INTRODUCTION

Bladder rupture is the frequent acute abdomen of urology, and it’s usually caused by trauma, road accident, gunshot and iatrogenic operation. The bladder is the most common injury in genitourinary organ that from blunt pelvic trauma. Bladder trauma is seldom an isolated injury and it is frequently missed in poly-trauma cases because we pay more...
attention to life-threatening injuries like head
injury, tension pneumothorax, hemothorax and
hemoperitoneum.\textsuperscript{2,8,9} Bladder rupture caused by
transurethral clot evacuation is rare in clinic, but
an emergency operation is indeed needed in the
patient with bladder rupture. In this study, we
analyzed the reasons of patients with bladder
rupture caused by transurethral clot evacuation,
and provided the countermeasures to prevent the
iatrogenic damage of bladder while doing the
transurethral procedure using the endoscope.

METHODS

The study was approved by the Institutional
Ethics Committee on September 6\textsuperscript{th}, 2020
from The Second Hospital of Hebei Medical
University, and written informed consent was
obtained from all participants.

We retrospectively reviewed the records of 287
patients, who had bladder tamponade resulting
from clots of blood for various kinds reasons
and underwent transurethral clot evacuation
from January 2007 to January 2019. We noted
six cases (2.1\%) with bladder rupture. General
information, such as age, gender, and cause of
bladder tamponade, was collected for all patients.
Bladder rupture in the six cases occurred when
they underwent transurethral clot evacuation
using cystoscopes sheath or resectoscope
sheath and Ellik flusher. Supra-pubis bladder
paracentesis hadn’t performed preoperatively. Of
the 6 patients, one appeared bladder tamponade
resulting from abundant of clots of blood when
he engaged in out-of-bed activity after three days
of percutaneous nephrolithotomy (PCNL), one
appeared bladder tamponade because of tardive
hemorrhage after seven days of PCNL, One
presented with massive hemorrhage after 13 days
of transurethral resection of prostate (TURP), two
patients whose bladder ruptured
intraperitoneally were changed to open surgery
to repair the bladder and clear the remanent
blood clots. The peritoneal cavity was opened
to clear the clots coming from the bladder crack
and the seroperitoneum. The urinary catheter
and bladder paracentesis catheter were detained
simultaneously after operation. Two patients
with extraperitoneal bladder rupture and a small
bladder crevasse underwent a conservative
therapy. Supra-pubis bladder paracentesis was
performed, and then under the monitoring of
cystoscopes, clot retention was successfully
evacuated using the suction through the tunnel
of bladder paracentesis. Ultimately, the urinary
catheter and bladder paracentesis catheter were
detained simultaneously. After operation, all
the six patients were given continuous bladder
irrigation, anti-inflammatory, hemostasis, fluid
infusion and other supporting therapies. Bladder
irrigation was suspended after one or two days
when the rinse solution was not red. Three
to five days after the operation, the catheter
clipping was performed within 24 hours before
the removal of the catheter to train the bladder
function. However, the paracentesis catheter was
reserved one month. Micturitional function and
urine storage function of the six patients were not
influenced finally.

RESULTS

Bladder rupture occurred in 6 of 287 patients,
and they were all male with their age from 28 to
76 years (mean 56.67±17.76). The analysis of the
reasons of the clinical characteristics of bladder
tamponade (Table-I), the correlation between
the incidence rate of bladder rupture and the
clinical characteristics variables of patients was
evaluated. The incidence of bladder rupture
was not associated with the reason of bladder
tamponade and the age, but may be associated
with gender, bladder paracentesis preoperative
and urinary retention preoperative.

The analysis of the characteristics of the patients
with bladder rupture caused by transurethral
Bladder Rupture with Transurethral Clot Evacuation

Table-I: Characteristics of bladder tamponade

| Clinical characteristics | Case no. (n=287) | Bladder rupture no. (n=6) |
|--------------------------|------------------|-------------------------|
| Age                      |                  |                         |
| ≤60                      | 112              | 2                       |
| >60                      | 175              | 4                       |
| Gender                   |                  |                         |
| Male                     | 219              | 6                       |
| Female                   | 68               | 0                       |
| Reason of Bladder Tamponade |                |                         |
| PCNL                     | 42               | 2                       |
| TURP                     | 216              | 3                       |
| Other                    | 29               | 1                       |
| Urinary retention preoperative (Yes or No) | |                         |
| Yes                      | 79               | 6                       |
| No                       | 208              | 0                       |
| Bladder paracentesis preoperative (Yes or No) | |                         |
| Yes                      | 62               | 0                       |
| No                       | 225              | 6                       |

Clot evacuation (Table-II), we observed that all six cases were male and the age had no obvious feature and had different extent urinary retention before operation. No Supra-pubis bladder paracentesis was performed preoperatively. The bladder crevasses located in the triangle zone and posterior wall of bladder entirely, and the length of the bladder crevasses range from 3 to 7cm (mean 4.83cm). Four cases’ bladders ruptured intraperitoneally while another two presented an extraperitoneal bladder rupture.

DISCUSSION

Bladder tamponade is a frequent complication of urologic disease and it must be managed urgently.3,10 Bladder tamponade will happen all sorts of urologic surgery including open surgery and endoscopy surgery.2,11,12 Blood clots will accumulate in bladder at the last, no matter bleeding appears in upper urinary tract or lower urinary tract, and this will result in bladder tamponade and urinary retention in succession, while a surgery is often indeed needed.2,10,11 Studies have reported rectal tube, catheter irrigating syringe, 6-hole irrigation catheter which were all successfully used for clot retention.13,14 Recently, with the enormous development of intracavity technique and equipment, the majority can be managed by transurethral clot evacuation using cystoscopes sheath or resectoscope sheath and Ellik flusher, except a few who underwent long time bleeding resulting in hematoma which need open surgery. It is easy to accept by patients because of its low side effects and no incision. Yu HS et al.14 reported a so-called “suction and fishing method” for severe clot retention. As a result, all the patients’ blood clots was successfully eliminated. Others reported applying stronger suction pressure through the cystoscope sheath in patients who had failed clot evacuation using the traditional Ellik evacuator, and all patients were rendered clot free.13 The operation may lead to bladder rupture is a new problem.15,16 The incidence of bladder rupture was 2.1% in 287 patients enrolled in this study. The incidence

Table-II: Characteristics of bladder rupture.

| Serial No. | Age (year) | Sex | Reasons of bleeding | Urinary retention preoperative (yes or no) | Bladder paracentesis preoperative (yes or no) | Location of the bladder rupture | Length of the rupture (cm) | Intraperitoneal or extraperitoneal |
|------------|------------|-----|---------------------|--------------------------------------------|-----------------------------------------------|-------------------------------|---------------------------|----------------------------------|
| 1          | 28         | Male | 7 days after PCNL   | Yes                                        | No                                            | Triangle zone and posterior wall | 5                         | Intraperitoneal                  |
| 2          | 43         | Male | 3 days after PCNL   | Yes                                        | No                                            | Triangle zone and posterior wall | 7                         | Intraperitoneal                  |
| 3          | 76         | Male | 13 days after TURP  | Yes                                        | No                                            | Triangle zone                  | 3                         | Extraperitoneal                  |
| 4          | 61         | Male | Bleed of Pca        | Yes                                        | No                                            | Triangle zone and posterior wall | 5                         | Intraperitoneal                  |
| 5          | 65         | Male | 2 days after TURP   | Yes                                        | No                                            | Triangle zone and posterior wall | 4                         | Intraperitoneal                  |
| 6          | 67         | Male | 1 days after TURP   | Yes                                        | No                                            | Triangle zone                  | 5                         | Extraperitoneal                  |
of bladder rupture was not associated with the reason of bladder tamponade and the age, but may be associated with gender, bladder paracentesis preoperative and urinary retention preoperative. We conclude the following viewpoints through our analysis and summary:

1. The bladder rupture is usually induced by intraoperative misoperation.
2. Generous blood clots influence the legibility of the visual fields of endoscopy, and the violent suction while the sheath of cystoscopes holds out against the bladder wall, bladder rupture may appear finally.
3. Bladder tamponade will result in urine retention, and then muscle fibers of the bladder will be obviously damaged when bladder volume stretches rapidly. It may induce bladder injure more easily under the damage of external force.
4. It will accumulate more and more gas while we are using Ellik to wash bladder, and thus increase the tension of the bladder wall.
5. Bladder rupture often appears in the triangle zone and posterior wall on the ground that the sheath of cystoscopes is much easier to damage there during the processes of suction.
6. During our study we observed that the patients were all male, bladder rupture may relate to the long urethra of male, and thus might easily lead to hypertonic bladder induced by the accumulation of gas and fluid. It was difficult to observe hypertonic bladder when the patients were females because of their short urethra, so the probability of bladder rupture reduced greatly.

In view of the above we suggest that to avoid bladder rupture:

1. Decrease movement of cystoscopes sheath or resectoscope sheath to avoid physical damage to bladder.
2. We must release the majority of the gas and fluid in the bladder through cystoscopes sheath or resectoscope sheath to make sure we have a hypisotonic bladder.
3. Slight and multiple bladder irrigation using Ellik are indeed needed.
4. Don’t scruple to perform the supra-pubis bladder paracentesis because the little damage will bring about enormous bench. We not only always use it to keep a hypisotonic bladder throughout the operation, but also to settle the bladder tamponade by using the wall suction through the tunnel of bladder paracentesis under the monitoring of cystoscopes.

We should decide to use expectant treatment or open surgery immediately according to the extent of the rupture when bladder rupture occurs. Patients who have extraperitoneal bladder rupture but the bladder crevasses are small (less than 3cm) will undergo a conservative therapy. The urinary catheter and bladder paracentesis catheter are detained simultaneously to let bladder recover itself. However in those patients with big and/or intraperitoneal crevasses, the selection of open surgery is advisable. We cannot only handle their bladder ruptures and clear the remanent blood clots, but also clear the clots crack and the seroperitoneum coming from bladder simultaneously since the peritoneal cavity was opened.

**Limitations of this study:** Although 287 subjects were included in this study, only six cases could be found to analyze the factors related to bladder rupture, so the research conclusions drawn from this study were limited in persuasion. We look forward to start multicenter clinical studies in the future to further expand the sample size.

**CONCLUSIONS**

The reasons of bladder rupture caused by transurethral clot evacuation may be associated with gender, bladder paracentesis preoperative and urinary retention preoperative. We should decide to use expectant treatment or open surgery immediately according to the extent of the rupture when bladder rupture occurs.

**Source of funding:** None.

**Conflicts of interest:** None.

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KL L, XW and JC Q designed and performed the experiments, prepared the manuscript, and are responsible and accountable for the accuracy or integrity of the work. CB Q conducted the experiments and revised the manuscript. All authors have read and approved the final manuscript.

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