Studies on
Colo and Caecocystoplasty
For Partial Substitution
Of The Urinary Bladder
In Buffalo Calves

Thesis
Submitted to the
RAJENDRA AGRICULTURAL UNIVERSITY, BIHAR
IN PARTIAL FULFILMENT OF THE REQUIREMENTS
FOR THE DEGREE OF
MASTER OF SCIENCE (VETERINARY)

By
Surendra Prasad Sharma
B. V. Sc. & A. H. (R. U.)
POST-GRADUATE DEPARTMENT OF SURGERY
BIHAR VETERINARY COLLEGE
PATNA
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Dedicated
To
My
Reverend Teacher

Dr. A. A. Khan, M.V.Sc., Ph.D., F.R.V.A.C. (Denmark).
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Dated, the 15th February, 1974.

I certify that this Thesis has been prepared under my supervision by Dr. Surendra Prasad Sharma a candidate for the degree of M.Sc. (Vet), with surgery as Major subject, and it incorporates the results of his independent study.

( A.A. Khan ).
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( Dr. Surendra Pr. Shama)
CONTENTS

INTRODUCTION. .................................................. 1 - 7

REVIEW OF LITERATURE. ........................................ 8 - 37

SURGICAL ANATOMY OF THE
BOVINE URINARY BLADDER
AND LARGE INTESTINE. ........................................ 38 - 43

MATERIALS AND METHODS. ..................................... 44 - 53

OBSERVATIONS AND RESULTS. .................................. 54 - 67

DISCUSSION. .................................................... 68 - 87

SUMMARY AND CONCLUSIONS. .................................. 88 - 92

BIBLIOGRAPHY. .................................................. I - XIX

Number of Tables. .............................................. 5
Number of Graphs. ............................................. 7
Number of Photographs. ....................................... 34.
INTRODUCTION

Veterinary surgery, which was at the threshold of a new era during the past but decades has made great progress in the recent times. A host of specialisations emerged with the developed cattle health care, great advancements in the field of surgery. Recent advancements in experimental surgery have given a new impetus to veterinary surgeons and the old concepts have practically changed after achieving the advancements of this science which had remained ignored and unexplored for a considerable time.

Although plastic reconstruction of the urinary bladder is a widely known field in surgery, its applicability has not been fully investigated in bovines.

The high incidence of urinary calculi in cattle usually occurs in breeding and the usual site is either at the sigmoid flexure of the urethra, the neck of the bladder or near the external urethral orifice in the nave. Rarely it may occur in the bladder itself. The obstruction of free flow of urine by such calculi leads to distortion of the bladder and the bladder may result in either perforation or rupture of the same. At this stage, only removal of the calculi can not relieve the symptoms, but removal of the calculi, or use of ureteral catheter or indwelling catheter will be deemed necessary. The indwelling catheter or indwelling catheters will be useful in the cases of renal will rupture, while repair of the urethra by native techniques will be performed if the case is earlier on noticed. But considerable damage...
INTRODUCTION

Veterinary surgery which was on the threshold of a new era during the past two decades has made much headway in the recent time. Lack of specialisation coupled with ill developed cattle wealth were great hazards in the field of surgery. Recent advancement in experimental surgery has given a new enthusiasm to veterinary surgeons and the old concepts have practically changed after achieving the dominance of this science which had remained ignored and unexplored for a considerable time.

Although plastic reconstruction of the urinary bladder is a widely used technique in human surgery, its applicability has not been fully investigated in bovine.

The high incidence of urethral calculi is commonly seen in bovine and its usual site is either at the sigmoid flexure of the urethra, the neck of the bladder or near the external urethral meatus in the male. Rarely it may occur at the ischial arch also. The obstruction of free flow of urine by such calculi leads to distention of the bladder and the ultimate result is either perforation or rupture of the organ. At this stage, only removal of the calculi can not relieve the agony, but repair of the bladder, or use of intracystic metal or indwelling catheters will be deemed necessary. The intracystic metal or indwelling catheters will be useful in the cases of dorsal wall rupture, while repair of the organ by suture technique will be preferred if the vent is smaller or without any considerable damage
to the organ. But in those conditions, where the bladder wall is extensively damaged, particularly if the tissue of the wall at the rupture site has poor suture retaining capacity, or the vent is larger enough due to any means either pathological or physical, plastic surgery of the organ will ultimately be required.

Other pathological conditions like malignant lymphoma, mucinous adenoma and chronic proliferative lesions of the bladder in cattle have also been recorded by Brobst and Olson (1963). In such conditions, extirpation of the lesions along with reconstruction of the organ will be the only treatment of choice.

Though, evidences regarding other pathological conditions are very little in large animals, yet the partial substitution of the organ can be achieved with a suitable substitute if needed, in the following conditions:

1. To repair the wall of the bladder when it is excessively damaged or badly ruptured due to urethral calculi, violence or non specific reason.

2. Recurrent papilloma and/or carcinoma of the bladder not involving the trigone.

3. Any anatomical defect of the bladder wall, like irreparable vesico vaginal fistula.

4. To increase the size and capacity of the bladder when it is contracted or ill developed.

5. Persistent atonic or hypertonic bladder of neurogenic origin or neurogenic dysfunction respectively.
(6) Intractable interstitial cystitis.

The plastic reconstruction of the urinary bladder is readily facilitated with its profusely anastomosing blood supply, interlacing muscle bundles of the wall and less delicate mucous membrane with its high regenerative capacity.

A successful procedure of creating or reconstructing an ideal bladder either partial or complete must meet the following criteria:

(i) The source of organ substitute must be easily available as a viable graft and must be in anatomical proximity to the bladder area.

(ii) It must not absorb excretory urinary constituents, and should not secrete mucus.

(iii) It should be pliable enough to be shaped into the configuration of a normal bladder.

(iv) It must be capable of distention and contraction.

(v) It must serve as an internal reservoir and excrete urine through the natural passage.

(vi) It must allow the regeneration of uroepithelium along its luminal surface.

An intestinal segment has proved to be the most useful replacement for a part of the urinary tract. The intestine being in close proximity, coupled with its utility for this purpose as a viable intestinal graft, is being used not only for the bladder but for many corrections of internal organs. As a material for a graft, such a segment
has the important advantages of proximity to the urinary tract, the blood and nerve supply which is easily retained intact, unidirectional peristaltic waves, and the capacity to hold and evacuate urine. It is highly vascular and can easily be sterilized with antibiotics. It’s loose attachment with the mesentery, favours easy mobilisation in the abdomen and the length of the mesentery determines the distance of utility of the viable segment of the gut.

An isolated intestinal segment, however, is not just a conduit since the epithelial lining retains secretory and absorptive capacity. There may be profuse secretion of mucus from the segment and development of metabolic imbalance from the absorption of urinary electrolytes.

It is proposed that if a segment of intestine is denuded of its mucosa, the resulting seromuscular segment would have no appreciable secretory or absorptive potential and there will be less chance of urinary infection; hence such intestinal segment could serve as a better urinary conduit.

The idea of creating an artificial bladder by a segment of intestine which would partially or totally replace the diseased bladder is not a new one. It was conceived and carried out experimentally for the first time by Tizzoni and Foggi (1888) by performing a two-stage ileocystoplasty on the dog.

The repair of defects and reconstruction of the bladder have been attempted by others with a variety of
materials other than the segment of intestine. The use of
free fascial grafts, omentum, pleurae, peritoneum, stomach
and gall bladder have also been reported (Neuhof, 1917;
Lay, 1925; Perlmann, 1927; Koontz, 1929; Baret et al., 1953;
DeMuth, 1953; Sinaiko, 1956; Goldstein and Gualtieri, 1967).
The other foreign materials like: (i) Homografts
from freeze dried aorta and (ii) plastic materials: Orlon
fabric, polyvinyl chloride sponge, Teflon fabric were used
by Swinney et al. (1961). The use of gelatine sponge, velour-
lined thin silastic artificial bladder and plastic molds
as the bladder prosthesis have also been reported (Tsuiji
et al., 1967; Orikasa and Tsuiji, 1970; Stanley et al., 1972).
However, due to availability and feasibility, many
surgeons (Couvelaire, 1950; Barnes et al., 1953; Cibert, 1953;
Tasker, 1953; Annis, 1956; Pyrah, 1956, 57; Wells, 1956;
Arcanti, 1957; Goodwin et al., 1958, 59; Orr et al., 1958;
Bourque, 1959, 60; Kuss, 1959; Martin, 1959; Murphy et al., 1959;
Houtapel and Grundemann, 1960; Gil-Vernet, 1965; Torbey and
Mozen, 1965; Charchet et al., 1967; Shawket and Muhlsen, 1967;
Warwick and Ashken, 1967; Maged, 1968; Kuss et al., 1970;
Kudale and Hattangady, 1971) have used isolated intestinal
segments for partial substitution of urinary bladder either
experimentally or clinically.
Although, different portions of small and large
intestine in urological surgery of dogs and human beings
have elaborately been tried experimentally and clinically
during the past two decades, yet there is very little
evidence of this work being conducted in bovine. Keeping in view the great economic importance of bovine in our country as well as high incidence of urethral calculi with its sequelae as rupture of the bladder and paucity of literature on cystoplasty in large animal have focused attention upon the bladder substitution in bovine.

In the present experimental study, emphasis has been given over the use of isolated intestinal segments from the large intestine rather than the small intestine; because of its larger diameter and capacity, a shorter segment \( \frac{1}{6} \) is required for reconstructing a larger area of the bladder and risks of intestinal obstruction, stenosis or stricture are also less with the large intestine.

Thus, for experimental studies on colo and caecocystoplasty for partial substitution of the urinary bladder in buffalo calves; the following surgical plan was outlined:

1. Replacement of a part of the urinary bladder with the help of a seromuscular intestinal graft either from colon or caecum by the method of colocystoplasty or caecocystoplasty respectively.

2. Use of Ethicon chromic catgut(No.2-0) and Ethicon black braided silk(No.3-0) as suturing material in cystoplasty.

3. Detailed observations with regard to clinical manifestations by the operated animals.

4. Estimation of blood urea nitrogen(BUN) from preoperative to 10th post operative day at 48 hours interval.
(v) Gross examination of the grafted bladder including urinary system as a whole, large intestine and surrounding viscera at the time of removal of the organ for histopathological study.

(vi) Histopathological study with a portion of tissue from the junctional area of the grafted bladder taken at different intervals from 15th to 75th day post operatively.

Therefore, the present series of work has been designed to study the 'open sheet' or 'flat patch' techniques of colocystoplasty and cococystoplasty to evaluate how far these methods of bladder reconstruction would be useful for clinical application in bovine and other animals.
REVIEW OF LITERATURE
REVIEW OF LITERATURE

The present experiment was conducted on buffalo calves mainly based on researches and experiences gained on dogs, as very little evidence is available regarding plastic reconstruction of the urinary bladder in large animals. The value of vesicoplasty with different techniques using different grafting materials have gained ample recognition both in human as well as in dogs.

Surgical repair of large vesical defects with particular emphasis on the restoration of normal bladder capacity and function has been the object of considerable study during the past 85 years. The earliest experiment in this field was made by Tizzoni and Foggi (1888). They successfully performed a two-stage ileocystoplasty on dogs by isolating 7 cm. of ileum and suturing it to the neck of bladder.

Von Mikulicz (1898) performed the first enterocystoplasty (ileocystoplasty) to enlarge the bladder in human beings.

Remedi (1906) made substitute-bladder from the rectum/or sigmoid with permanent abdominal sigmoidostomy.

Verhoogen (1908) used the ileocaecal region of the bowel as a bladder and brought the appendix to the skin as urethra in man. He transplanted ureters into an isolated segment of terminal ileum and ascending colon and reported this procedure in two cases regarding total cystectomy for
carcinoma of the bladder.

Shoemaker (1909) carried out the operation of ileocecoplasty in two stages in a man for a contracted tuberculous bladder.

Makkas (1910) reported two successful cases of extrophy of the bladder in which an artificial bladder was constructed from the ileocaecal region.

Lengemann (1912) substituted bladder from the ileocaecal region with abdominal appendicostomy. He created an artificial bladder in 12 patients with extrophy of the bladder or with bladder carcinoma. It was his belief that anastomosis so conducted would remove the threat of urinary tract infection. The operative mortality was 66 percent in this early series.

Lemoine (1912) performed colocystoplasty in man for enlarging the urinary bladder.

Kotzenberg (1917) made substitute-bladder from the ileum controlled by the vesical sphincter.

Neuhof (1917) performed segmental repair of bladder with free fascial grafts. He studied experimentally and clinically in dogs and human patients respectively. He used fascial transplants not only for correcting the vesical defects, but for other hollow viscera like: urethra, oesophagus, stomach, intestine, pleura, pericardium, trachea, diaphragm, lungs etc.
Lay(1925) used a preserved gall bladder as a substitute of urinary bladder in a patient who died later on due to uremia post operatively.

Perlmann(1927) utilized pedicled peritoneum to repair large defects of the bladder-wall.

Koontz(1929) performed segmental repair of the bladder with free fascial grafts.

Sebenning(1932) used an isolated intestinal loop to enlarge the capacity of the urinary bladder.

Turner and Saint(1932) studied and demonstrated that after ordinary uretero-sigmoidal anastomosis, the entire large bowel acted as a reservoir for urine in four of six cases.

Folsom et al(1940) performed subtotal cystectomy in dogs leaving only the vesicourethral orifice and trigone. They observed the restoration of bladder's capacity and weight after the operation. They also conducted the same operation in man for the treatment of Hunner's ulcer of the bladder.

Scheele(1941) performed ileocystoplasty (Ring plastic) to enlarge a small bladder. He anastomosed the centre of an isolated loop to the bladder and thus joined it to the dome of the bladder.

Bisgard(1943) substituted urinary bladder with a segment of sigmoid in dog. The operation was performed successfully in two dogs; and by means of the sigmoid pouch
normal urinary secretory and excretory functions were re-established. There was no evidence of an ascending urinary infection and so, he concluded that the operation could be utilized safely in man.

Cortes (1946) used the ileocaecal region of the bowel as bladder-substitute and the appendix to form the urethra on three female patients with vesico-vaginal fistulae.

Rubin (1948) experimentally reconstructed an artificial bladder from a portion of the sigmoid in dogs with very satisfactory results. The dogs were continent and voided with good control. The infection of the new sigmoid bladder could be effectively brought under control by adequate antibiotic therapy. In his words "a similar procedure so successful in dogs, surely should prove less difficult, and as successful, in man".

Flocks (1949) described the management of patients undergoing uretero-intestinal anastomosis. He had shown preoperative, operative and postoperative measures in 33 human patients. His ideas regarding several recent developments like: (i) great improvement in the maintenance of nutrition in preoperative and postoperative periods, (ii) the use of antibiotics, and (iii) the recognition of the role of maintenance of the blood supply in the wall of the bowel and ureter in the determination of the fate of the region of anastomosis, had greatly increased the safety of this operation.
Bricker and Eiseman (1950) reconstructed the bladder from the cæcum and ascending colon following resection of pelvic viscera.

Couvelaire (1950) substituted the bladder from the cæcum and the ileum controlled by the vesical sphincter. In all, 5 cases were reported out of which, in 3 cases he enlarged a small, healed, tuberculous bladder by joining to it an isolated loop of cæcum and in 2 cases with the ileum.

Gilchrist et al. (1950, 51) replaced bladder and urethra using isolated cæcum and ascending colon as bladder and terminal ileum as urethra and thus bowel continuity was re-established by an ileocolostomy. The ureters were transplanted into the cæcum. The operation was performed on a series of dogs as well as human patients. They opined that a continent suitable bladder could be made from cæcum if the cut off action of the ileocaecal valve and the peristaltic action of the ileum could be utilized.

Thompson (1950) performed total cystectomy and sigmoid loop substitution in the dog. The ureters were transplanted into the isolated sigmoid colon. The dog's general physiological condition seemed to be improved over urethro-sigmoidostomy, as measured by their weight and total plasma protein. The new bladder capacity and pressure were adequate for its action as a urinary reservoir. Urinary continence was attainable even after removal of the bladder neck in both male and female dogs.
Boyce (1951) described the absorption of certain constituents of urine from the large bowel of the experimental animal (dog). The operation included the ligation of the urethra and the dome of the bladder anastomosis to the caecum and mid portion of the sigmoid colon respectively. In his opinion the absorption of urinary constituents was probably most rapid from the caecum and adjacent colon and diminished progressively to little or no absorption from the rectum.

Cordonnier and Lage (1951) evaluated the ureterosigmoid anastomosis by mucosa-to-mucosa method. A total of 54 cases were done without a single operative mortality.

Glaser (1952) constructed the artificial bladder from the ileocaecal segment and gave a short review on the subject. He performed this operation during bladder carcinoma in human patients.

McC lean and Fais (1952) utilized segments of small intestine in urological surgery. They concluded that in the dog a segment of small intestine could be used to replace one or both ureters without changing the clinical appearance of the animal. Though, both catgut and cotton threads were used by them, yet they emphasized on cotton thread.

Peck and Newland (1952) described 5 cases in which they substituted urinary bladder. They utilized the ileocaecal valve as a sphincter mechanism, with the terminal segment of the ileum as a urethra.
Reiger and Weisser (1952) also substituted the bladder on a paraplegic human patient from the ileocaecal segment.

Wells (1952) anastomosed ureters to a blind pouch of ileum with permanent abdominal ileostomy.

Wenger (1952) substituted bladder after pelvic evisceration for treatment of radiation necrosis which resulted into multiple fistulas. A new bladder was constructed and the pelvis was completely eviscerated.

Baret et al (1953) and De Muth (1953) used free fascial grafts for segmental repair of the bladder in experimental animals.

Barnes et al (1953) performed plastic surgery of the urinary bladder on experimental animals and human patients in the following ways:

(i) Reconstruction of lower segment of ureter,
(ii) Construction of suprapubic spigot for permanent cystostomy.
(iii) Reconstruction of urethra with the tube made from bladder flap.
(iv) Reinforcing the bladder wall by overlapping to reduce the size and for increasing the tone of the bladder.
(v) Anastomosis of an isolated loop of sigmoid to bladder for enlarging its capacity.
(vi) Transplantation of trigone to sigmoid.

Cibert (1953) adopted ileocystoplasty operation for enlarging the bladder in men. It was his belief that during treatment of chronic cystitis (tuberculous or not) enterocystoplasty seemed to be superior to ureterosigmoidostomy and
cutaneous ureterostomy.

Foret and Heusghem (1953) performed uretero-ileo-vesical anastomosis and replaced both ureters by an ileal graft in a female patient suffering from bilateral stenosis of the ureteral meatuses. The last portion of the terminal ileum was resected and utilized in a U-shaped loop, the base of this loop was anastomosed with the bladder, and two lateral limbs were substituted for the pelvic and iliac portions of both ureters.

Kinman et al (1953) substituted the bladder from the excluded rectosigmoid colon.

Levitsky (1953) transplanted the ureters into an isolated ampulla of the rectum after total cystectomy. The sphincter ani functioned in a double capacity both for normal defecation and the substitute for urethral sphincter of an artificial bladder.

Moor (1953) made an artificial bladder from the right colon in men with excellent result. The operative procedure included the following methods:

(i) With preservation of urethral sphincter control.
(ii) With preservation of anal sphincter control of rectal-artificial bladder and establishment of terminal colostomy.
(iii) Skin stoma only of artificial bladder with no sphincter control.
(iv) Skin stoma only of artificial bladder with sphincter control of ileocaecal valve.
Tasker (1953) performed ileocystoplasty for enlargement of the bladder. He used a new method in which intestinal segment was opened to form a sheet graft. Such grafts were utilized for bladder replacement.

Annis, Hunter and Wells (1954) used an isolated length of ileum as urinary channel in a variety of circumstances. It's suitability was demonstrated both experimentally and clinically. During the operation, they transplanted the ureters into an isolated length of ileum, the upper end of which was closed and the lower end brought out as a urine draining ileostomy.

Baum (1954) substituted the ureter clinically from the terminal ileum. He concluded that the terminal ileum might be utilized to by-pass the loss of ureteral continuity in those instances where more conservative measures were not applicable. This procedure was mechanically sound and technically feasible, as the successful use of small bowel as a conveyer of urine was dependent on the rapid progress of urine through it and not on its function as a reservoir.

Bricker, Butcher and Mc Afee (1954) substituted the bladder with isolated ileal segments. They described the results of 106 bladder substitution, consisting of transplantation of both ureters to isolated segment of terminal ileum. Out of all cases only 15 deaths were reported.

Davids and Bellwina (1954) advocated that in artificial bladder construction, the length of an isolated
segment of ileum had great importance in maintaining the normal level of chemicals in the blood. In their opinion an ileal segment of approximately 20 cms or shorter in length was compatible with normal urine function and a segment longer than 20 cms resulted in urinary absorption, electrolyte disturbance in the blood followed by uremia and death.

Prust and Campbell (1954) also substituted the urinary bladder from the ileum controlled by vesical sphincter.

Bohne et al.(1955) demonstrated the regeneration of the urinary bladder in dogs after total cystectomy. The experimental procedure was accomplished in two stages:

(i) By performing the cystectomy and (ii) by formation of the plastic mold (an acrylic solid mold). They removed the entire bladder and obtained a regenerated pouch lined with transitional epithelium which contained smooth muscle in its wall. A number of animals were continent and voided in normal manner. Later on, they also utilized this procedure successfully in men and observed that a functioning reservoir developed provided intermittency of filling and emptying of the bladder could be maintained after removal of the mold.

Hamner et al.(1955) used viable segments of the small bowel for anastomosing it to the trigone of the bladder.

Jay et al.(1955) reconstructed the artificial bladder from the ileocaecal segment with abdominal ileostomy.

Paull and Hodges(1955) substituted the bladder from the rectosigmoid colon.
Shoemaker and Marucci (1955) used experimentally the inverted seromuscular grafts from ileum and colon for bladder reconstruction in dogs. In this study, subtotal resection of the bladder leaving only the trigone and a narrow margin around urethra and ureteral orifices was made. Resultant normal voiding ability, absence of residual urine, blood chemistry studies, urograms, cystograms and cystometrograms indicated the essential normal physiologic phenomena. Histologic examination demonstrated the overgrowth of seromuscular graft by transitional epithelium, preservation of musculature and rich vascularity of the intact viable graft.

Smith and Hinman (1955) created intussusception in an ileal segment and performed ileo-cystomy in dogs. They utilized ileum and caecum in different ways and concluded that the antiperistaltic ileal segment was most effective in which a valve was formed by an intussusception; such valves hold urine at vesical pressure.

Annis (1956) utilized an isolated ileal segment in urological surgery. He performed different types of operations in a number of patients e.g. Ileocystoplasty without ureteric transplant(one), ileal ureterostomy (58) and ileal replacement of ureter (5).

Baker and Graf (1956) anastomosed ureters to a blind pouch of ileum with permanent abdominal ileostomy.

Cibert and Durend (1956) performed the operation
of ileocystoplasty for the treatment of certain cases of neurogenic bladder. They described that the reflux was due to decreased bladder's ability to relax and the change in its elasticity. The aim of treatment was then solely the protection of the renal parenchyma threatened by the pressure of the urine retained in the ureter, pelvis, and calyces. To obtain this end they resected the detrusor (subtotal cystectomy), replacing it to an ileal loop and keeping only the trigone.

Hanley (1956) utilized various ileal loops in urology and studied the emptying mechanisms of these loops with the X-ray amplifier. He demonstrated that enlarging the bladder by ileocystoplasty would greatly reduce or even prevent ureteric reflux. His preliminary observations with the X-ray image amplifier indicated the importance of employing the very powerful peristaltic force of the loop to propel urine in the direction in which he wished it to travel.

Mc Mina and Johnson (1956) repaired artificial ulcers in the urinary bladder of a cat.

Pyrsh (1956, 57) used isolated segments of small and large intestine in urological surgery. Two kinds of operations were performed by him:

(i) In which loops of ileum were used, the operation aimed at the remodeling of part of the urinary tract (a portion of the bladder or ureter) for restoring its anatomic structure to serve its original purpose.
(ii) In which loops of the small and large intestine were used, the operation aimed at constructing a conduit or a reservoir for urine, as a method of urinary diversion. He used isolated loop of ileum to enlarge a small bladder (ileocystoplasty), to replace a part or whole of the ureter, ileal bladder as a reservoir completely replacing a normal bladder (ileourethral anastomosis) and as a urinary conduit to the exterior. He preferred firstly the small intestine and described that an isolated loop of the lower ileum (last portion) was convenient anatomically for incorporation into the urinary tract, and secondly the isolated sigmoid bladder which was thought to be the most satisfactory method of urinary diversion.

Sheemaker and Long (1956) conducted experimental studies on the reconstruction of the neurogenic bladder in dogs. Neurogenic bladders induced by pelvic neurectomy and posterior rhizotomy were reconstructed with ileal segments. Preliminary observations on those animals from one to three months revealed no significant residual urine after voiding, adequate capacity, continence, and essentially normal cystometry.

Sinaiko (1956) formed artificial bladder from the segment of stomach in dogs. They observed little or no disturbance in blood chemistry. Kidney, and ureters were normal after a survival period of 15 months. He also utilized this procedure successfully later on in human patients.

Stonington and Eiseman (1956) substituted bladder
from sigmoid with the proximal sigmoid end through the anal sphincter. They performed total cystectomy together with pelvic lymphadenectomy, ureterocolostomy, and perineal sigmoidostomy for carcinoma of the bladder in human patients and obtained sufficiently encouraging results.

Wells (1956) performed ileocystoplasty on 55 human patients in a series of 212 patients. They utilized both blind loop and Tasker sheet graft method of ileocystoplasty. Operations were conducted most frequently for carcinoma of the bladder and congenital abnormalities. Results were much satisfactory.

Arcangi (1957) utilized the isolated ileal segment for contracted bladder and succeeded in enlarging the capacity of the latter. He also used the ileum as a means of urinary diversion in reconstructive urinary surgery.

Campbell (1957) reconstructed the bladder with a seromuscular graft from the bowel.

Ferris (1957) enlarged the urinary bladder with a segment of ileum. In his opinion the use of a short segment of the lower part of the ileum was suitable anatomically and physiologically for plastic enlargement of the urinary bladder in either sex.

Delev (1958) reported bladder substitution from sigmoid colon in three human patients with incontinence of
the urine. Cystectomy was effected and a new bladder was made from the large intestine. He preferred silk thread as suturing material for the organ and advocated that the anastomosis of the new bladder should be effected terminolaterally to avoid stenosis employing silk as suturing material.

Goodwin, Turner and Winter (1958) performed ileocystoplasty and demonstrated the result of this operation in 18 patients. They concluded that the operation of ileocystoplasty to increase bladder capacity was technically satisfactory, anatomically sound and not practically dangerous. They preferred the 'flat' or 'patch' technique in place of the other techniques designed to use the ileum as an intact tube.

Mellinger and Suder (1958) adopted ileal reservoir method of urinary diversion in which they performed uretero-ileo-urethral anastomosis in two patients. There did not appear any disturbance of electrolyte balance through absorption from the segment.

Menville, Nix and Pratt (1958) performed caeco-cystoplasty in a white woman. In their opinion enlargement of a contracted bladder by the use of an isolated ileal or caecal segment would almost invariably relieve the intolerable symptoms of urinary frequency, reduce the tendency of vesico-ureteral reflux and seldom be associated with electrolyte disturbances.
Orr, Thomley and Campbell (1958) enlarged the bladder after performing ileocystoplasty. They opined that the ileocystoplasty was a procedure which offered great possibilities for the relief of the suffering associated with a contracted bladder, where all other conservative procedures had failed.

Bourque (1959, 60) performed colocystoplasty and substituted the bladder after total cystectomy in 25 cases. For bladder enlargement and bladder substitutions he advocated that:

(i) The sigmoid colon was the segment of choice.
(ii) The ileum could serve sometimes, particularly if they had to substitute a long segment of ureter.
(iii) The caecal bladder was indicated in radical and total pelvic exenteration.
(iv) The ileum was the segment of choice for ureteral substitutions.

Goodwin, Winter and Barker (1959) adopted 'cup-patch' technique of ileocystoplasty for bladder enlargement or partial substitution. In this technique, an isolated loop of ileum was opened and formed in the shape of a U. It was then fashioned into a cup which fitted on the dome of the bladder. They also used 'flat-patch' technique of sigmoidocystoplasty like a year earlier for enlargement of urinary bladder in 4 human patients. The bowel continuity was re-established using 2 layers of sutures. Catgut was used for the inner, muscular layer and interrupted silk for the muscularis and serosa. The isolated sigmoid was opened on its
antimesenteric border so that it formed a flat 'patch'.

Greenfield (1959) made artificial bladder from isolated ileal segment and observed eversion stripping in the production of a nonsecretory, nonabsorptive urethral emptying ileal bladder in dogs. By this procedure the ileal segment was denuded of its mucosal and submucosal layers. The resulting muscularis lined lumen was overgrown with transitional epithelium from the adjacent urethrotrigonal stump.

Küss (1959) performed the operation of colocystoplasty (19 cases) and ileocystoplasty (36 cases) in man and emphasized on colocystoplasty rather than ileocystoplasty.

Markowitz et al (1959) described the use of viable segment of bowel for increasing the capacity of the bladder. They anastomosed it to the trigone of the bladder for reinforcement.

Martin (1959) used uroepithelial lined ileal segment as a bladder replacement in dog. He enlarged the organ by the use of denuded, nonreversed seromuscular ileal segments, with or without vesical mucosal grafts, over an inflatable spherical rubber mold.

Murphy, Rattner and Schoenberg (1959) performed partial and total bladder replacement by an isolated bowel segment and evaluated it experimentally in dogs.

Shoemaker and Long (1959) described the functional studies on transplanted intestinal smooth muscle grafts used for reconstruction of denervated canine bladder.
Thompson (1959) used isolated loop of bowel in urological surgery and agreemented with the fact that separation of the urinary and a fecal system was pertinent to long term survival as well as reasonable normalcy of renal mechanism and electrolyte balance.

Tsuji, Kuroda and Ishida (1959) adopted a 'bladder flap tube' method for the reconstruction of the urinary tract. Such tubes were utilized for the reconstruction of the lower ureter or urethra. They observed the development of a valve like action at the entry of tube into the bladder.

Cordonnier and Nicolai (1960) evaluated the use of an isolated segment of ileum as a means of urinary diversion. They performed this operation in 215 patients. Operative death was 3.7 per cent (8). In their opinion the isolated ileal segment was superior to all previously used methods.

Gil-Vernet (1960) performed total substitution of the cancerous bladder with an isolated segment of sigmoid colon and the latter was anastomosed to the urethra. Thus, he constructed a functional artificial bladder from which the patient voided through the natural outlet. He emphasized on sigmoid colon for construction of an artificial bladder while disapproving the use of ileal segments because of their poor contractile power to expell urine, small volumetric capacity, excessive mucus formation, possibilities of invagination and obstruction, the electrolyte disturbances due to reabsorption (typical physiological property of the ileum) and shortness of the mesentery.
Houtapel and Gründemann (1960) made observations on ileoplasty and demonstrated some late complications like abnormal dilatation and elongation of the transplant. In their opinion ileoplasty was not the ideal method for enlargement of bladder. They preferred an isolated piece of sigmoid in place of ileum. For replacement of the ureter also an isolated piece of sigmoid was probably the best solution for them for the time being.

Parkhurst and Leadbetter (1960) reported 93 ileal-loop urinary diversions in 91 patients and confirmed that the use of isolated ileal segment was a satisfactory operation to provide substitution for ureter, bladder or urethra.

Torbey (1960) made urethral and sphincter substitution with a special seromuscular segment of ileum in male and female dogs. He described urinary continence and normal urination after replacement of the bladder neck and urethra. He demonstrated that urothelial regeneration to cover the raw surface of the ileal segment took place in a period of 4 weeks and left the animal with clean urine that was free from mucus. In his opinion, absence of mucus in the urine contributed to cessation of active infection. There was insignificant electrolyte disturbance.

Mandy (1961) made ileal pouch with transitional epithelium and anal sphincter as a continent urinary reservoir. He performed this operation in dogs and utilized both reversed and non-reversed seromuscular ileal pouches.
Bleicken(1961) performed the operation of bladder substitution. For selecting the bowel segment, he preferred ileoplasty when the mesentery was long and sigmoidoplasty during the shorter mesentery. To ensure the flow of urine, he supported the ureters with plastic tubes (Polyethylene tubes) which were directed outside through urethra.

Cibert(1961) used intestinal plastic in urology and gave the statistical report on his own 200 observations. Out of 200 intestinal plastics, he performed only 8 xanthine colon plastic. He used plastic against chronic cystities, total lack of vesical urine and lack of ureter. Mostly he operated the persons because of chronic tuberculous cystitis (177 cases). Operation mortality was 12 per cent (15 cases) which was mostly due to renal insufficiency.

Deleveliotis and Macris(1961) replaced the cancerous bladder with an isolated segment of sigmoid in man. After replacement of the organ, the micturition was physiological. The X-ray and laboratory examinations were also normal and the patient's general condition allowed them to assume regular working activities.

Mason, Keefe and Boria(1961) created urinary diversion by means of an ileal segment leading from the fundus of the bladder to the outside during isolation and collection of prostatic fluid in experimental dogs.

Schmiedt(1961) used the segments of large intestine (colon) for plastic surgery of nonfunctioning or
subfunctioning bladder or ureter. He used this technique mainly for the following purposes:

(i) Use of sphincter ani to provide enough urine continent.
(ii) Directing urine towards skin, and
(iii) Additional use of natural ureter for plastics.

Swinney, Tomlinson and Walder (1961) replaced parts of the drainage system of the urinary tract by foreign materials. They used:

(i) Homografts of freeze dried aorta,
(ii) Plastic materials eg. (a) orlon fabric (acrylic fibre),
    (b) Polyvinyl-chloride sponge, and (c) Teflon β fabric
    (polytetrafluoroethylene).

According to them the aortic homografts were not satisfactory for this purpose and woven teflon seemed most satisfactory among the used plastic materials. They concluded that the prosthesis took no part in the re-formation of the urinary tract. It acted as a scaffold around which fibrous tissue was formed.

Anderson (1962) substituted the contracted bladder by an isolated loop of ileum and succeeded in enlarging the capacity.

Burghele (1962) described the function of the bladder created by intestinal cystoplasty. In his idea the removal of urine from the new reservoir was mainly produced by the abdominal pressure, because there was not enough contraction of the implants provided by the pressure of urine to overcome
the resistance of the sphincter system. He had shown 3 methods to diminish the resistance of the sphincter system: (a) cutting of the plexus hypogastricus superior, or (b) endoureterate; and (c) novocaïn infiltration of Na pudendi.

Goodwin et al(1962) performed ileocystoplasty in a female patient and marked no difficulty in full term pregnancy and spontaneous delivery after this operation. During operation a section of ileum, 22 cms in length, was fashioned into a cup-like structure which was anastomosed to the dome of the markedly contracted bladder.

Torbey and Leadbetter(1962) replaced the ureter by the intestinal seromuscular tube and performed uretero-ileal and ileo-vesical anastomosis. They demonstrated that the intestinal mucosa did not regenerate but uroepithelium extended from the adjacent bladder.

Askari, Morales and Hotchkiss(1964) made ileo-vesical anastomosis during complete replacement of ureter by an ileal segment in a human patient. They described that by virtue of its peristalsis, this action prevented accumulation of urine in its lumen and minimized the absorption of trace elements into the blood stream. They compared this peristaltic activity to a certain degree with the peristalsis of the ureter in prompting drainage of the renal pelvis.

Blandy(1964) replaced the bladder with a graft of ileum from which mucosa and submucosa were removed and
studied experimentally in dogs. He demonstrated the formation of a lining of urothelium by spreading from an ureteral transplant.

Weinberg (1964) performed ileocystoplasty or sigmoidocystoplasty in human patients with interstitial cystitis and true contracture of the bladder with satisfactory results.

Gil-Vernet (1965) used ileocolic segment in urological trouble in 26 patients. Though he used sigmoid colon in 158 cases of vesicoplasty and the ileum in 33 cases of ureteroplasty earlier to these operations, yet this operation was far better in his opinion than ileocystoplasty and colocystoplasty. Thus, he concluded that the ileocolic segment was a surgical unit, either anatomically or physiologically and an ideal substitute for both bladder and ureter.

Hradec (1965) performed partial or complete bladder substitution by segments of colon or ileum in a series of 114 human patients. Operations were conducted with regard to: bladder tumors, radiation damage in the bladder wall, chronic interstitial cystitis and functional bladder dysfunction. The operative mortality was 6.1 per cent.

Lange and Lindner (1965) evaluated various plastic procedures with intestinal segments in urology. They used such plastics for reconstruction of urinary ducts in 87 patients and concluded that the ileum was the best plastic material for the stenosis of the urinary duct for bringing
it to normal function again. They also substituted the bladder from the segment of ileum and rectum and succeeded in enlarging the capacity of the organ.

Lutzeyer (1965) substituted the bladder from the segment of the large intestine (colon) in cases of vesical fistula which occurred after the operation of rectal carcinoma, and in cases of unreparable vesico-vagino-rectal fistula. He used this method of vesicoplasty only in such cases, when other operative methods were not possible.

Hakim, Lifson and Creevy (1966) reconstructed the bladder from intestinal segment in dogs and studied the fluxes of water, sodium and chloride ions from the bladder. They reconstructed the organ in two different ways: (i) from intestinal wall with intact intestinal mucosa, and (ii) from intestinal wall with vesical mucosa replacing the intestinal mucosa.

The transport behavior of normal bladders and of bladders reconstructed with vesical mucosa was similar, whereas the transport behavior of bladders reconstructed with intestinal mucosa resembled with that of normal intestinal mucosa.

Hatch (1966) used intestinal seromuscular pedicle graft to repair the defects of the ureteropelvic juncture in dogs. Such grafts from ileum or jejunum were sutured to defects produced by subtotal elliptical excision of the ureteropelvic juncture. He found the graft lined with
urothelium which produced a satisfactory conduit. This was evaluated by excretory urography, gross as well as microscopic studies.

Leites et al (1966) performed the operation of ileocystoplasty and colocystoplasty in dogs and rabbits. They studied the changes of vascular network of the bladder postoperatively. They reported that ileocystoplasty and colocystoplasty slowed the usual process of thickening of vascular network and stumps, dilation of the polygonal vascular network and the decrease in the diameter and convolutions of the arteries after resection of the urinary bladder.

Torbev and Mozdjen (1966) demonstrated an experimental use of a seromuscular segment of ileum as a urinary bladder substitution. They described the technique, histologic changes and absorptive capacity in dogs. Surgical replacement of the urinary bladder by a seromuscular segment of ileum provided a substitute, which more closely resembled the natural urinary bladder with improved physiologic function. They observed that the demucosal segment was resurfaced by transitional type epithelium and there by converted into a more nearly ideal conduit, with insignificant reabsorptive capacity.

Atwill, Boyarsky and Glenn (1967) replaced ureter by ileal seromuscular tubes lined with cutaneous epithelium in dogs. It retained the advantages of intact ileal segments without their inherent disadvantages of mucus secretion, chronic infection and electrolyte disturbances.
Charghi, Charbonneau and Gauthier (1967) performed colocystoplasty for bladder enlargement and bladder substitution. They reported late results of this operation in 31 patients during a period of 5 to 8 years.

Goldstein and Gualtieri (1967) demonstrated regeneration of subtotally cystectomized bladder patched with omentum in rabbits. A complete lining of newly formed bladder-wall developed on the patched area in one to two months. In their experimental study, omentum proved to be an excellent grafting substance for repair of vesical defects.

Hakim and Creevy (1967) described the characteristics of bladder reconstructed from intestine covered with vesical mucosa in dogs. They performed the operation like preceding year and the difference in observations made them to conclude that the intestinal tissue lined with vesical epithelium would probably reduce the incidence and severity of complications associated with the use of such tissue with its intact intestinal mucosa for urinary tract replacement.

Servadio (1967) treated successfully a case of severe neurogenic urinary incontinence by subtotal cystectomy and ileocystoplasty.

Shawket and Muhsen (1967) performed the operation of ileocystoplasty and colocystoplasty in 8 patients of bilharzial-contracted bladder and enlarged the organ by an isolated loop of ileum or colon with no deaths. They preferred the use of colon rather than the ileum.
Tsuiji et al (1967) reconstructed the bladder with gelatin sponge following subtotal cystectomy in dogs, rabbits and human with bladder cancer. An alcohol treated gelatin sponge was used as grafting material which dissolved spontaneously.

Warwick and Ashken (1967) conducted the operation of partial, subtotal and total cystoplasty and described the functional results of these operations with special reference to ureterocoeccocystoplasty, selective sphincterotomy and cystocystoplasty. They replaced the bladder and assessed the results of this operation in 34 patients. They preferred the use of caecum than the ileum and sigmoid in this series.

Heeg et al (1968, 69) used experimentally the intact colon to expand the bladder capacity in dogs. They performed an extensive segmental resection of the bladder so that the bladder remnant in each dog had a volume of 5 c.c. after reconstruction. The bladder margins were anastomosed to the serosal aspect of the sigmoid colon. They observed that the bladders returned to at least 75 per cent of the preoperative level.

Magid (1968) made ileocystoplasty operation for the contraction of the bladder and evaluated the different techniques used for this operation in 32 human patients. They performed both closed and open loop operation with several techniques and the distal portion of the ileum was used for the loop. Preparation of the loop was essentially the same in all techniques. The loop, preserved with its
mesentery and blood supply, was connected to the bladder in either a closed loop or an open sheet.

Rifaat(1963) performed the operation of recto-vesicourethrostomy in 15 human patients which were suffering from bilharzial cancer of the bladder. In his experience, this new operation was superior to all known methods of urinary bladder substitution.

Küss et al.(1970) performed intestinocystoplasty and reviewed 185 cases in a 16 year follow up. According to them, the results were excellent in contracted, tuberculous bladder, promising in bilharziasis, encouraging in some neurogenic bladders, and so far, often disappointing in bladder carcinoma.

Orikasa and Tsuji(1970) enlarged the bladder by the use of gelatin sponge in human patients of tuberculous contracted bladder. The advantage of this procedure was to perform the operation extraperitoneally without opening the peritoneal cavity. Thus, even if the operation could fail, reoperation using an isolated intestine might be possible without difficulty. However, they did not recommend this method in cases of high grade contracted bladder having its capacity less than 50 c.c.

Kudale and Hattangady(1971) described the utility of an intestinal pedicle for correcting defects of the wall of urinary bladder in dogs. They used 3 to 4 inches of seromuscular ileal segment from the terminal ileum in this operation. They opined that the procedure could be used to
enlarge the bladder capacity in cases of interstitial cystitis, excessive fibrosis of the bladder wall and other non-malignant bladders.

Pond and Texter (1971, 72) made the trigonal-ileal anastomosis in a series of dogs and on human patients with encouraging results. The operation consisted joining of the trigone with intact ureters to an isolated ileal segment. In this manner the normal anatomical relations of the ureteral orifices and trigone were preserved.

Smith and Hardy (1971) described a case where carcinoma occurred as a late complication in the ileal part of the bladder following ileocystoplasty. In the year 1952 a closed loop 'cat tail' type of ileocystoplasty was performed in that case.

Stanley et al (1972) performed subtotal cystectomy and prosthetic bladder replacement in the experimental animals (7 sheep and 5 dogs). A cup-shaped, velour-lined, thin walled, silastic artificial bladder prosthesis was implanted after removal of 60 to 85 per cent of the animal's bladder. Eleven of the 12 animals did well post operatively and re-established good bladder function one month after the implantation.

Prasad et al (1973) performed experimental caecocystoplasty in 12 buffalo calves. They used an isolated pouch of caecum with its intact mucosa during this operation. After isolation, the caecal pouch was sutured to the partially cystectomized bladder in running lock-stitch fashion with chromic catgut No.1. A second row of sturure was placed to
strengthen the anastomosis with simple continuous stitches. Biochemical examinations revealed the normal physiologic functions. During histological observation, they could not get complete replacement of intestinal epithelium by uroepithelium in any case.
SURGICAL ANATOMY OF THE
BOVINE URINARY BLADDER
AND LARGE INTESTINE
SURGICAL ANATOMY OF THE BOVINE URINARY BLADDER AND LARGE INTESTINE

THE URINARY BLADDER:

It is a musculo-membranous sac which acts as a temporary reservoir for urine. Its shape, size, position and relations vary according to the quantity of its content. When the bladder is empty and contracted, it is a dense, pear-shaped mass, about the size of a fist, and lies on the pelvic floor. As it is moderately filled with urine and distended, it is ovoid in form and projects into the abdomen. Its position also varies with the fullness of the rectum.

The rounded blind anterior end is termed the vertex, faces forward and bears on its centre a cicatrical tissue (a vestige of the urachus); which in the foetus forms a tubular connection between the foetal bladder and the allantois. The middle part of the bladder is termed the body which is flattened from above downwards and becomes rounded in distended condition. It presents two surfaces, dorsal and ventral. The dorsal surface is more convex and the ureters enter into the bladder at the posterior part of this surface.

The posterior narrow part of the organ is the neck. It is directed backwards and continues as the urethra.

The relations of the bladder vary with the degree of fullness of the organ and the sex of the animal. The dorsal surface, in the male, is related to the rectum, genital fold, terminal parts of the vasa deferentia, vesiculae seminales and prostate gland; in the female, it is related to the ventral surface of the body of the uterus and the vagina. The ventral surface of the organ is related to the floor of the pelvis and also to the abdominal floor when distended with urine in both sexes. The bladder is related laterally to the walls of the pelvis. The vertex of the distended bladder has variable relations with the rumen and the coils of the intestine.

The bladder is maintained in its position by
peritoneal folds (ligaments of the bladder) and a large amount of loose connective tissue. The former holds the anterior half of the organ while the latter attaches the retroperitoneal part. The ligaments of the bladder are:

(a) Ventral or middle ligament is a median, triangular fold which attaches the ventral surface of the bladder to the floor of the pelvis and abdomen.

(b) The lateral ligaments (paired) attach the anterior portion of the lateral parts of the bladder to the walls of the pelvis. Each lateral ligament contains in its free margin a rounded cord-like structure, the round ligament of the bladder which is the remnant of the foetal umbilical artery. There is a lack of peritoneal covering in the posterior part of the bladder and is attached to the surrounding parts by loose connective tissue and a quantity of fat. The posterior portion of the bladder is fixed in position, while the anterior part is movable.

The wall of the bladder has serous, muscular, submucous and mucous coats. The serous coat is external and is derived from the peritoneum. It extends a little further backwards on the dorsal surface than on the ventral surface. A small area has no serous covering on the posterior portion. The serous covering on the dorsal surface posteriorly is reflected to form the genital fold in male and the vesico-genital pouch in the female. The muscular coat consists of unstriped muscle fibres; some of which are longitudinally placed and some are either oblique or circularly placed. They are distinctly arranged in layers. The circular fibres which are around the neck of the bladder, form the sphincter vesicae. The submucous coat loosely connects the muscular and mucous layers. The mucous membrane is covered by transitional epithelium and is pale and thin. It is continuous with that of the ureters and the urethra. When the organ is empty, it is thrown into a number of folds due to its loose attachment to the muscular layer. There is lack of these folds over a triangular area.
on the dorsal wall close to the neck which is termed the trigonum vesicale. The angles of this space lie at the orifices of the two ureters and the urethra. The two ureteral orifices are placed near each other on either side of median line. Extending from each ureteral orifice is a mucous fold which passes backwards and meets with its fellow to form the median urethral crest. Before penetrating the mucous membrane each ureter passes for about 2.5 cm in an oblique manner between the muscular and mucous layers. This ensures a valve-like arrangement and prevents the regurgitation of urine from bladder to the ureters. The internal urethral orifice lies at the apex of the trigonum and is about 12 mm behind the ureteral orifices.

Blood and nerve supply of the bladder:

The bladder receives the blood supply from the umbilical and internal pudic arteries. The veins form plexuses posteriorly and terminate chiefly in the internal pudic veins. The nerves are derived from the pelvic plexus (Sympathetic and ventral branches of 3rd and 4th sacral nerves). They form a plexus in the submucosa which presents microscopic ganglion.

THE LARGE INTESTINE:

It is that part of the alimentary canal which extends from the termination of the small intestine (ileum) to the anus. It's length is about 11.4 metres and diameter for the first 1.2 metres is about 12 to 15 cm, but diminishing gradually thereafter to about 5 cm. The capacity of this part is about 25 to 30 litres. A greater part of this intestine is situated in the dorsal part of the common mesentery. It is related on its left to the right face of the rumen and to the right abdominal wall on the right side. It is divided into 3 parts: The caecum, colon and rectum.

THE CAECUM:

It is the first part of the large intestine and lies between the termination of ileum and the beginning of colon.
It's average length is about 75 cm (30 inches), diameter about 12 cm (5 inches) and has nearly a cylindrical form. It begins at the termination of the ileum (the ileocaecal junction) which is on the medial side usually near the ventral end of the last rib and extends backwards and upwards along the right flank. It's termination is a rounded blind end which lies usually at the right side of the pelvic inlet. This extremity is directed backwards and is rounded, globular which floats freely in the abdominal cavity. Some times this extremity may be bent dorsally or ventrally and in such condition blind end faces forward. It is directly continuous with the colon in front of the termination of the ileum. Demarcation between the caecum and colon is indicated some times by a small constriction at the point of their continuation. The ileo caecal orifice is very small so that it can hardly admit a large finger and is occluded by the longitudinal folds of the mucous membrane. This circular orifice is guarded by a sphincter.

The caeco-colic orifice is dilated and larger and is the direct continuation of the caecum. This orifice is about 15 to 17.5 cm in diameter. In between the two orifices mentioned above is a caeco-colic fold which normally directs the food to the caecum, instead of the colon.

The medial surface of the caecum is attached to the mesentery in its anterior two-thirds while the posterior third is free. Its dorsal surface is attached to the colon by peritoneum and lateral surface is in contact with the right abdominal wall at the flank.

THE COLON:

It is the second part of the large intestine and begins at the caeco-colic orifice and terminates by joining the rectum. It's greater part is situated between the layers of the mesentery and is coiled upon itself in such a manner as to form a number of elliptical convolutions. The coils are held to each other by areolar tissue. Its average length is about 10 meters (35 feet) and the diameter in the first 0.45
metre is the same as that of the caecum and thereafter diminishes to about 5 cm (2 inches). After beginning as a direct continuation from the caecum, it passes first forwards for a very short distance (about 5 to 7.5 cm), then turns upwards and backwards at about the level of the lower end of the last rib, and then continues its backwards course along the right flank and above the caecum to reach the posterior part of the sublumbar region. It turns forwards and runs parallel to the second part up to the first or the second lumbar vertebra, it passes again backwards and is then continued by the spiral part (Ansa-spiralis). The coils are alternately centripetal and centrifugal and they are best seen from the left side. The last spiral turn (Ansa distalis) is at a little distance from the others, it then passes as far forwards as the anterior mesenteric artery, passes to the left of this vessel, turns backwards, again passes dorsal to the third (terminal) part of the duodenum. It inclines to the right and passes backwards along the ventral surface of the right kidney, forms an S-shaped (sigmoid) curve a little in front of the pelvic brim (near the pelvic inlet) and then continues as the rectum. The terminal part of the colon is attached to the sublumbar region by a short fold of mesentery. Though, the division of the colon into a large and a small colon is not marked, yet some consider the coiled part as representing the large and the terminal part suspended by mesentery as the small colon of the solipeds. But it is remarkable that the great mesenteric artery supplies to the first part and the small mesenteric to the second portion as in the horse.

**THE RECTUM**

It is the terminal section of the alimentary tract which extends from the level of the pelvic brim to the posterior opening of the digestive tube (the anus) and passes backwards either in a straight or an oblique direction. It is a little less than 30 cm in length and its walls are thicker and more dilatable than the preceding portions of
the intestine. The caliber of anterior part is same as that of the terminal part of the colon but posteriorly it gradually dilates to form a temporary reservoir for the faecal matter until the latter is expelled.

The rectum is related superiorly and laterally to the pelvic walls, and inferiorly in the male, to the bladder, vasa deferentia, vesiculae seminales, prostate, pelvic part of the urethra and cowper's (bulbourethral) glands and in the female to the uterus and vagina.

The walls of the large intestine have externally a serous coat except the adherent portion of the spiral part and the rectum. The retro-peritoneal part is very short and is surrounded by fat and connective tissue. In the middle is the muscular coat which has longitudinal and circular layers. In between these two muscular layers Auerbach's plexuses are present. The submucous coat has the ramification of vessels and nerves and the plexus of Meissner. The mucous coat does not present any villi or the Brunner's glands as in the small intestine. The intestinal glands (Lieberkühn) and solitary glands are large and numerous. Peyer's patches are not present.

Blood and nerve supply of the large intestine:

This part of the intestine receives blood supply from the anterior and posterior mesenteric and internal pudic arteries. It receives nerve supply from the anterior and posterior mesenteric and pelvic plexus of sympathetic system.

(Sisson and Grossman, 1953; Raghavan, 1964).
MATERIALS AND METHODS
MATERIALS AND METHODS

MATERIALS

SELECTION OF ANIMALS:
Sixteen healthy male buffalo calves weighing between 80 kg. to 115 kg. were selected for the present study (Table No. 2 and 3). The experimental animals were procured at different intervals and kept under close observation for a period of one week for checking up their health. Pre operative pulse, respiration and temperature were recorded during this period. The animals were kept under similar environment and diet after the selection.

SUTURING MATERIALS:

(1) Ethicon chromic catgut -.00- for intestinal anastomosis and cystoplasty.

(ii) Ethicon black braided silk -'000-'-do--

(iii) Hanks ligature silk ----. for closing the abdominal wall and skin.

DESIGN OF THE EXPERIMENT:

The present study was conducted on a total number of 16 experimental animals. All the animals were placed in two different groups by random selection. The animals of each group were again subdivided randomly in two subgroups. Thus, each sub-group contained four animals with a total number of 8 in each group. In group I, colon-cystoplasty and in group II, cecocystoplasty were performed. Both, 2-0 chronic catgut (absorbable) and 3-0 black braided silk (non absorbable) were used as suture
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<thead>
<tr>
<th>Buff. Calf No.</th>
<th>Group No.</th>
<th>Sub-Group No.</th>
<th>Technique of cystoplasty</th>
<th>Suture material used in visceral organs</th>
<th>Period of observation (in days)</th>
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<td>Colocystoplasty</td>
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* Died on 3rd post operative day.
materials in vesicoplasty as well as intestinal anastomosis in both the sub-groups respectively (Table No. 1).

The temperature, pulse and respiration were recorded pre and post operatively for a week. The other examination which was conducted during the pre and post operative period included:

Blood urea nitrogen (BUN) estimation: It was done pre and post operatively at 48 hours interval up to 10th post operative day according to the method of Levine et al (1961) using photo colorimeter.

The examination was conducted alternatively on 8 animals i.e. 2 animals from each sub-group were examined completely for 10th day of operation (Table No. 4).

The operated animals were observed for any clinical changes at an interval of 15, 30 and 75 post operative days. Then they were sacrificed and materials collected for gross and histopathological study.

METHODS

PRE OPERATIVE CONSIDERATION:

Following examinations were conducted before proceeding for surgery: The temperature, pulse and respiration were recorded pre operatively. Blood urea nitrogen estimation was conducted pre operatively as mentioned earlier (Table No. 4).

PREPARATION OF THE ANIMAL A DAY EARLIER TO SURGERY:

The animal was selected at random on the previous
day of operation. A Light diet was given for a day and food was completely withheld from the evening i.e. at least 12 hours prior to surgery. The area of the abdominal floor in front of the pubic region and parallel to the penis on right side was shaved and washed clearly with soap and water. Two per cent mercuriochrome was painted over the shaved area and the animal was brought in a clean and dry place.

PREPARATION OF THE ANIMAL ON THE DAY OF SURGERY:

The temperature, pulse and respiration of the experimental animal were recorded in the morning. The operative site was scrubbed well with soap and water and painted again with two per cent mercuriochrome solution after drying the part. The operations were conducted mostly in the morning with a view to get ample time for observing the operated animal for the rest of the day.

ANESTHESIA:

A dose of chloral hydrate 6 to 7 gm/50 kg. body wt. in a 6 per cent solution was given intravenously after casting the animal about 15 minutes before the operation. Then 20 ml. of two per cent novocain was infiltrated on the proposed line of incision.

OPERATIVE TECHNIQUE:

The animal was positioned in dorsal recumbency and draped with sterile shrouds exposing only the field of operation (Plate No. 1).
A 6 inches long right paramedian incision about two
and half inches lateral to the penis extending from the
prepubic region cranially was carried out (Plate No.2).
The prepubic tendon, muscle and peritoneum were incised in
the similar manner and thus, right paramedian posterior
laparotomy was performed. The peritoneum, muscle and tendon
were retracted and held with four pairs of Allis forceps
(Plate No.3).

The terminal portion of the colon in group I and
the apex of the caecum in group II, were searched and
withdrawn from the abdominal cavity through the incision
after careful packing of the viscera with warm saline soaked
sterile towel. A portion of the colon or caecum was selected
for the preparation of an intestinal' sheet graft' (Plate No.4
and 10).

Preparation of 'open sheet' or 'flat patch' intestinal graft:

Preparation of an isolated segment of intestine
in the form of an open sheet or flat patch for colocystoplasty
or caecocystoplasty was essentially based on the same
principle of preserving the blood supply to the graft and
stripping of the mucosal layer for preventing the absorptive
and secretory power of the mucus membrane of the grafted
tissue. The techniques included: the isolation of the
intestinal segment with its intact blood supply either
through the vessels of the mesentery or through the caecal
wall, and cutting of the isolated portion of the bowel
longitudinally so that it could be utilized in the form of
an open sheet or flat patch. Owing to difference in the anatomical construction of two different portions of the large intestine (caecum and colon); methods of preparation of intestinal grafts were slightly different in these two techniques:

Preparation of graft in colo-cystoplasty:

A portion of the terminal colon about 3 to 4 inches long was selected and isolated with its intact blood supply from the rest of the intestinal tract with the help of four rubber shod Doyen’s intestinal clamps (Plate No. 4). The required portion thus isolated was divided at both ends by giving two transverse incisions between two adjacent clamps (Plate No. 5). After taking care to preserve the blood supply to the graft, a wedge shaped portion of the mesentery was released. The length of the incised mesentery was made suitable to provide an adequate length of the graft for the required purpose and for avoiding the tension over the graft. Bleeding points were checked after ligating the vessels. Then the isolated intestinal segment attached with its mesentery was wrapped in warm moist packs and kept aside while intestinal anastomosis was performed.

The intestinal continuity was restored by end-to-end anastomosing using a two clamp closed technique (Plate No. 6 and 7). The 2-0 chronic catgut and 3-0 black braided silk were used in each sub-group respectively,
as suturing material (Plate No. 21). The vent created in the mesentery was closed by interrupted sutures (Plate No. 7).

The isolated intestinal segment was then processed. It was irrigated with warm saline solution to remove all the fecal material that was present within the lumen. The segment was opened longitudinally by cutting along the antimesenteric border with scissors for making an 'open sheet' or 'flat patch' (Plate No. 8). Then the mucosal layer was stripped off with the help of the scalpel. For easy removal of the mucous membrane, four artery forceps were fixed at the corners of the opened sheet and the latter was lightly stretched (Plate No. 9).

Then the inner surface was washed with warm saline solution and margin of the transplant was slightly trimmed to form a square like 'sheet' or 'flat patch'. Thus the seromuscular graft was kept ready for the recipient bladder.

**Preparation of graft in caecocystoplasty:**

The free end of the caecum was selected and its content was milked out. Then two rubber shod Doyen’s clamps were placed about 3 to 4 inches away from the apex adjacent to each other (Plate No. 10). The caecal pouch was sectioned in between the two adjacent clamps taking care to preserve its blood supply intact from the other side of the wall (Plate No. 11). Thus isolated caecal segment attached with a portion of its intact caecal wall was wrapped in a warm moist packs in the same manner as preceding. The opening of
the caecal stump was closed by a double row of Lembert's suture (Plate No. 12). The 2-0 chronic catgut and 3-0 black braided silk were used for closing the caecal stump in two different sub-groups respectively.

The isolated caecal pouch was irrigated and washed with warm saline solution and opened to form a 'sheet' or 'patch' by cutting in the middle of the resected wall up to the apex with scissors (Plate No. 13a). The mucosal layer was stripped off and a square-like sheet or flat patch intestinal graft was prepared in the same manner as described in colocystoplasty with only difference that its blood supply remained intact through the long, elongated intact caecal wall (Plate No. 14).

Preparation of the recipient bladder:

The bladder was palpated and brought to the operative site through the laparotomy incision. It was emptied by giving gentle pressure over it and held with two Allis forceps at the operative site. A piece of gauze was placed on either side of the wall of the bladder at the point of the bite of these forceps to avoid any trauma to the tissue of the organ. The dorsal surface of the vertex was incised with another scalpel and scissors. Thus, a square area of the bladder wall was removed by creating a vent in the organ (Plate No. 15).

Method of cystoplasty:

Though, flat seromuscular patches from two different portions of the large intestine were prepared,
the method of transplantation was essentially the same in both the operative procedures. The size of the intestinal graft was kept slightly bigger than the damaged area in the bladder wall.

The prepared intestinal graft was then placed over the damaged area of the bladder, so that the serous layer of the transplant faced out side and opposed to the serous layer of the bladder-wall. At first 3 or 4 stay sutures were placed to minimize tension on the suture lines. Then, suturing of the wall of the bladder and the margin of the graft was started at one point (Plate No. 16 and 18), and worked around all sides of the graft and thus, the damaged area of the bladder-wall was repaired completely with a row of continuous Lembert's suture (Plate No. 17 and 19). The chronic catgut No.2-0 and silk thread No.3-0(Black braided) were used respectively for fifty per cent of the experimental animals in each group (Plate No.21). A second row of Lembert's suture using the same suturing materials was placed to strengthen the line of suture. Thus, the damaged bladder was repaired by the method of cystoplasty(Plate No. 17 and 19).

The abdominal packs were removed and the abdominal cavity was flushed with warm saline solution. It was mopped off clearly with sterile cloth and terramycin liquid(topical) was applied over the operated viscera and in the abdominal cavity. After replacing the bladder and intestine in their normal position, the abdomen was closed in usual manner using hanks ligature silk as suturing material (Plate No. 20).
Terramycin liquid was again applied over the suture line and a protective pad of sterile bandage piece was applied to avoid contamination. The surrounding area was properly cleaned. The animal was then ambulated in the byre and allowed complete rest.

**POST OPERATIVE CARE AND MANAGEMENT:**

The animals were kept in clean and dry place and injected 250 ml of five per cent Dextrose solution I/v daily for 3 days, only in group-I. All the animals received 5 ml of terramycin injectable solution* I/m daily up to 5th day of operation. Two measuring spoons of Hostacycline water soluble powder* were given orally in the form of a drench daily for 5 days post surgery. In a few cases abdominal pain was manifested after operation and in such condition 2.5 ml. of squil® was injected intramuscularly. The animals were maintained mainly on rice gruel for the first two days after operation and other feeds were completely withheld. They were allowed water ad. lib. and maintained on green grasses and hay after the third day of operation. They were also allowed to graze from the third post operative day.

The temperature, pulse and respiration were recorded daily in the morning and evening for one week post operatively. The other examinations were conducted as mentioned earlier. Skin sutures were removed on the 8th day of operation and terramycin skin ointment® was applied on the line of suture. The animals were observed carefully
for any complication during whole of the period till sacrificing them at different intervals.

SURGICAL PATHOLOGY

The experimental animals were sacrificed at different intervals from 15 to 75 days post operatively by intravenous administration of saturated solution of magnesium sulphate. Autopsy was conducted to detect any gross lesions in the urinary system and the intestine. Bladders from operated animals were collected and preserved in 10 per cent formaline solution for gross and histopathological study.

MICROSCOPICAL EXAMINATION

A piece of tissue from the junctional area of each grafted bladder was taken and paraffin blocks of the tissues were made by standard technique. Sections through the junction of the grafted and the recipient bladder tissue were made and slides were stained with standard technique of Haematoxylin and Eosin and mounted. Then the slides were examined microscopically for histopathological changes.

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* Terramycin injectable solution 50 mg./ml. for veterinary use (Pfizer).
+ Hostacycline water soluble powder veterinary (Hoechst).
@ Siqul injection of 5 ml. vial for veterinary use (Squibb).
& Terramycin skin ointment veterinary (Pfizer).
OBSERVATIONS AND RESULTS
OBSERVATIONS AND RESULTS

In the present experiment two techniques of cystoplasty: colocystoplasty and caecocystoplasty were studied on sixteen male buffalo calves using both absorbable and nonabsorbable sutures. The observations were made with particular references to:

( 1) The clinical manifestations by the animals which included any abnormality in the process of urination, defecation, temperature, pulse, respiration and changes in their habitus.

( ii) Estimation of blood urea nitrogen from a day prior to operation till the 10th post operative day at 48 hours interval.

(iii) Macroscopic changes regarding the soft tissue adhesion with the grafted bladder as well as the intestine, and so also the gross pathological changes in the urinary system including the viability of the graft.

(iv) Microscopic changes at the junction of the graft and host tissue from the 15th to 75th day post operatively.

GROUP - I

In this group, colocystoplasty was performed. All the operated animals survived well except the buffalo calf No. 3 which died on the third day of operation. Observations were made separately in two sub-groups while employing one type of suturing material for each.

SUB-GROUP- IA

In this sub-group, absorbable sutures (2-0 chromic
Hence, average post-operative readings are only of three days.

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<thead>
<tr>
<th>Sub-group: 1A</th>
<th>Sub-group: 1B</th>
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Note: of average post-operative and average post-operative temperature pulse and respirations of experimental animals in coo 1962:

*(Group-I)*

*Table NE.5*
<table>
<thead>
<tr>
<th>No. of buffalo calf</th>
<th>Body wt. in kg.</th>
<th>Temperature in °F</th>
<th>Pulse reg. per minute</th>
<th>Operative respiration in g/min</th>
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<td>100.6</td>
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* No. of buffalo calf is in continuation with Group-I.

Table showing pre-operative and average post-operative temperature, pulse and respiration of cows in case of hysterectomy (Group-II).
catgut) were used for cystoplasty and intestinal anastomosis in each of the four animals. They were observed carefully as follows:

**Clinical Manifestations:**

All the operated animals appeared to be normal on the day of operation except the buffalo calf No.1 which manifested abdominal pain, arched back and frequent micturition; but it was combated by intramuscular injections of novalgin and aqual. However, this type of complication was lacking in rest of the animals. In each individual animal temperature was found slightly elevated for a couple of days and thereafter, it became normal (Table No 2, Graph No.3). They also exhibited accelerated pulse for 2 to 3 days which normalised in due course. However, there was no marked change in respiration. For the first two to three post-operative days, the animals voided blood-tinged urine and later on almost clear urine with few blood clots up to a week. But none had urinary obstruction due to these clots.

All the animals were found ruminating and defecating normally except the buffalo calf No.2 which was not voiding stool and in place of it whitish mucus discharge was seen.

All other animals were active and grazing in the field normally after two days of operation. But the buffalo calf No.2 was slightly dull and showed inappetence. This case was suspected for intestinal disorder; hence it was reoperated on the 7th day of operation. On exploratory
<table>
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<th>Group</th>
<th>Average Post</th>
<th>Post Mortem loss of weight of</th>
<th>Post Mortem level in days</th>
<th>Bone weight of buffalo</th>
<th>Level in mg/100 ml of blood (or blood urea nitrogen (P.U.M) Table Showing pre and post operative blood urea nitrogen (P.U.) of experiment) Pre operative level in days</th>
<th>Bone weight of live</th>
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laparotomy adhesions and stricture of the large intestine were detected. During reoperation, the mesenteric attachment to the graft was severed and adhesions were gently broken down. After that, enterectomy and reanastomosis of the intestine at the preoperated site were performed. Thereafter, the general condition of the said animal improved markedly with normal defecation and rumination. Buffalo calf No. 3 died on the third day of operation after showing symptoms of acute tympany. No other clinical symptoms were marked in this case except dullness and bloat which remained unchanged even after continuous treatment. However, all the survivors displayed the normal physiologic phenomena and nothing change in their habitus could be observed even up to the last day of observation (Plate No. 22).

Local incisional wound of the prepubic region showed primary healing in almost all animals and thus the skin sutures were removed on 8th post operative day.

Blood urea nitrogen:

The estimation of blood urea nitrogen (BUN) at every 48 hours interval up to the 10th post operative day of the buffalo calves No. 1 and 4 of this sub-group did not indicate much variation beyond the normal physiologic level. Though, its level was slightly increased but fluctuated within the normal range (Table No. 4, Graph No. 1).

Macroscopic observations:

On autopsy, no soft tissue adhesions were present
around the grafted bladder, intestinal anastomosis or the surrounding viscera except in the buffalo calf No. 2 which was reoperated on the 7th day of operation. In this case the colon was adherent with the mesentery, peritoneum and small intestine, as well as at the site of intestinal anastomosis a mild degree of stricture was detected. But after sacrificing the animal for gross examination and collection of the organ for histopathology, nothing abnormal could be detected in the gastro-intestinal tract.

The external suture lines of the grafted area were indistinguishable after 15 days. The graft was found completely healed and could not be detached from the host tissue. But in buffalo calf No. 3 which died on the 3rd day of operation, the grafted tissue was found some what necrosed. In all other animals, the vascular supply to the graft was uninterrupted maintaining the graft's viability. On the 75th post operative day only long elongated vessels to the graft with markedly increased length were present which indicated the grafted area (Plate No. 23). On gross examination, the area around the vessel appeared much reddish at this stage denoting rich vascularity of the graft.

The line of union was distinguishable from the mucosal surface up to the 30th day of operation; but on the 75th day, it was difficult to differentiate in between the grafted and the host tissues. There was lack of any demarcation at this stage, but only thing that the additional blood vessel supply to external surface of the part from a
distal place was the imaginary guide line for the grafted area of the bladder after the 75th day of operation. No other gross lesions were found on the mucosa of the graft and the bladder. Nothing abnormal could be detected with naked eyes in the ureters and kidneys of the operated animals.

Microscopic observations:

Histological studies revealed that there was complete union of the muscularis and serosal layers of the grafted and the host tissue at 15 days. During this stage, epithelial lining was not clearly discernible on either side in the region of junction. The accumulation of fibrous tissue, arranged irregularly were visible at the junctional point. A large number of blood vessels and lymphocytes were present at the junction and also at other places of the grafted tissue (Plate No.25). Rich vascularity in the mucosa of the bladder near the zone of the junction was noticed. But less vascularity was seen in the similar region of the transplanted piece of colon. The vascularity was more marked in the region away from the zone of the junction in the mucosa of the bladder. Contrast to this, very less vascularity was observed in the similar region of the transplanted piece of colon.

At the end of 30 days, union between the corresponding layers of the bladder and the graft was found to be complete and at this stage the transitional epithelium of the bladder had developed over the grafted part also.
The cells were trying to be arranged in regular manner. A large number of blood vessels and capillaries were present below the epithelial layer. The thickness of epithelium over the grafted tissue was somewhat lesser at the junction than on the other parts. The fibrous tissue was somewhat compactly arranged. Lymphocytes were comparatively less in number as observed at the end of 15 days of the grafted tissue. Blood vessels and capillaries were also visible below the epithelial layer.

The inflammatory changes continued up to 75 days, but mild tissue reaction was noticed in this stage. The transitional epithelium of the bladder had completely developed over the grafted part of the colon (Plate No. 26). Although, it was lesser in thickness than the epithelium of the bladder itself, yet it was clear that uroepithelium had developed from the host side. The lymphocytes were very few. The connective tissue fibres were regularly arranged and blood vessels were fewer in number (Plate No. 26).

**SUB-GROUP - IB**

In this sub-group, nonabsorbable sutures (3-0 black braided silk) were used and observed carefully as follows:

**Clinical manifestations:**

All the animals survived well. Variation in the temperature, pulse and respiration in the operated animals was alike the previous sub-group (Table No. 2, Graph No. 4).
There was primary healing of the local incisional wound in almost all animals, but an oedematous swelling around the site of incision was noticed in buffalo calf No. 7, which subsided gradually during the observation period.

All of the operated animals were urinating and defecating normally. Urine was blood-tinged for a couple of days and then it became almost clear. Blood clots were noticed coming out through urine even up to 6th post operative day. Ruminations was normal and the animals were grazing normally after the 3rd post operative day. There was lack of any marked unusual symptoms. All of them were active with good appetite.

**Blood urea nitrogen (BUN):**

The level of urea nitrogen in the blood was slightly increased but fluctuated within the normal range (Table No. 4; Graph No. 1).

**Macroscopic observations:**

On autopsy, there was lack of soft tissue adhesions around the grafted bladder, intestine or the surrounding viscera. The grafts were taken completely by the host tissue. Leakage or other marked pathological lesions could not be detected in any case. All the naked eye observations were same as mentioned in the preceding sub-group (IA) with only difference that no one showed the soft tissue adhesions or any other complications.
Microscopic observations:

In this sub-group also, a complete union of the muscularis and serosal layers of the grafted and the host tissue was evident on 15th day. Epithelial lining was not clearly discernible at the junctional zone in this stage. All the inflammatory changes in this group were similar to the previous sub-group. Formation of transitional epithelium over the junctional area was noticed on 30th day (Plate No. 27), and complete regeneration of the uroepithelium of the bladder was observed over the grafted seromuscular part on 75th post-operative day (Plate No. 28). Unlike the preceding sub-group, no pathological changes could be detected histologically.

GROUP-II

In this group of animals, the observations were made after performing the caecocystoplasty. All the operated animals survived well. The animals of this group were comparatively much active than group-I, even from the day of operation. They were observed separately in two sub-groups alike the first group of colocystoplasty:

Sub-group II A

In this sub-group, absorbable sutures (2-0 chromic catgut) were used. All of them were observed carefully as follows:

Clinical manifestations:

The operated animals showed slightly elevated
temperature for the first two days and after that it came
to normal (Table No. 3, Graph No. 5). Pulse was also
accelerated for the 3rd post operative day which became normal
afterwards. Respiration was somewhat unaltered. All the
animals voided blood-tinged urine for the first two to three
days and later on almost clear urine. Though, few blood
clots were noticed during micturition for a week but none had
shown urinary disturbances due to these clots.

Each individual animal showed normal rumination.
The process of urination and defecation was physiological.
They were active and grazing grasses normally after 2 days of
operation. None of them had shown inappetence or any other
untoward clinical symptoms.

Blood urea nitrogen (BiN):

Blood urea nitrogen estimation at 48 hours
interval up to the 10th post operative day in buffalo
calves No. 9 and 11 of this sub-group exhibited slight
increase in its level but within the normal physiologic
level. The percentage fluctuated within the normal range
(Table No. 4, Graph No. 2).

Macroscopic observations:

No soft tissue adhesions were present around
the grafted bladder, caecal-stump or the surrounding viscera.

The external suture lines of the grafted area
were indistinguishable after 15 days (Plate No. 24). The graft
was found completely healed and could not be detached from the host tissue. The bladders revealed perfect union of the caecal graft. Unlike group I, in place of long elongated blood vessel, a blind tubular passage was marked in the connecting caecal wall inbetween the caecal-stump and the grafted area of the bladder. But none had developed a vesico caecal fistula or any other disturbance due to this blind passage. The vascular supply to the graft was uninterrupted maintaining the grafts viability. The bladder of each individual animal contained clear urine after 15 days.

The line of union was distinguishable from the mucosal surface up to the 30th day of operation. In some cases ecchymotic haemorrhage on the bladder mucosa and peelable necrotic foci on the mucosa of the graft were encountered at this stage. But afterwards on 75th day, these changes in the bladder mucosa were absent and it was quite difficult to differentiate the grafted and the host tissue. Other pathological lesions could not be marked with the naked eyes. No abnormality was noted in the upper urinary tract.

Microscopic observations:

On 15th day, complete union of the muscularis and serosal layers of caecal graft with that of the bladder was evident. The epithelium towards the grafted caecal side was not developed but it was noticed that few cells
were trying to spread from the uroepithelium of the bladder towards the caecal graft. At the zone of junction and its vicinity there was a large number of fibrous tissue, blood vessel and lymphocytic infiltration (Plate No. 29). At other parts of the grafted tissue there was a large number of lymphocytes and fibrous tissue also. On caecal side away from the junction of the graft, the blood vessels were more in number scattered in the fibrous tissue and the epithelial cells were just in the process of development.

Union between the corresponding layers of the bladder and the graft was found to be complete at 30 days. It was noticed that the epithelium of the bladder was creeping towards the caecal side and it seemed that a group of epithelial cells were trying to overlap the grafted caecal tissue at the junction (Plate No. 30). The thickness of the epithelium at the junctional point between caecum and bladder was lesser as compared with the distant caecal part. The cells of the epithelium were globular and arranged in more than two layers. So, it could be said that the uroepithelium of the bladder had developed over the grafted caecal part. Lymphocytes had accumulated just below the epithelium (Plate No. 30). The fibrous tissue had become compactly arranged. At some places lymph nodules were also seen under the epithelium.

An inflammatory reaction of a milder degree was noticed even up to 75 days. The lymphocytes and also the blood vessels were scarce in number. The connective tissue
fibres were arranged regularly in this stage. The transitional epithelium of the bladder had completely developed over the grafted caecal part. Though, its thickness was lesser as compared with the epithelium of the bladder itself yet, regeneration of the intestinal epithelium was not evident in any case.

**SUB-GROUP - IIB**

In this sub-group, non absorbable sutures (3-0 black braided silk) were used and the animals were observed carefully as the earlier sub-groups:

**Clinical manifestations:**

Each of the operated animals exhibited slight rise of temperature and accelerated pulse for a couple of day which later on came to normal (Table No. 3, Graph No. 6). The change in respiration was insignificant. Objective study of the animals showed that there was no incontinence, frequency or retention of urine. Though, urine was found blood-tinged for the first 2 to 3 days and few blood clots were also marked during micturition for five to six days but it became apparently clear afterwards.

All the animals were voiding urine and faeces normally. They were active, alert with normal habitus. They were grazing normally after 2nd day of operation and showed the normal appetite. The other symptoms were alike the previous sub-group and nothing abnormal was observed in any case.
Blood urea nitrogen (BUN):

Like the other sub-group, estimation of blood urea nitrogen revealed little elevation of its level and was slightly higher than the pre-operative value. Its level fluctuated within the normal range up to 10th post operative day (Table No.4, Graph No.2).

Macroscopic observations:

The necropsy finding showed normal urinary bladder and urinary tracts with viable intact grafts in all cases. All the grafted bladders healed well. There was no adhesion either around the grafted bladder, caecal-stump or the surrounding viscera. There was no marked gross disimination between graft site and its remnant in these animals. The other gross observations were similar to that of preceding sub-group.

Microscopical observations:

Histological sections made from the junctional area showed gradual development of transitional epithelium in the area previously occupied by serosa. A perfect union between the seromuscular graft and the host tissue was evident on 15th day. There was lack of distinct epithelial lining at the zone of junction in this stage (Plate No.33). But on 30th day, regeneration of uroepithelium was noticed (Plate No.32). On 75th day, the development of transitional epithelium of the bladder was fully marked over the grafted caecal part (Plate No.33). All the inflammatory changes
were similar to previous sub-group which continued even up to the last day of study (Plate No. 31-33). The reaction was of moderate degree. Histological studies could not reveal any pathological change. Intact muscular layers and abundant vascularity were noted in all instances.
DISCUSSION
DISCUSSION

It is obvious from the available literature that the clinical and experimental replacement of the bladder, urethra or ureter is not a new concept for human beings and dogs but it remained unestablished in large animals. The available literature on this subject indicates that plastic reconstruction of the drainage part of urinary system to function satisfactorily as a reservoir for urine and as an excretory organ has not been tried adequately so far in large animals. This paucity of literature on large animals and successes attained with vesicoplasty in man, dog and other experimental animals stimulated the author to apply the present technique of intestino-cystoplasty in bovine.

Isolated segments of the large and small intestine have been used in urological surgery mainly for partial fulfilment of two purposes:

(1) For remodeling the part of the urinary tract (ureter, bladder or urethra either partially or completely) so as to restore it anatomicallly to serve its original purpose.

(ii) For constructing a conduit or a reservoir for urine, as a method of urinary diversion.

The damaged or diseased ureters are corrected and substituted by isolated intestinal segments. Various workers like Mc Lean and Fais, 1952; Foret and Heusghem, 1953; Baum, 1954; Annis, 1956; Pyrah, 1956, 57; Houtapel and
Grüdemann, 1960; Torbey and Leadbetter, 1962; Askari et al., 1964; Gil-Vernet, 1965; Lange and Lindner, 1965; Atwill et al., 1967; Hakim and Creevy, 1967; have replaced one or both ureters with the help of intestinal transplant successfully. At the same time, workers like Barnes et al., 1953; have reconstructed lower segments of ureter from a tube made from a bladder flap in calves with good success.

When there is complete damage of the urinary bladder due to extensive carcinoma or even due to pelvic evisceration then complete substitution of the bladder is generally practiced (Risgard, 1943; Rubin, 1948; Bricker and Riseman, 1950; Gilchrist et al., 1950, 51; Thompson, 1950; Glasier, 1952; Peck and Newland, 1952; Wenger, 1952; Moor, 1953; Bricker et al., 1954; Girbo and Durand, 1956; Pyrah, 1956, 57; Delev, 1958; Bourque, 1959, 60; Gil-Vernet, 1960; Deleveliotis and Macris, 1961; Hradec, 1965; Warwick and Ashken, 1967).

Many of the surgeons (Cordonnier and Lage, 1951; Levitsky, 1953; Aniss et al., 1954; Pyrah, 1956, 57; Arconti, 1957; Mellinger and Suder, 1958; Cordonnier and Nicolai, 1960; Parkhurst and Leadbetter, 1960; Girbo, 1961; Schmiedt, 1961; Kafetsisulis and W. Swinney, 1963) had made urinary conduit or diversion either with the help of isolated intestinal segment or by directly transplanting the ureters to sigmoid colon or rectum. The purpose of the last maneuver was to evacuate urine with the stool.

When ever, there is any lesion affecting a
portion of the bladder, it can be repaired successfully with the help of an intestinal pedicle graft; as there is no need to substitute the organ completely. Many of the workers (Shoemaker, 1909; Lennox, 1912; Scheele, 1941; Couvelaire, 1950; Barnes et al, 1953; Gibert, 1953; Tasker, 1953; Annis, 1956; Pyrah, 1956, 57; Wells, 1957; Arconti, 1957; Goodwin et al, 1958, 59; Meaville et al, 1958; Orr et al, 1958; Küss, 1959; Markowitz et al, 1959; Martin, 1959; Murphy et al, 1959; Houetapel and Grundemann, 1960; Anderson, 1962; Weinberg, 1964; Gil-Vernet, 1965; Lange and Lindner, 1965; Torbey and Mozden, 1966; Charghi et al, 1967; Shawket and Muhsen, 1967; Warwick and Ashken, 1967; Maged, 1968; Küss et al, 1970) have performed partial or subtotal replacement of the bladder with the help of isolated intestinal segments either for enlarging the capacity, reinforcing the bladder-wall, or for correcting any defect of the wall of the organ.

In the present study, an attempt has been made to reconstruct the wall of the urinary bladder with the help of seromuscular segments from colon and caecum in sixteen male buffalo calves.

Rupture of urinary bladder is not uncommon in bovine and it is mainly encountered due to urethral calculosis. As far as its treatment is concerned, Prasad et al (1973) have discussed the importance of caecocystoplasty for repair of ruptured-wall of the bladder during the experimental studies in buffalo calves. In their opinion the repair of the wall only by suture technique
is feasible in those cases where the tissue on the bladder-
wall is healthy enough to withstand minimum physiologic
cystic pressure required to stimulate relaxation of the
bladder sphincter. But abnormal distension of the bladder
prior to rupture is seemingly enough to cause intramural
vascular compression to the extent that the bladder tissue
virtually becomes nonviable. The author is in disagreement
with the view of these workers regarding the treatment of
cases of ruptured bladder. While taking the above facts
in view, Mally and Bommaiah (1972) advocated the use of
intracystic metal catheter through ischial urethrotomy
without closing the vesical rent when bladder had poor
suture retaining capacity. Rao et al (1972) have treated
cases of ruptured bladder and urethral obstruction in oxen
with the help of indwelling catheters (polythene tubes)
without repairing the rent in the organ. Metallic or other
indwelling catheters may however be more useful when there
is only leakage especially during the dorsal wall rupture;
but in cases of ventral ruptures, leakage at the ruptured
site would continue. This will further disprove the
condition of the patient even after the aforementioned
surgical correction.

Then a surgeon is increasingly anxious to know
about the surest means of treatment for the cases of ruptured
bladder or incurable extensive lesions in the bladder wall,
where the possibility of self repair or repair by suture
technique is not feasible. In author's opinion, reconstruction of the wall of the bladder with the help of seromuscular colonic or cecal grafts may be helpful with promising results if urethral obstruction is also relieved simultaneously in cases of calculi. The methods of present study of intestinocystoplasty are intimately concerned with the technique, estimation of post operative level of urea nitrogen in the blood and the changes brought about in gross and histopathological examinations of the tissues at the junction of the grafted sites.

From the operative experience, it was felt that approach through suprapubic site was convenient for laparotomy in buffalo calves. Through this approach, bladder was brought easily at the operative site after simple traction and thus it was visible from all the sides.

In the present series, sixteen operations of intestinocystoplasty (6 colocystoplasty and 8 cecocystoplasty) were performed for partial substitution of the wall of the urinary bladder in buffalo calves. Two types of suturing materials namely, 2-0 Ethicon chronic catgut (absorbable) and 3-0 Ethicon black braided silk (non absorbable) were used for suturing the visceral organs. The silk threads were used for testing the validity whether these non absorbable sutures could be used internally in the bladder or not as other workers (McLean and Fais, 1952; Dalev, 1958; Goodwin et al., 1959; etc.) had used and emphasized over the non-absorbable sutures for their use in urological surgery.
The isolated intestinal segments from two different portions of the large intestine: Colon and Caecum were used for cystoplasty employing one method for each group of animals, as detailed below:

**COLOCYSTOPLASTY:**

The seromuscular pedicle grafts from colon served as satisfactory substitutes for the bladder reconstruction in buffalo calves. No doubt, the operative procedure is somewhat longer and it needs great precaution at the time of intestinal anastomosis. However, the method of colocyctoplasty is worthy and results are much satisfactory in buffalo calves.

The surgical technique in the present study of colocyctoplasty was same as adopted by many surgeons (Tasker, 1953; Shoemaker and Marucci, 1955; Wells, 1956; Pyrah, 1957; Goodwin et al., 1958, 59; Martin, 1959; Torbey and Leadbetter, 1962; Torbey and Mozden, 1965; Maged, 1968; Kudale and Hattangady, 1971) in urological surgery of dogs and human beings. Mostly they had used the isolated intestinal segments from small or large intestine in the form of an open sheet for vesicoplasty and succeeded in enlarging the capacity of the bladder or corrected the defects of the wall of the organ either experimentally or clinically.

In the present series of work, the author also used an isolated colonic segment which was incised longitudinally along the antimesenteric border to form an
'open sheet' or 'flat patch' while maintaining the blood supply to the graft through the intact mesenteric vessels.

Since the intestinal mucosa is primarily a medium of absorption and secretion so, in the present experiment, it was stripped off from the isolated intestinal segment on the same line as followed by Shoemaker, 1955; Shoemaker and Marucci, 1955; Greenfield, 1959; Martin, 1959; Torbey, 1960; Torbey and Leadbetter, 1962; Hundy, 1961, 64; Hatch, 1966; Torbey and Mogden, 1966; Kudale and Hattangady, 1971. If these absorptive and secretory properties of the intestinal mucosa are removed, the resultant seromuscular graft can no longer alter the electrolyte metabolism and may be more nearly an ideal bladder substitute. This type of substitute is feasible not only for the urinary bladder but in other circumstances such as for ureters, urethra and enlarging the bladder when increased capacity is desired, as many workers like Martin, 1959; Shoemaker, 1955; Torbey, 1960; Torbey and Leadbetter, 1962; Torbey and Mogden, 1966; etc. have used successfully.

The mucosal stripping, not only reduces the absorptive and secretory capacity but also appears to have certain other advantages over the gratted bladder with intact intestinal mucosa e.g.

(1) Checking of infection,
(ii) Proliferation of uroepithelium over the grafted tissue

For these reasons, though Prasad et al (1973) have used
caecal pouch with its intact mucosa for caecocystoplasty in buffalo calves and have shown no significant alteration in the body electrolytes perhaps due to reutilization of blood urea by the system in ruminants, yet they have discussed that probably bacteria harbouring in the caecal mucosa might have invaded the bladder wall causing some pathological changes in the bladder mucosa. That's why they have also advocated that stripping of caecal mucosa prior to grafting on the bladder and post operative antibiotic treatment are suggestive to get rid of these complications. The above findings are fully inagreement with the findings of the author, who could not get any gross pathological change in the mucosa of the bladder in case of colo-cystoplasty. In the author's opinion stripping also favours proliferation of uroepithelium over the grafted bladder as evidenced by complete regeneration of transitional epithelium over the seromuscular colonic graft, but contrast to this Frasad et al did not find complete replacement of intestinal epithelium by transitional epithelium. It was their belief that complete replacement of intestinal mucosa by transitional epithelium was not evident due to intact mucosa of the grafted caecal pouch. Thus the author's opinion regarding stripping of mucosa was compatible with these workers. For the above reason they also opined that "uroepithelial proliferation is found to be enhanced by stripping as has been observed in canines(Blandy,1961)."
On the other hands workers like Martin, 1959; Torbey and Morden, 1966; Hakim et al, 1966, 67; used vesical mucosal patch where as Atwill et al (1967) used cutaneous epithelium over the seromuscular intestinal grafts for ureteral and bladder replacement. They concluded that the intestinal tissue lined with vesical epithelium would probably reduce the incidence and severity of complications associated with the use of such tissue with its intact intestinal mucosa for urinary tract reconstruction.

As far as absorptive, secretory or infective property is concerned the author is in agreement with the removal of intestinal mucosa, but at the same time he could not get any significant change in the level of blood urea nitrogen post operatively in buffalo calves. Hence, the use of bladder or cutaneous epithelial patch over the seromuscular intestinal graft seemed useless for bovine.

Due to the secretive and absorptive potential of the intact bowel segment and to overcome these objections inherent in bowel epithelium, Grotzinger et al (1954); Shoemaker and Marucci, (1955); and Blandy (1961) have used the reversed seromuscular intestinal segments in reconstructing the bladder. But on the other hand many surgeons (Folsom et al, 1940; Bohne et al, 1955; Goldstein and Gualtieri, 1967; Tsuji et al, 1967; Orikasa and Tsuji, 1970; Stanley et al, 1972) have described complete regeneration of the bladder and so also the transitional epithelium after subtotal or total cystectomy along with the use of
either mold, omental patch or prosthetic material in dogs and other experimental animals. Owing to high regenerative power of transitional epithelium of the bladder the author also agreed with those workers who had used only the seromuscular intestinal grafts. Heeg et al (1968, 69) had also shown that the bladder capacity returned to at least 75 per cent of the preoperative level in dogs after extensive segmental resection and there after either the margins anastomosed to the serosal aspect of sigmoid colon or covered over a 5 cc. Foley balloon. This also indicated the high regenerative power of the bladder epithelium.

In this experiment, all the operated animals survived well except the buffalo calf No. 3 which died on the third day of the operation showing marked tympanic syndrome. The secondary complication was observed only in one calf i.e. buffalo calf No. 2 due to intestinal stricture which was corrected after reoperation on the 7th postoperative day. There was manifestation of abdominal pain in buffalo calf No. 1 after operation which was combated by intramuscular injections of novalgin and siguil. It might be due to shorter length of the mesenteric attachment to the graft and could have been prevented by incising mesentery deeply at the time of operation. But this complication was over soon subsequently in rest of the animals. All the survivors were active, alert and taking feed normally.
An initial rise of temperature above the normal for a maximum period of three days after the operation was found in almost all animals and this might be due to tissue reaction following surgery. The temperature became normal in due course after the animals received usual antibiotic therapy. Antibiotic treatment was also resorted to prevent any probable development of septic complication like peritonitis, cystitis, external wound infection etc. post-operatively.

Estimation of blood urea nitrogen up to the 10th post operative day showed slight deviation from the preoperative level. During the post operative period clinical observations and the pattern of blood urea - nitrogen level proved that there was no obstruction to the normal passage of urine even though few blood clots were noticed passing through urine. These findings of blood urea nitrogen estimation in young male buffalo calves are in agreement with the result of Prasad et al (1973). Results of this study was also similar to the previous workers like, Shoemaker and Marucci (1955), Annis (1956), Mellinger and Suder (1958), Menville et al(1958), Devel eliotis and Macris (1961), Hakim and Creevy (1967), Rifaat (1968), etc. who had described the level of blood urea nitrogen within the normal physiologic range after plastic reconstruction of the urinary system in human beings, dogs and other experimental animals.
Local incisional wound on the abdomen had shown primary healing in almost all animals. Clinical examinations showed an oedematous swelling around the site of incision in animal No. 7 which subsided gradually during the observation period. This swelling might be due to irritation at the site of incision as a local reaction.

Fluid therapy was given in almost all animals of this group as they were found to be somewhat dull and depressed after the operation as well as they were not allowed to graze or take feed till the second post operative day. Such fluid therapy was undertaken to prevent shock and to provide body strength.

Gross examination revealed no inflammatory changes in the wall of the grafted bladder tissue except in buffalo calf No. 3 which died on the third post operative day showing marked tympany. The grafted tissue in the particular animal was somewhat necrosed and this might have resulted from impairment of the blood supply due to shorter pedicle graft or strangulation of the vasculature. The actual reason for the death could not be assessed as there was marked tympany due to over grazing of grass on the 2nd day of operation. Thus, the death might also be due to asphyxia and dehydration. The secondary complication like intestinal stricture from which buffalo calf No. 2 suffered and subsequently cured after reoperation, could be prevented after taking precaution at the time of intestinal anastomosis.
In all the survivors, however the seromuscular intestinal graft healed well with the host tissue without any evidence of urinary infection. The presence of long elongated vessel of increased size on 75th post operative day might be due to tension in the mesenteric attachment and bladder after the cystoplasty.

When the pieces of tissue from the junctional point were taken for histopathological study, black threads were noticed in the bladder tissue even up to the 75th day of operation in group- IB. It denotes that the black braided silk thread (No.3-0) remained unaltered till the last day of observation. There was no more significant difference in between the sub-groups.

In all the animals, microscopical examination of the tissue taken from the junction of the graft and host tissue revealed complete union of the corresponding layers of the intestinal and bladder tissues. There was lack of distinct mucosal layer on 15th post operative day but it was evident on 30th day. A large number of vascularity as well as lymphocytic infiltration was marked which might be due to inflammatory changes in the process of repair. That's why the fibrous tissues which were irregularly arranged on 15th post operative day became compactly arranged on 30th day and the number of lymphocytes was also less in this stage. On 30th day, the thickness of epithelium over the grafted tissue was some what lesser
at the junction than the distant part of the graft and this might be due to more blood supply through the mesenteric vessel lying on that part of the colonic graft. On 75th day, all the inflammatory changes were minimal and there was complete development of uroepithelium over the grafted tissue from the host side.

These histological findings were in agreement with the results of Greenfield (1959), Torbey and Leadbetter (1962), Mandy (1961, 64), Hatch (1966), who had shown complete regeneration of transitional epithelium either from vesical, ureteral or urethral stump after complete removal of mucosa or mucosa along with submucosa.

Sheemaker and Marucci (1955), have used reversed seromuscular graft for bladder reconstruction and have shown development of transitional epithelium over the serosal layer of the graft in 7 weeks. On the other hand, Kudale and Hattangady (1971) have shown regeneration of intestinal epithelium over the seromuscular ileal graft after ileocystoplasty. However, it is clear from the work of Sheemaker and Marucci (1955), who have used seromuscular segment of the intestine for cystoplasty and kept serosal surface internally; and other workers (Folseon et al 1940; Bohne et al, 1955; Goldstein and Gualtieri, 1967; Tsuji et al 1967; Orikasa and Tsuji, 1970 and Stanley et al 1972) who have used either mold, omental patch or prosthetic material in experimental animals after partial or total cystectomy.
and have discussed the development of transitional epithelium and musculature in new reconstructed bladder that there is regeneration of transitional epithelium from the remaining urinary stump. No doubt, there may be regeneration of the intestinal epithelium if it is not removed completely, but there will be complete regeneration of the uroepithelium if mucosa is removed completely. For this reason, Prasad et al (1973) have also advocated for stripping the caecal mucosa, as they could not get the complete regeneration of transitional epithelium over the caecal graft due to use of isolated caecal segment with intact mucosa.

CAECGYSTOPLASTY:

It is notable from the available literature that an isolated caecal segment in the form of a 'flat patch' or 'sheet graft' has not been tried adequately in small animals as well as human beings in reconstructive urological surgery. The reason might be due to the smaller size of caecum, which carries a peculiar appendix at its free end, in case of dogs and human beings.

Even though, workers like Couvelaire (1950), Menville et al (1958), and Warwick and Ashken (1967) have preferably used the isolated loop of caecum for bladder enlargement in dogs and men. But due to smaller size of the caecum along with the presence of appendix in these subjects, many surgeons (Verhoogen, 1908; Makkas, 1910;
Lengemann, 1912; Cortes, 1946; Bricker and Eiseman, 1950; Gilchrist et al., 1950; Glaser, 1952; Peck and Newland, 1952; Reiger and Weisser, 1952; Jay et al., 1955) employed either ileocaecal, caecocolic or ileocaecocolic regions for bladder substitution after total cystectomy in cases of carcinoma, exstrophy or other incurable anatomical defects. Some of these workers also used this technique during resection of the pelvic viscera. Thus, for complete substitution of the bladder, they used caecum or caecum with ascending colon as a bladder and brought the appendix or terminal ileum to form the urethra.

Due to such anatomical construction of caecum in those subjects, Bourque (1959, 60) also opined that the caecal bladder had been indicated in radical or total pelvic exenteration.

However, in author's opinion the larger size of caecum coupled with its apex which is usually at the right side of the pelvic inlet in close proximity to the bladder would provide a good substitute for bladder in bovine. Thus, keeping in view, the surgical anatomy of the caecum in bovine and successful use of seromuscular grafts from colon or ileum in dogs and human beings prompted the author to apply the same principle of colocystoplasty for caecocystoplasty in buffalo calves.

The surgical technique in the present study of caecocystoplasty involved isolation of a caecal pouch from
the apex but leaving the wall intact on the other side for getting blood supply to the graft. Then the isolated pouch was incised in the middle extending to the apex so as to form an open sheet or flat patch. Thus a square like graft was prepared on the same principle of colocystoplasty with only difference that in the latter experiment graft got nourishment through the mesenteric vessels whereas in the present series through the intact caecal wall.

In author's opinion this type of graft would be feasible for correcting defects of the wall of urinary bladder at any place; where as the method which Prasad et al (1973) had used might be only valuable either for enlarging the bladder capacity or for correcting defects at the vertex, as they used a complete caecal pouch which could be fitted on the vertex side only. As far as isolation of caecal pouch is concerned, the method employed in this series is agreeable to them.

It has been discussed previously while discussing colocystoplasty that many surgeons have used isolated opened segment from ileum or colon in cystoplasty. Due to certain merits of an open loop, Goodwin et al (1958, 59) had also used this method of ileocystoplasty and colocystoplasty to increase bladder capacity and advocated that the 'flap' or 'patch' technique gave more normally responding urinary bladder than the other techniques designated to use the ileum or colon as an intact tube.

The caecal mucosa from the opened graft was
removed on the same line as followed in colocystoplasty. Though, Prasad et al did not strip the caecal mucosa during the experimental studies in buffalo calves, yet in their opinion, removal of intestinal mucosa was essential for checking infection in the mucosa of urinary bladder and complete development of uroepithelium over the graft.

It is evident from the results of the present study that the seromuscular pedicle grafts from the caecum served as satisfactory substitutes for bladder reconstruction in buffalo calves. The technique of caecocystoplasty was easier than colocystoplasty, as the former did not involve the process of intestinal anastomosis. Hence, the fear from secondary complication like stricture, stenosis or obstruction of intestine at the site of anastomosis was obviated.

In the present series of caecocystoplasty, all the animals survived well after operation. In this group mortality rate during the observation period was nil. Alike colocystoplasty an initial rise of temperature for the first few days was noticed in almost all animals, but other secondary complications or untoward symptoms could not be observed in this group. All the animals were active even from the day of operation. They were grazing grasses and taking feed normally after 2nd day of operation.

Fluid therapy was not given to a single animal in this group as they were found apparently active.
and alert even from the day of operation. So, they were only allowed rice gruel and water ad lib.

Estimation of blood urea nitrogen up to the 10th post operative day did not indicate any significant alteration from the normal level. No doubt, it was slightly elevated from the pre operative level but fluctuated within the normal physiologic range like colocystoplasty.

The changes observed during gross examination of the organ were more or less similar to colocystoplasty with only difference that in few cases of this series ecchymotic haemorrhages on the bladder mucosa and peelable necrotic foci on the caecal graft were noticed, even up to the 30th day. Such type of haemorrhages on the bladder mucosa might be due to some bacterial infection invading the host tissue from the graft side. Bacteria harbouring in the caecal mucosa would have been left at the time of mucosal stripping and cleansing of the graft. In author's opinion, this type of haemorrhage was harmless as none of the animals showed any complication or untoward symptoms even up to the 75th day of observation. However, this could be prevented by thorough washing of the graft and by use of some liquid bacteriocistats before grafting. Necrotic foci which were present on caecal graft up to 30th day might be due to effect of urine which is in agreement with findings of Prasad et al (1973).

In the present study of caecocystoplasty, a blind tubular passage was found in the connecting
caecal wall inbetween the caecal stump and grafted bladder in each of the operated animals, but none had developed a vesico caecal fistula. The formation of this blind tubular passage in the connecting caecal wall is one of the indicatives in author’s opinion that the seromuscular caecal flap may also be utilised for reconstructing a part or whole of the ureter in large animals as many surgeons (McLean and Fais, 1952; Foret and Heusghem, 1953; Baum, 1954; Annis, 1956; Pyrah, 1956, 57; Houtapel and Gründemann, 1960; Askari et al., 1964; Gil-Vernet, 1965; Lange and Lindner, 1965; Hatch, 1966; Atwill et al., 1967) replaced it either with a seromuscular tube or isolated intact tube from the bowel in dogs and human beings successfully.

Histological examination from the junctional tissue revealed similar changes as discussed in colocystoplasty. Regeneration of caecal mucosa could not be observed in any case but regeneration of transitional epithelium over the grafted tissue was noticed even from the 30th day and complete development of urothelium on 75th day was evident. Thus, it was clear from the present study that removal of caecal mucosa prior to grafting enhanced the proliferation of transitional epithelium over the grafted tissue from the bladder side.
SUMMARY AND CONCLUSIONS
SUMMARY AND CONCLUSIONS

In bovine, rupture of urinary bladder is a common feature encountered most frequently in the male as sequelae to urethral calculosis. Sometimes it also occurs due to external trauma or violence. Many surgeons have repaired the ruptured bladder by sutures technique; while the others have used either intracystic metal catheter due to poor suture retaining capacity of the bladder tissue or indwelling catheters for easy approach, without closing the vesical rent. But these techniques will not be useful in all the conditions. Hence, the method of colocystoplasty or cecocystoplasty is advocated; and it may be valuable in reconstructing a part or whole of the bladder in many conditions:

(i) In cases of ruptured bladder where self repair or repair by suture technique is not possible.

(ii) In certain pathological conditions like: malignant lymphoma, mucinous adenoma and chronic proliferative lesions of the bladder.

(iii) For correcting large vesical defects either congenital or acquired.

(iv) For enlarging the capacity of the bladder.

In the present study, colocystoplasty and cecocystoplasty were performed on 16 male buffalo calves using 8 animals for each method independently. The technique involved the isolation of an intestinal segment, which was
then opened longitudinally to form an 'open sheet' or 'flat patch' from which mucosa was stripped off and the resulting seromuscular graft was sewn to partially cystectomised bladder. In both the techniques, 2-0 chronic catgut (absorbable) and 3-0 black braided silk (non absorbable) were used for suturing the visceral organs.

The success of cystoplasty was evaluated on the basis of observation and results in respect of clinical manifestations, determination of blood urea nitrogen as well as gross and histopathological examinations for a maximum period of 75 days post operatively. All these observations made throughout the study substantiated the well being of the operated animals with satisfactory results.

**TABLE No.5**

<table>
<thead>
<tr>
<th>Method of cystoplasty</th>
<th>No. of animal showing post operative complication in which reoperation was indicated</th>
<th>No. of non-survivors</th>
<th>No. of survivors</th>
<th>% of survivors</th>
<th>% of unsuccessful cystoplasty</th>
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<tr>
<td>Colo-cystoplasty</td>
<td>8</td>
<td>1</td>
<td>1</td>
<td>7</td>
<td>87.5</td>
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<tr>
<td>Caecocystoplasty</td>
<td>8</td>
<td>-</td>
<td>-</td>
<td>8</td>
<td>100</td>
</tr>
</tbody>
</table>

Though, the successes attained in caecocystoplasty was cent percent with no post operative complication, yet the
viability of the graft and the process of repair in the
grafted and host tissue was somewhat superior in colocolosto-
plasty rather than the caecocystoplasty; which might be due
to rich vascularity of the colonic pedicle graft through the
mesenteric vessels.

Microscopical studies revealed complete regeneration
of uroepithelium over the seromuscular graft on 75th post-
operative day.

Detailed surgical techniques, estimation of urea
nitrogen in the blood as well as macro and microscopic
changes are described.

On the basis of the above experimental studies the
following conclusions were arrived at:

1) The seromuscular pedicle grafts from the colon and
caecum served as satisfactory substitutes for bladder
reconstruction in buffalo calves.

2) The technique of caecocystoplasty was easier and safer
than the colocoloplasty.

3) But the viability of the graft and the process of repair
was somewhat superior in colocoloplasty rather than
caecocystoplasty.

4) Non absorbable sutures like Ethicon black braided silk
(No.3-0) can be used safely in urological surgery.

5) For colocoloplasty, it is beneficial and safer to take
an intestinal segment of sufficient length, so that it
should contain intact mesenteric vessels.
(6) To overcome the tension over the graft and for maintaining the viability of the graft in colocolostomy, the mesentery should be incised deeply without interrupting the blood vessels to the graft.

(7) In colocolostomy, great precaution should be taken at the time of intestinal anastomosis.

(8) Complete removal of the intestinal mucosa and thorough cleansing of the graft prior to grafting is essential for the following reasons:

(a) To prevent absorptive and secretive potential of the graft.

(b) For checking infection.

(c) For complete regeneration of uroepithelium over the grafted tissue.

(9) There is no need to use either inverted seromuscular graft, bladder or cutaneous epithelial patch over the seromuscular graft in buffalo calves.

(10) To overcome any type of post-operative visceral complications the mesenteric attachment to the graft can be severed even on the 7th day of operation.

(11) The microscopical studies reveal complete development of uroepithelium over the seromuscular graft on 75th day.

(12) The 'open sheet' or 'flat patch' technique is more feasible than the close loop or using as a complete pouch for reconstructing the bladder wall in colocolostomy and caecocystoplasty respectively.

(13) Although, both the colocolostomy and caecocystoplasty are worthy and feasible in buffalo calves, yet the
latter may be preferred due to the following reasons:

(a) It does not involve intestinal anastomosis.
(b) Caecal stump is closed at the severed end only.
(c) A large caecal segment can be used safely and because of its larger diameter, even a bigger area of the bladder can easily be reconstructed.
(d) There is less chance of intestinal adhesions, as the apex can be brought easily to the operative site without manipulating the other viscera.
(e) There is less tension over the graft after caecocystoplasty.
(f) Operative procedure is less time consuming.
(g) There is no need to fast the animal for a longer period after the operation.

(14) Formation of a blind tubular passage in the connecting caecal wall after caecocystoplasty suggested that an isolated caecal flap or intestinal segment could also be used for reconstructing a part or whole of the ureter in bovine.

Since the studies were conducted on restricted animals, therefore, it requires further experience and elaboration for more details and is awaited for its clinical use in bovine and other animals where ever needed.
GRAPH NO. 1

GRAPHICAL REPRESENTATION OF BLOOD UREA NITROGEN LEVEL IN mg% per 100 ml. OF BLOOD OF EXPERIMENTAL ANIMALS IN COLOCYSTOPLASTY

A = PRE OPERATIVE
B = POST OPERATIVE
(Average)

50 -
45 -
40 -
35 -
30 -
25 -
20 -
15 -
10 -
5 -
0 -

Sub-Group - IA
A B A B A B A B A B

Sub-Group - IB
A B A B A B A B A B
GRAPH SHOWING PRE AND POST OPERATIVE TEMPERATURE OF EXPERIMENTAL ANIMALS.

GRAPH NO. 3

BUFF. CALF NO. 4

BUFF. CALF NO. 3

BUFF. CALF NO. 2

BUFF. CALF NO. 1

*No. 3 died on 3rd post-operative day.
GRAPH NO. 3

Graph showing pre and post-operative temperatures of experimental animals.

BUFF. CALF NO. 16

BUFF. CALF NO. 15

BUFF. CALF NO. 14

BUFF. CALF NO. 15

The OP. POST OPERATIVE DAYS
PERCENTAGE OF SUCCESS (2 LARGER SQ. = 10%)
Plate No. 1
Showing the operative area covered with sterile drape.

Plate No. 2
Showing the stage of skin incision.
Plate No. 3

Showing the skin, muscle and peritoneum all incised and reflected.

Plate No. 4

Showing a portion of the colon which is isolated with the help of four rubber suction Doyen's intestinal clamps.
Plate No. 5

Showing selected portion of the colon that is freed from the intestinal tract with its blood supply intact through the mesenteric vessels.

Plate No. 6

Showing continuation of end-to-end intestinal anastomosis.
Plate No. 7

Showing complete anastomosis of the intestine and vent in the mesentery which is closed by interrupted sutures.

Plate No. 8

Showing cutting longitudinally along the antimesenteric border of the isolated colonic segment with scissors.
Plate No. 9
Showing mucosal stripping from the opened sheet of isolated colonic segment after holding the corners with 4 artery forceps.

Plate No. 10
Showing free end (apex) of the caecum which is selected and isolated with the help of two rubbershod Doyen's clamps.
Plate No. 11

Showing selected portion of the caecum sectioned in between the two adjacent clamps keeping the blood supply intact through the intact caecal wall on the other side.

Plate No. 12

Showing opening of the caecal stump completely closed.
Plate No. 5

Showing selected portion of the colon that is freed from the intestinal tract with its blood supply intact through the mesenteric vessels.

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Plate No. 12

Showing opening of the caecal stump completely closed.
**Plate No. 13 a.**

Showing cutting in the middle of the freed wall of the isolated caecal pouch towards the apex with scissors.

**Plate No. 13 b.**

Showing freed wall of the isolated caecal pouch which is cut up to the apex to form an 'open sheet'.
Plate No. 14.
Showing mucosal stripping from the opened sheet or flat patch of the isolated caecal segment after holding with 4 artery forceps fitted at corners.

Plate No. 15
Showing a square shaped area of the bladder wall removed completely and vent created for reconstruction.
Plate No. 16

Showing suturing of the wall of the bladder and margin of the opened colonic graft continued.

Plate No. 17

Showing completely repaired damaged area of the bladder after colocystoplasty and graft attached with the mesentery carrying the intact mesenteric vessels.
Plate No. 18
Showing suturing of the bladder-wall and margin of the opened caecal graft continued and carried out towards the vertex side.

Plate No. 19
Showing the damaged area of the bladder completely repaired after caecocystoplasty and attached only with the intact caecal wall for getting nourishment.
Plate No. 20
Showing complete closure of the skin incision.

Plate No. 21
Showing 2-0 Ethicon chronic catgut (absorbable) and 3-0 Ethicon black braided silk (non-absorbable) used for suturing the vesical organs.
Plate No. 22

Showing one of the experimental animals in normal general condition and health on 75th day of colocystoplasty.

Plate No. 23

Showing completely healed bladder attached only with long elongated mesenteric blood-vessel of increased length on 75th post-operative day of colocystoplasty.
Plate No. 24

Showing completely healed bladder on 15th post operative day of caecocystoplasty.

Plate No. 25

Photomicrograph from the junctional area of the colonic graft on 15th day of cystoplasty using 2-0 chromic catgut showing not clearly discernible epithelium on either side of the zone of junction and marked infiltration of lymphocytes. (H. & E. 10X10).
Plate No. 26
Photomicrograph of the grafted colon on 75th day of cystoplasty using 2-0 chronic catgut which shows completely developed transitional epithelium over the grafted part and presence of few blood vessels. (H. & E. 10X10).

Plate No. 27
Photomicrograph from the junctional area of the colonic graft on 30th day of cystoplasty using 3-0 black braided silk showing the development of transitional epithelium over the grafted part but in lesser thickness as compared to the bladder side. (H. & E. 10X40).
Plate No. 23

Photomicrograph from the junctional area of the colonic graft on 75th day of cystoplasty using 3-0 black braided silk showing a few blood vessels and completely developed transitional epithelium. (H. & E. 10X10)

Plate No. 29

Photomicrograph from the junctional area of the cecal graft on 15th day of cystoplasty using 2-0 chronic catgut showing the epithelium which is not clearly visible on the grafted side but its thin layer is marked on the bladder side and infiltration of lymphocytes and blood vessels is noted. (H. & E. 10X10)
Plate No. 30

Photomicrograph from the junctional area of the grafted cecum on 30th day of cystoplasty using 2-0 chronic catgut showing development of transitional epithelium over the grafted part and presence of lymph nodule under the epithelium. (H. & E. 10X10).

Plate No. 31

Photomicrograph from the junctional area of the cecal graft on 15th day of cystoplasty using 3-0 black braided silk showing very thin layer of epithelium on the bladder side and a portion of it may be seen migrating at the junctional point. A large number of lymphocytic infiltration and presence of suturing material at one of the lower corners are also marked. (H. & E. 10X10).
Plate No. 32

Photomicrograph from the junctional area of the cecal graft on 90th day of cystoplasty using 3-0 black braided silk showing development of transitional epithelium on the grafted part. (H. & E. 10X10).

Plate No. 33

Photomicrograph from the junctional area of the cecal graft on 95th day of cystoplasty using 3-0 black braided silk showing well developed transitional epithelium over the grafted part. (H. & E. 10X10).
BIBLIOGRAPHY
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<th>Author(s)</th>
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<td>and Macris, S.G.</td>
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<td>Author(s)</td>
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<td>Reference</td>
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<td>---------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Forrest, J. and Heusghem, C.</td>
<td>1953</td>
<td>Replacement of both ureters by an ileal graft. The Lancet, 1: 1181.</td>
</tr>
</tbody>
</table>


(L Personal communication).


Orr, L.M., Thomley, M.W. (1958) and Campbell, J.L.  
Illeocystoplasty for bladder enlargement.  

Oser, B.L. (1965)  
Hawk's Physiological Chemistry.  
The Blakiston Division,  

A report on 93 ileal loop urinary diversions.  
J. Urol., 83: 593-603.

Parkhurst, E.C. (1968)  
Experience with more than 500 ileal conduit diversions during a 12-year period.  

Parsons, F.M., Powell, F.J.N. and Pyrah, L.N. (1952)  
Chemical imbalance following ureterocolic anastomosis.  
The Lancet, 2: 599-602.

Paull, D.P. and Hodges, C.V. (1955)  
The rectosigmoid colon as a bladder substitute.  

Peck, M.B. and Newland, D.E. (1952)  
Substitute for urinary bladder.  

Perlmann, S. (1927)  


Remedi, V.  
Reversed seromuscular grafts in urinary tract reconstruction.  
J. Urol., 74: 455.

Uroepithelial lined ileal segment as a bladder replacement.  

Rifaat, M. A.  

Rubin, S. W.  
(1943)  The formation of an artificial urinary bladder with perfect continence: An experimental study.  

Runnels, R. A., Monlux, W. S. and Monlux, A. W.  

Scheele, E. K.  
Use of segments of small and large intestine in urological surgery  
with special reference to problem of ureterocele anastomosis.  
J. Urol., 78: 683.

Schmiedt, E.  
(1961)  The importance of large intestine for plastic urology.  
(Personal communication).

Sebenning, W.  
Regeneration of subtotally cystectomized bladder patched with  


<table>
<thead>
<tr>
<th>Author(s)</th>
<th>Year</th>
<th>Reference</th>
</tr>
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