation of surgical wound (colour-red, pink and black; odour-malodour, putrid and no-odour;

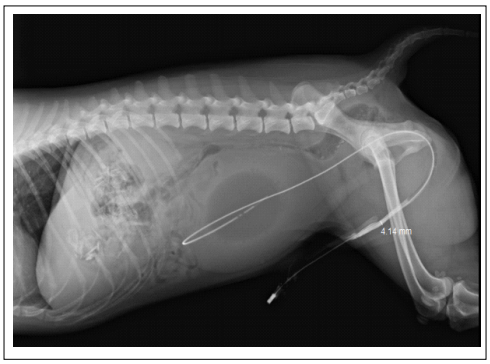


Fig 1: Group I post-operative contrast radiograph-post-op day 7.

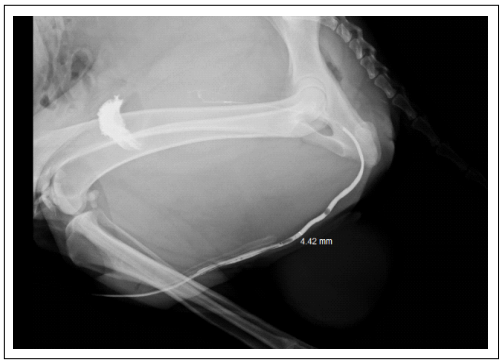


Fig 2: Group II post-operative contrast radiograph-butt view post-op day 7.

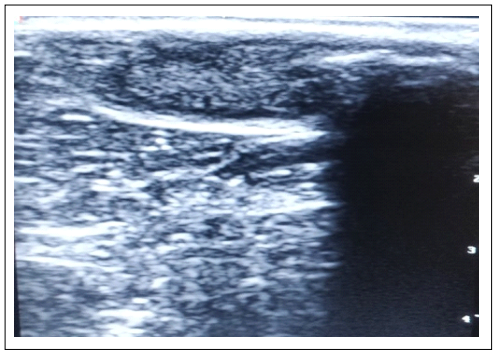


Fig 3: Group I pre-operative ultrasound of urethra-cross section.

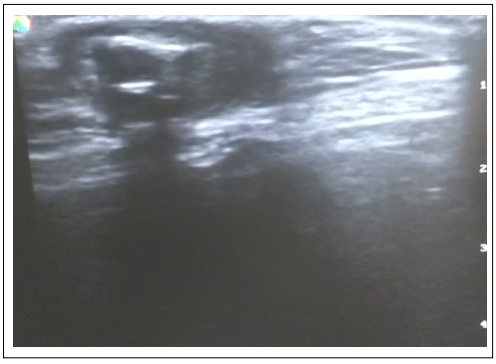


Fig 4: Group II post-operative (day 0) ultrasound of urethra-cross section.

exudates-exudative, moderate exudate and no-exudate as per Gokulakrishnan *et al*. (2017). Pain in the urethrotomy site was assessed based on the glassgow composite measure pain scale (CMPS) post-operatively on days 0,3,7 and 14 (Reid *et al.,* 2007). The pain scale was divided into 4 broad categories based on the behavioural signs within the kennel or house, outside during walk, pressure around the wound area and overall appearance exhibited by the dog.

RESULTS AND DISCUSSION

In the present study, twelve male dogs ranging from 2-7 years of age with a mean age of 5.25±0.49 years comprising of 4 non-descripts, 2 pugs, 2 dalmatians, 2 spitz, 1 doberman cross and 1 shih-tzu were included. All the dogs were presented with clinical signs of urinary obstructions such as inappetance, depression, dysuria, stranguria and hematuria which are also in accordance with the case report presented by Rani *et al*. (2011). Catheterisation was attempted with hydropropulsion using an appropriate sized urinary catheter for all the dogs in both the groups. After unsuccessful attempts of dislodging the urethral calculi decision was made to remove the calculi surgically with urethrotomy procedure.



Fig 5: Group II urethrotomy. Placement of prepared collagen stent.

There was no significant difference (P<0.05) in hematological values within and between the groups except in WBC counts. The reduction in WBC levels could be attributed to the reduced inflammatory changes at the urethra because of the low immunogenicity of collagen stent (Lin *et al*., 2006). A significant difference was noticed in the BUN and creatinine values (P<0.01) within both the groups I and II between pre-operative and 14th day of post-operative evaluation. In this study, the elevated BUN and creatinine values during pre-operative evaluation might be due to post-renal azotemia caused by obstructive urolithiasis which then gradually reduced to normal reference range after relieving the obstruction caused by the calculi through urethrotomy.

A significant difference (P<0.05) was observed in phosphorus values within the group I and a highly significant difference (P<0.01) in group II from pre-operative to 14th day of post-operative evaluation.

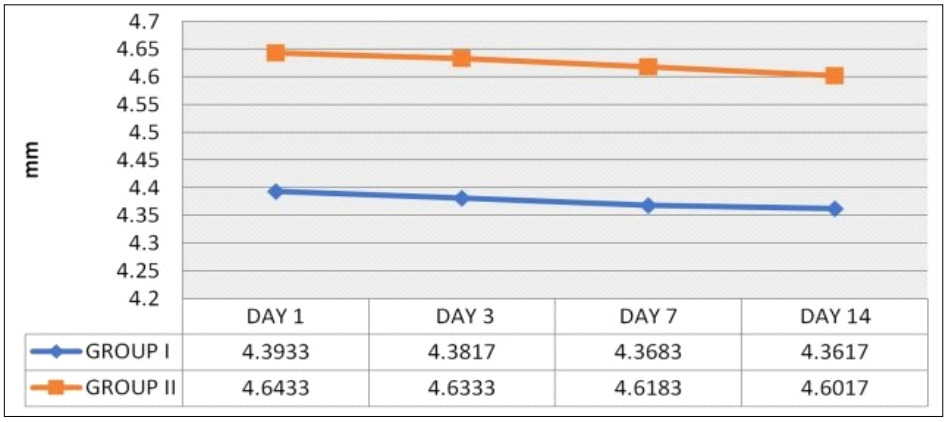
Severity of renal damage would have resulted in a significant difference (P<0.01) in serum sodium and potassium values within both the groups I and II. A reduced renal function due to obstructive urolithiasis, disrupted the sodium-potassium homeostasis during pre-operative and 0 post-operative days.

Radiography

There was no significant difference in the urethral diameter between and within the groups I and II on pre-operative and post-operative radiographic assessments which indicated that there was no urethral stricture formation post-operatively in both the groups (Table 1,2). It could be inferred that use of collagen stent in urethra might have reduced the incidence of urethral stricture post-operatively after urethrotomy in dogs (Fig 6). This is in accordance with the findings of Jia *et al*. (2015).

Ultrasonography

All the animals in both the groups I and II were confirmed with urethral calculi pre-operatively on ultrasonographic examination. In the present study, ultrasound was not only used to identify and locate the calculi but also to check the collapse, migration and absorption of the collagen stent



	DAY 1	DAY 3	DAY 7	DAY 14
GROUP I	4.3933	4.3817	4.3683	4.3617
GROUP II	4.6433	4.6333	4.6183	4.6017

Fig 6: Urethral lumen diameter radiographic assessment.

placed inside the urethra by using different echogenicity between the urethral tissue and collagen matrix post-operatively on days 0, 3, 7 and 14 (Table 3). In addition, Colour flow Doppler was used to check for urethral blood flow post-operatively. Stent collapse was noticed when an increased pressure was exerted on the ultrasound probe over the urethrotomy site while a gentle pressure negated the collapse of collagen stent. Absorption of collagen stent

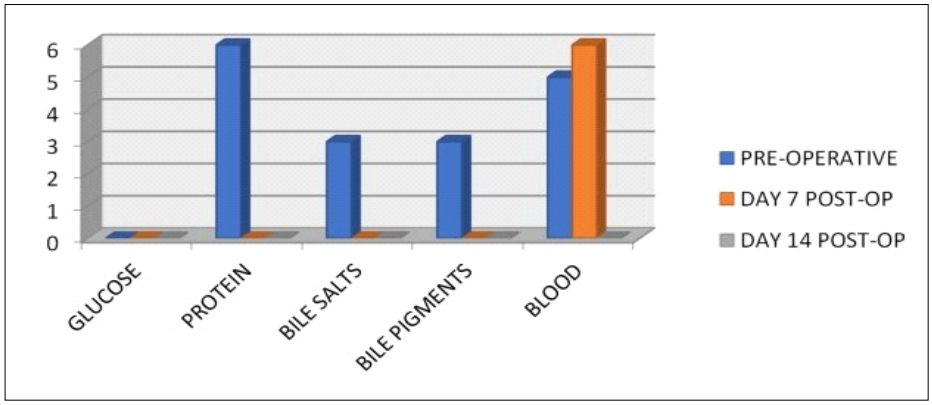


Fig 7: Urinalysis chart group I.

Table 1: Radiographic assessment of group I.

Radiographic assessment of group I						
Animals	Parameters	Pre-OP	Post-OP			
			Day 0	Day 3	Day 7	Day 14
Dog 1	Lumen diameter	4.46	4.54	4.53	4.5	4.51
	Urinary leakage	No	No	No	No	No
Dog 2	Lumen diameter	3.73	3.82	3.8	3.81	3.82
	Urinary leakage	No	No	No	No	No
Dog 3	Lumen diameter	5.46	5.62	5.57	5.55	5.52
	Urinary leakage	No	No	No	No	No
Dog 4	Lumen diameter	3.72	3.87	3.86	3.84	3.83
	Urinary leakage	No	No	No	No	No
Dog 5	Lumen diameter	4.3	4.41	4.42	4.41	4.4
	Urinary leakage	No	No	No	No	No
Dog 6	Lumen diameter	4.06	4.1	4.11	4.1	4.09
	Urinary leakage	No	No	No	No	No

Table 2: Radiographic assessment of group II.

Radiographic assessment of group II						
Animals	Parameters	Pre-OP	Post-OP			
			Day 0	Day 3	Day 7	Day 14
Dog 1	Lumen diameter	5.21	5.32	5.31	5.3	5.28
	Urinary leakage	No	No	No	No	No
Dog 2	Lumen diameter	4.14	4.22	4.21	4.18	4.17
	Urinary leakage	No	No	No	No	No
Dog 3	Lumen diameter	3.81	3.9	3.91	3.9	3.88
	Urinary leakage	No	No	No	No	No
Dog 4	Lumen diameter	5.52	5.64	5.62	5.61	5.6
	Urinary leakage	No	No	No	No	No
Dog 5	Lumen diameter	3.61	3.72	3.71	3.7	3.68
	Urinary leakage	No	No	No	No	No
Dog 6	Lumen diameter	4.9	5.06	5.04	5.02	5
	Urinary leakage	No	No	No	No	No

was identified by the absence of difference in echogenicity of the collagen matrix to the surrounding urethral and connective tissue. There was no stent absorption, migration or stent collapse on days 0 and 3 in all the animals in group II. However, there was a partial absorption of collagen stent observed in all the animals in group II on post-operative day 7. Complete absorption of collagen urethral stent was observed on day 14 in all the animals in group II. There was no stent migration or stent collapse observed on any of the post-operative day in all the animals in group II which could be attributed to the inclusion of the collagen matrix in the suturing of urethra which prevented the stent migration post-operatively which was similar in findings with Hill *et al*. (2014).

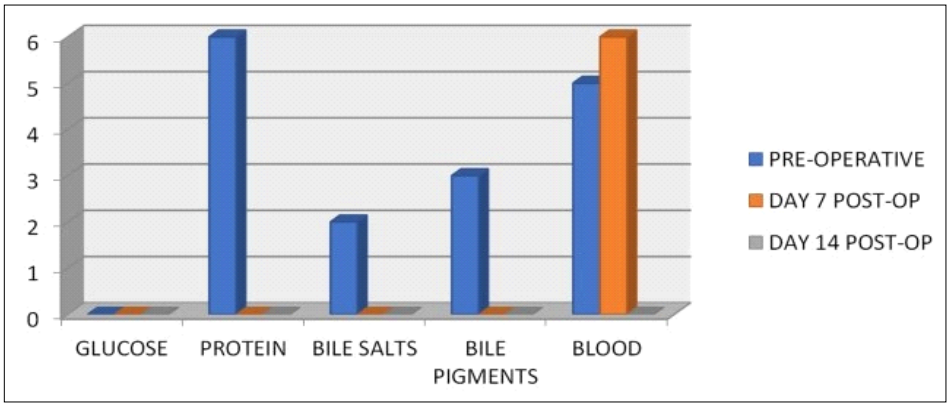


Fig 8: Urinalysis chart group II.

Table 3: Mean±S.E. of pain score assessment of group I and group II (n=6).

Parameter	Group	Day 1	Day 3	Day 7	Day 14	F value
Pain score	Group 1	6.000±0.365	5.000±0.365	4.000±0.365	2.333±0.211	0.0001**
	Group 2	5.667±0.211	4.167±0.4014	3.333±0.4944	2.167±0.1667	0.0001**
	t value	0.341^{NS}	0.533^{NS}	0.290^{NS}	0.234^{NS}	

NS-Not significant (P>0.05).

*-Significant (P<0.05).

**-Highly significant (P<0.01).

Table 4: Ultrasonographic assessment of urethrotomy of group II.

Animals	Parameters	Post-OP			
		Day 0	Day 3	Day 7	Day 14
Dog 1	Stent absorption	No	No	Partial	Complete
	Stent collapse	No	No	No	
	Stent migration	No	No	No	
Dog 2	Stent absorption	No	No	Partial	Complete
	Stent collapse	No	No	No	
	Stent migration	No	No	No	
Dog 3	Stent absorption	No	No	Partial	Complete
	Stent collapse	No	No	No	
	Stent migration	No	No	No	
Dog 4	Stent absorption	No	No	Partial	Complete
	Stent collapse	No	No	No	
	Stent migration	No	No	No	
Dog 5	Stent absorption	No	No	Partial	Complete
	Stent collapse	No	No	No	
	Stent migration	No	No	No	
Dog 6	Stent absorption	No	No	Partial	Complete
	Stent collapse	No	No	No	
	Stent migration	No	No	No	

Urinalysis

Bile salts and bile pigments were found in urine sample in 50% of the animals in group I and 33.33% of animals in group II pre-operatively. Blood was found in urine samples of 83.33% of animals in both groups I and II pre-operatively. Blood was also found in all the animals in both the groups I and II on the 7th day post-operative urinalysis and absent in all the animals in both the groups I and II on 14th day post-operative urinalysis (Fig 7 and 8).

The presence of protein, bile salts and bile pigments in the urine pre-operatively could be attributed to the renal damage which compromised the glomerular filtration and



Fig 9: Group I-urethrotomy-post-operative evaluation of surgical wound on day 3.



Fig 12: Group II-urethrotomy-post-operative evaluation of surgical wound on day 3.



Fig 10: Group I-urethrotomy-post-operative evaluation of surgical wound on day 7.



Fig 13: Group II-urethrotomy-post-operative evaluation of surgical wound on day 7.



Fig 11: Group I-urethrotomy-post-operative evaluation of surgical wound on day 14.



Fig 14: Group II-urethrotomy-post-operative evaluation of surgical wound on day 14.

tubular reabsorption which led to excess excretion of protein, bile salts and bile pigments. The presence of blood in urine in the pre-operative period could be due to the over distension of the urinary bladder, haemorrhage during cystocentesis or capillary damage at glomerular level. Presence of blood in urine on day 7 which might be due to the surgical procedures that receded on day 14 urinalysis upon bladder and urethral healing.

Subjective evaluation of the surgical wound

Subjective evaluation of the wounds from urethrotomy surgeries from group I and group II (Fig 9-14). There was no significant difference in the pain score between the groups I and II. However, a significant difference ($P<0.01$) was observed in pain score within the group I and group II. The pain was reduced to permissible levels in both the groups by day 14 of post-operative care (Table 4).

CONCLUSION

Pre-operative and post-operative plain and contrast radiography revealed no significant difference in the urethral lumen diameter between pre-operative and post-operative evaluation in both the groups indicating that the collagen matrix reduced urethral stricture. Ultrasonography reveled absence of stent collapse or migration. Partial collagen stent absorption was noticed on day 7 and a complete stent absorption was noticed on day 14.

There was no significant difference in the pain scores between the groups indicating that the collagen stent does not elicit any extra pain than normal urethrotomy procedure. Hence it was concluded, that collagen stents proved to be an effective means of preventing urethral strictures and reduced post operative urethrotomy complications.

Conflict of interest: None.

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