



Novel Technique to Remove Specimen Using Capillary Action during Transurethral Resection Surgery

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Abstract

Purpose: Conventional methods of mechanical suction such as Ellik evacuator and Toomey syringe for clots evacuation or specimen removal with bladder retention or resected masses from endoscopic surgery has risk of bladder perforation. The purpose of this study was to devise a novel method to remove specimen easily without causing complications.

Materials and Methods: Trans Urethral Resection of Bladder Tumor (TURBT) was performed for patients with bladder tumors. Resected tumor masses were removed using a novel technique with capillary action.

Results: The novel technique to remove specimen involved the following five steps. First, tumor masses are resected with a resectoscope having wire loop and electro coagulation is performed for the bleeding point. Second, the valve of irrigation line is locked to prevent distention of bladder. Third, the resectoscope is taken to be close to the specimen. Fourth, the resectoscope is pulled half way back from the sheath to form capillary pressure. Fifth, specimens are spontaneously drained by capillary action.

Conclusion: A novel technique to remove specimen from TURBT using capillary action without mechanical suction such as Ellik evacuator or Toomey syringe was developed. In addition to specimen removal, stone fragments and clots could be easily removed without causing complications.

Keywords: Capillary action; Drainage; Suction; Transurethral resection

Introduction

Trans Urethral Resection of Bladder Tumor (TURBT) and Trans Urethral Resection of Prostate (TURP) are the most common urologic procedures [1-3]. Effective urinary bladder evacuation and irrigation have significant impacts on patient safety and outcomes [4,5]. Failure to achieve complete drainage of resected mass is an important cause of postoperative clot retention [6,7]. A large multi-center retrospective study has reported that the incidence of clot retention after TURP is about 3.3% [8,9]. Clot retention can also cause severe pain, tachycardia, hypertension, bladder rupture, and perforation [7]. The most commonly used method of evacuation of resected mass by TUR or clot retention management is cystoscopic evacuation using mechanical suction such as Ellik evacuator or Toomey syringe [10]. However, these methods can cause serious side effects such as bladder mucosal injury, bleeding, bladder rupture and perforation [10]. In addition to mechanical suction, intravesical instillation of chemicals such as hydrogen peroxide, streptokinase, tissue plasminogen activator, and pancreatic enzymes has also been used [11-13]. However, these methods have limitations in removing large and hard clots [14]. The objective of this study was to develop a novel and simple technique for spontaneous drainage through capillary action using conventional cystoscope sheath or resectoscope sheath without compulsory pressure by mechanical suction.

Materials and Methods

After lithotomy position under general anesthesia, aseptic skin preparation and draping were performed. A lubricant was injected into the urethra and a sheath with obturator (KARL STORZ, Germany) was inserted into the urethra. Irrigation line, light cable, and monopolar electrode were connected to the instrument. A resectoscope (KARL STORZ, Germany) was inserted and the inside of the bladder was observed. Tumor mass was subjected to transurethral biopsy with biopsy forceps. Transurethral coagulation was performed for the bleeding point. Tumor mass was identified and transurethral resection was performed. Resected mass and clots were removed using a novel technique through capillary action without mechanical suction such as the use of Ellik evacuator

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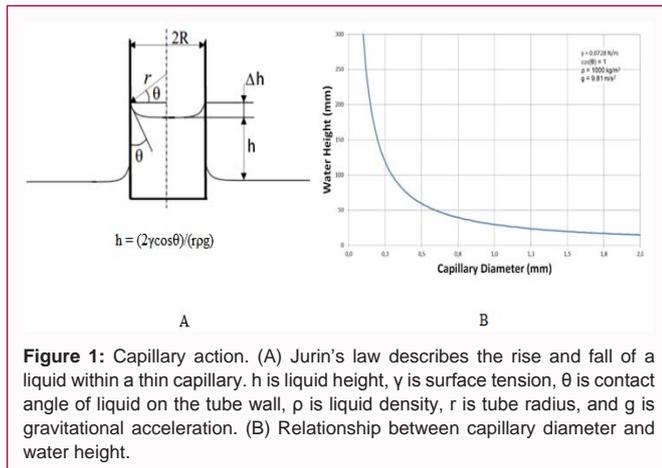
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or Toomey syringe. The specimen was completely removed and the operation was terminated after confirming no bleeding. The following is a detailed description of the novel technique to remove specimen with five steps (Figure 1A and 1B).

Results

Mass resection with resectoscope

First, tumor mass was confirmed and transurethral biopsy was performed using biopsy forceps (Figure 2A and 2B). Remaining tumor masses were then resected using a monopolar resectoscope. Transurethral coagulation was performed for the bleeding point (Figure 2C).

Stop irrigation

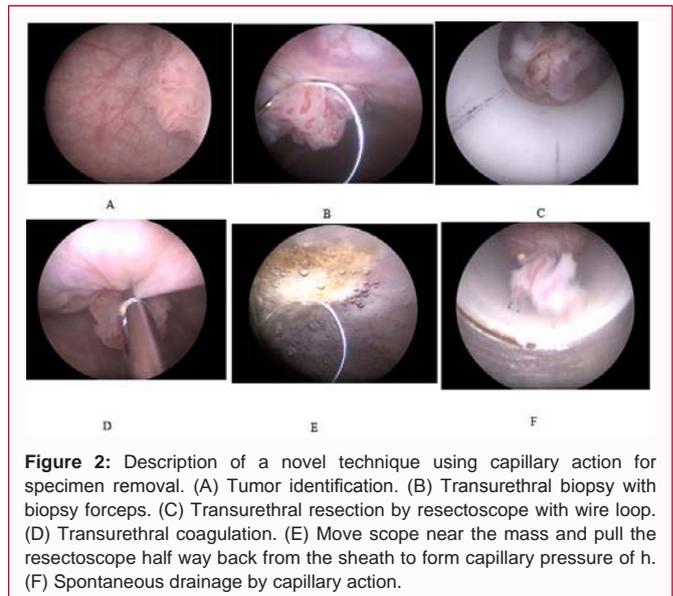
Lock the valve of irrigation line so that the bladder does not distend. However, if there is no water in the bladder, fill an appropriate amount of water.

Moving the scope around resected mass

Find the resected mass or clots and bring a resectoscope near it.

Formation of capillary action

Pull the resectoscope half way back from the sheath to create capillary pressure (Figure 2D and 2E). Capillary action refers to a phenomenon when the capillary is placed in the liquid and the liquid level in the tube becomes higher or lower than the liquid level outside the tube or it refers to a phenomenon when the liquid that fills the thin tube goes up or down by attractive force between molecules or attraction between molecules and the wall of the thin tube. When liquid is placed on the lower end of a vertical glass tube (capillary), a meniscus is formed. The height of the liquid column is given by Jurin's Law (Figure 1A) [15]. Surface tension γ acts at an angle θ from the pipe wall on the circumference of the top of liquid column. Since the liquid column is stationary, weight (left side) of the liquid column itself and the force due to surface tension (right side) are the same. The height h of the meniscus is shown in Figure 1A. The height h of the meniscus is inversely proportional to the radius r of the capillary (capillary phenomenon is better in a narrow tube) while the weight of the liquid column is proportional to the square of the capillary radius r^2 (Figure 1B). Under standard laboratory conditions, air inlet tubes are filled with water at $\gamma=0.0728$ N, $\rho=1000$ kg/m³, and $g=9.81$ m/s². The relationship between the height of water column and tube diameter is shown in Figure 1B. As shown in Figure 2A and a video clip, capillary pressure due to capillary action which is as much as the



distance of the resectoscope in the sheath can be confirmed.

Spontaneous drainage of clots

As shown in Figure 2F and the video clip, clots can be spontaneously drained by capillary action. Drainage occurs spontaneously by the formed capillary pressure near the specimen when the sheath is moved to the left and right. If the resected mass or clots are slightly larger to drain, the resectoscope is pulled back further in the sheath to form a larger capillary pressure in step 4. This is because greater pressure will facilitate drainage if the scope is brought close to clots. In addition, when the assistant gently presses the bladder at the same time with their hands, a larger pressure can be created and clots can be pushed out. If the mass or clots are pushed out, leave the sheath intact and remove the resectoscope completely to identify the mass that has been pushed out.

Discussion

The objective of this study was to develop a novel technique to spontaneously drain clots or resected mass during TURBT or TURP by capillary action formed between the sheath and the resectoscope without mechanical suction. The most commonly used method to evacuate resected mass or clot by TUR is through cystoscopic evacuation using mechanical suction such as Ellik evacuator or Toomey syringe [10]. However, the most serious side effect of using these methods is bladder rupture or perforation by suction pressure [10]. When using an Ellik evacuator, a negative pressure of 250

mmHg or more may be applied [10]. Bladder perforation may also occur when bladder is pumped to the bulb of a Toomey syringe or Ellik evacuator with the bladder distended [10]. Therefore, a suction bridge is connected to a mechanical evacuator and a suction method is simultaneously carried out with a pressure of 250 mmHg to 400 mmHg [10]. However, this is dangerous because it will create highly negative pressure. Apul Goel et al. [14] have reported that old, large, and hard clot could be removed with a moderately negative pressure (150 mm Hg to 250 mm Hg) over a 25-F cystoscopic sheath or 26-F resectoscopic sheath using a traditional Ellik evacuator. Ho Song Yu et al. [16] have developed suction and fishing method with a catheter connected with wall suction on the highly organized clot evacuation. Since all these methods require negative pressure above a certain pressure, there is a risk of bladder mucosal injury or perforation. Takeshita et al. [17] have reported a simple technique for evacuating air bubbles with scum from the bladder dome using routine resectoscope. However, it has limit to remove clots or tumor masses. In this study, we developed a simple technique for spontaneous drainage using capillary action of sheath and resectoscope without mechanical pressure. This technique does not involve forced or negative pressure. There were no intraoperative or postoperative complications. No extra equipment is needed. It is excellent for reducing cost of an operation. This technique can also be applied to remove stone fragment after cystolitholapaxy for bladder stone or prostatic stone. It can also be used to remove remnant mass and clots after TURP or HoLEP operation with BPH. This study has several limitations. First, this novel technique could not remove large amounts of clots at once because there is no large pressure like mechanical evacuator such as Ellik evacuator or Toomey syringe. Therefore, it might have limit to manage clot retention. However, it may be powerful to remove small remnant mass that causes intraoperative and postoperative clot retention without having complications. Second, there was a lack of data collection to objectively demonstrate the performance of the technology, such as the amount or number of masses that can be removed, the time taken to completely remove, and so on. We plan to collect more specific data for more patients in the future.

Conclusion

We developed a novel and handy technique that could spontaneously drain specimen using a capillary action without mechanical suction such as Ellik evacuator or Toomey syringe. This technique could be used to safely remove specimen, clots, and fragmented stones after endoscopic surgery without causing complications because there is no strong negative or pumping pressure.

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Supplementary Materials

The supplementary video clip for novel technique to remove specimen using capillary action during transurethral resection surgery.

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