

# Endoscopic laser en bloc removal of bladder tumor. Surgical radicality and improvement of the pathological diagnostic accuracy

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**Summary** Introduction: Bladder cancer is one of the most common tumors among the general population. The first surgical approach to the tumor is often the transurethral resection with monopolar or bipolar loop.

Recently, laser energy has become an alternative for resection of small bladder tumor, because it allows to obtain high quality samples with the "en bloc" technique. Our study aims to show the results of endoscopic diode laser treatment of bladder tumor up to three centimeters in maximum diameter.

Materials and methods: 189 patients underwent "en bloc" resection with diode dual length laser (980 nm-1470 nm). Follow up was over 12 months. Patients age range was from 45 to 75 years. Maximum diameter of the lesions was 3.0 cm. For each patient, a cold forceps biopsy sample was performed.

Results: All samples collected presented detrusorial layer.

Pathological exam showed: 28 (14.8%) Ta, G1-G2; 7 (3.7%) T3, G2-G3; 14 (7.4%) T1, G2-G3 and 140 (74.1%) Ta, G2-G3.

No complications occurred during or after surgery. At a median follow-up period of 6 months, we had no recurrence in the previous site of tumor. In the follow up at 3/6/12 months in 4 cases we had recurrence in different sites of bladder wall.

Conclusions: Laser "en bloc" resection is an effective, feasible, and safe treatment for bladder tumor. It could be a valid alternative to monopolar and bipolar resection in small bladder cancer treatment.

**KEY WORDS:** Laser; Bladder tumor; Endoscopic resection; En-bloc; Diode.

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## INTRODUCTION

Bladder cancer is one of the most common tumors of the genitourinary system. More than 81.000 new cases resulting in 17.100 deaths have been estimated in 2022 in the United States (1). Moreover, bladder cancer confers the largest financial burden per patient of all types of malignant tumors. This is because of its high recurrence and progression rate, which requires lifelong monitoring and repeated treatment (2). Most cases (75%) are non muscle-invasive bladder cancer (NMIBC), and transurethral resection of bladder tumor (TURBT) is regarded as the standard diag-

nostic and therapeutic method even if, this technique, has been associated with significant complications (bleeding, bladder perforation, obturator nerve reflex, and even bladder explosion) (3). Another problem is incomplete primary endoscopic resection with absence of muscle tissue in the samples and uncertainty of the margins, which often leads to reprogramming, especially in T1, a second look TUR after forty days from the first intervention, with an increase in costs for public health and discomfort for patients, especially in this period of pandemic not yet fully resolved (4). We know that TURBT "incising and scattering" procedure contradicts the basic surgical oncologic principles of take out the tumor "en bloc" with sure margins of resection and histopathology evaluation of wall invasion. Another problem is the possible seeding of exfoliated cancer cells (5). Each urologist has his/her own experience in endoscopic treatment of bladder tumors, which refers, in particular, to the type of energy used during the surgical procedure. Monopolar energy in cutting loop is the most used current for the treatment of NMIBC although it is correlated with some adverse events including blood loss or disorder of electrolyte balance for mannitol absorption. Recently, use of bipolar energy has spread due to reduced risk of metabolic alterations and improved precision of resections (6-8).

In 1984, Food and Drug Administration (FDA) approved the use of laser in bladder resection. In the last 10 years, various types of laser energy have been used for the endoscopic treatment of bladder cancer, due to their efficient tissue vaporization and hemostatic effect as well as high safety (Holmium and Thulium, in particular).

The use of laser surgery helps in "en bloc" resection and can provide an intact tissue specimen for a more accurate pathological evaluation; it also reduce the risk of dissemination of malignant cells (9-11).

Our study, therefore, aims to verify if diode laser "en-bloc" surgery of bladder tumors could be able to improve the diagnostic rate and to reduce the risk of positive margins and incomplete resection of the bladder base implant of the neoplasm.

We want also to evaluate safety and reduction of catheterization and hospitalization time.

No conflict of interest declared.

## MATERIALS AND METHODS

From January 2015 to February 2022, 189 patients underwent “*en bloc*” resection with the laser. Random cold forceps biopsy samples were also taken. The total operation time, pathologic result, and intraoperative and post-operative complications were recorded. Each patient was followed up for  $\geq 12$  month.

Patients age range was from 45 to 75 years, and 20% of patients were females.

We used a diode dual length laser (980 nm-1470 nm). The two waves length can be freely mixed. A power of 15/20 watts with a mix of 85% of 980 and 15% of 1470 was used. The conical front emitting laser fiber of 1000 micron was used. We treated bladder tumor of a diameter up to 3.0 cm of maximum diameter. Maximum number of lesions was 2. The time of the operation depended on the size of the neoplasm, from a minimum of 20 min, for neoplasms smaller than one centimeter up, to 45 min for neoplasms with a maximum diameter of 3.0 cm

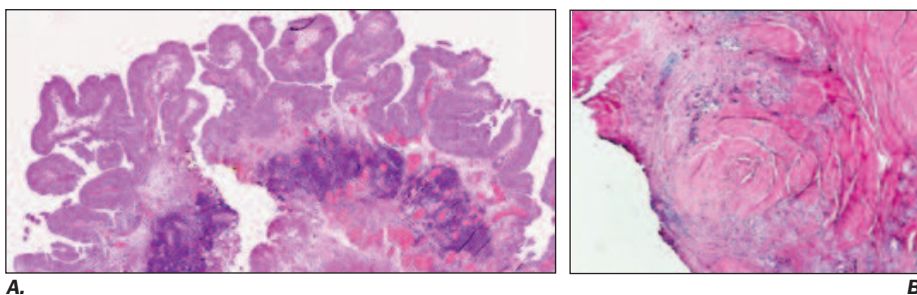
## RESULTS

The “*en bloc*” resection of tumors was successful in all cases. The resected tumors were intact with detectable margins and the detrusor muscle architecture was always available for pathologic evaluation. Definitive pathological analysis resulted in: 28 (14.8%) cases of Ta,G1-G2; 7 (3.7%) T2,G2-G3, 14 (7.4%) T1,G2-G3 and 140 (74.1%) Ta,G2-G3 (Figure 1). No complications occurred during or after surgery.

No bladder wall perforation was observed.

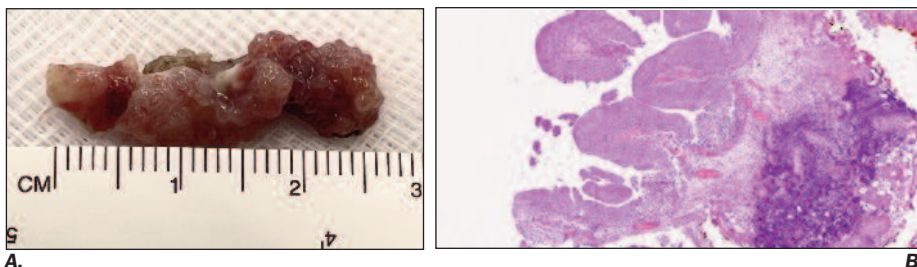
### Figure 1.

A. Low power image of the “*en bloc*” resection of a pTa urothelial papillary carcinoma low grade with intense lymphocytic infiltrate of the suburothelial connective tissue. The tumor is totally resected and the deep resection margin is on normal tissue.  
B. A case of MIBC diagnosed by “*en bloc*” surgery. It was possible to highlight, in a precise way, the depth of invasion of the tumor in the muscular strates of the detrusor (pT2 urothelial carcinoma).



### Figure 2.

A. Anatomic operative specimen obtained by “*en bloc*” removed bladder neoplasia.  
B. A detail of the “*en bloc*” sample showing the deep resection margin on normal tissue (4X).



The specimens were extracted from the bladder cavity from the outer channel of the resectoscope that was used like a trocar. Morcellator was not used.

All patients were able to return home the day after operation without catheter. After patients' dismissal, we observed 2 events of late hematuria, resolved with the recommendation of high hydration. At a median follow-up period of 6 months, we had no recurrence in the previous site of tumor. In the follow up at 3/6/12 months the recurrence in other sites of bladder was of 28 cases without any case of progression.

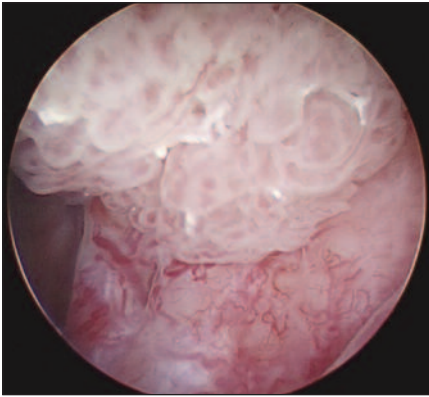
## DISCUSSION

The evolution of technology, over the last few years, has made possible to significantly improve the endoscopic treatment of bladder tumors, especially for NMIBCs.

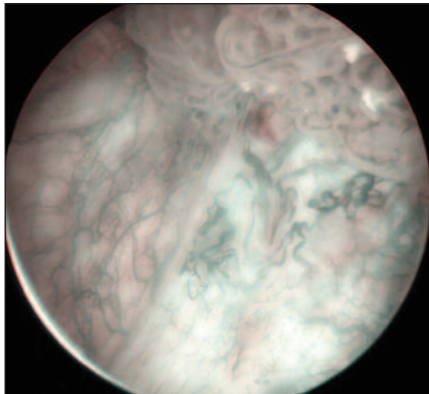
Nowadays, in particular, great attention is given to the use of lasers for the “*en-bloc*” treatment of small bladder tumors. The Holmium and Thulium lasers are of certain efficacy and safety, despite the limited differences in terms of operating time compared to monopolar and bipolar energy (12). On the other hand, improvements have been made in terms of obturator nerve reflex, transient hematuria, postoperative bladder irritation and catheterization and hospitalization time (13). Further advantages of “*en bloc*” resection are samples of better quality and less residual tumor (14).

The diode laser has recently been widely used in the treatment of benign prostatic hyperplasia and showing high efficacy and tolerability (15, 16). The main advantage of the diode laser is its high hemostatic capacity, which makes it more effective especially in patients on antiplatelet and anticoagulant therapy (17). There are currently not many studies regarding the use of diode lasers in the treatment of bladder tumors. Our preliminary data, therefore, appear to be of particular interest as they allow us to observe how this type of laser can also be safely used on bladder wall.

The absence of complications and the precision of the treatment made it possible to obtain samples of excellent quality. In all cases the detrusor layer was included in the sample (Figure 2), avoiding the patient to perform second look TUR. The “*en bloc*” resection, if compared with traditional TURB, allows the histological evaluation of a larger and anatomically oriented portion of the bladder wall. This could increase the detection of small foci of neoplastic cells in the sub-urothelial tissue or in the tonaca muscularis and have an impact in the correct staging of the tumor.



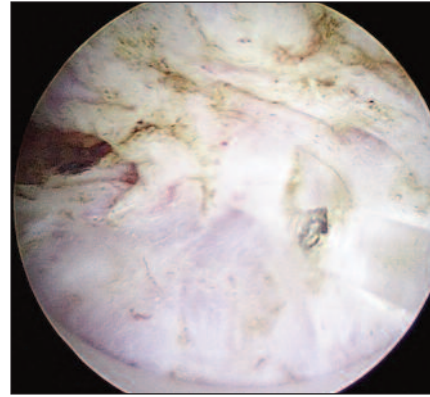
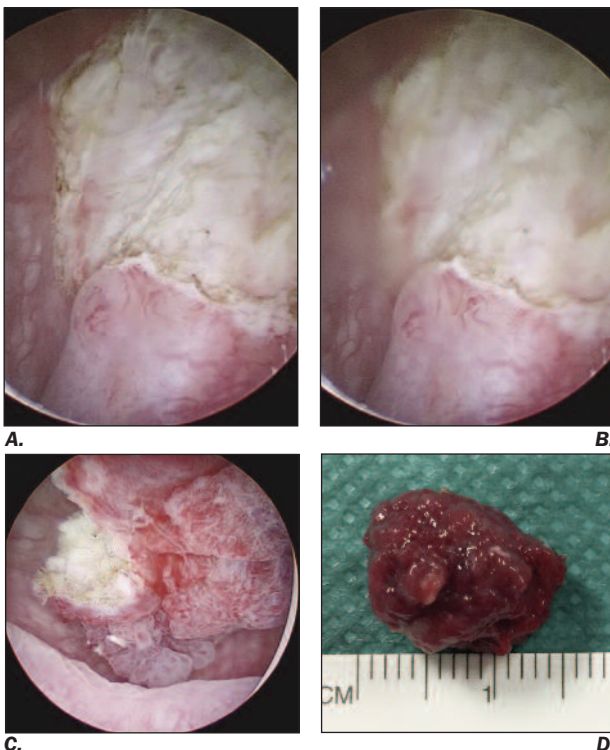
**Figure 3.**  
Bladder tumor that laps the upper border of the left ureteral orifice.



**Figure 4.**  
The use of NBI allows us to better identify the limits of the tumor.

**Figure 5.**

- A. Perfectly spared ureteral orifice with millimeter incision of the neoplasm.
- B. Ureteral orifice preserved during urination.
- C. The tumor resected by *en bloc* technique floating inside the bladder cavity.
- D. Tumor extracted ready to be sent for histopathological examination.



**Figure 6.**  
The tumor with the muscle tissue of the implant base is above the right section of the picture. The laser fiber is used to tension the muscle fibers and better define the incision line.

The limit of “*en-bloc*” method are obviously large tumors, as they cannot be extracted from the resectoscope without causing injury to the sample or having to use a morcellator, which would make the sample not evaluable by the pathologist. According to our experience, the most common sites in which the “*en bloc*” laser surgery of invasive non-muscle bladder neoplasms becomes unsurpassable is when they are located close to the ureteral meatus (Figure 3). We usually use the *narrow band imaging* (NBI) system to better define the margins of the neoplasm that are marked before starting the “*en bloc*” removal procedure (Figure 4).

In doing so, we have never had positive margins. In these cases, it is possible to remove the neoplasm without having to resect the meatus as often happens with traditional surgery (Figure 5).

The most difficult site for tumor removal is the posterior wall. In these cases, an accurate section plane must be achieved by proceeding lateromedially from both sides and subsequently, from bottom to top, to completely eradicate the neoplasm with its implant base. The upper locations, often difficult for traditional surgery, does not present any problem for “*en bloc*” laser surgery. In these cases, we proceed in a proximal distal direction after having identified the right section plane. The neoplasm is gradually pulled from the wall with its implant base until it is completely removed by cutting the flap of mucosa that holds it adhering to the wall. The use of 1000 micron fiber to move or lift the neoplastic tissue adhering to the muscular wall is of great help. The muscle fibers are put in tension and in doing so it becomes easy to proceed quickly in dissecting the muscular plane (Figure 6).

An important trick to have a bloodless field is to gradually photo-coagulate the small vessels that are encountered in the dissection, and which often are identified by transparency, before engraving the tissue.

It should be noted that, based on the reduced thickness of the bladder wall of the woman, when we implement an “*en bloc*” in a female subject, we always operate with a medium-low bladder filling in order not to thin the bladder wall.

### CONCLUSIONS

The results of our study have shown that laser “*en-bloc*” resection is an effective, feasible, and safe alternative to monopolar and bipolar loop energy for bladder tumor resection. It is able to reduce the second-look TURB in

case of T1 or for absence of the muscular tissue in the sample of first resection. It was associated with no complications and allows accurate oncological pathologic evaluation. It is associated to a reduced hospitalization and catheterization time. The laser "en bloc" surgery of NMIBC can be considered, in our preliminary experience, an evolution of endoscopic surgery of bladder cancer.

## REFERENCES

1. American Cancer Society. *Cancer Facts & Figures 2022*. Atlanta, Ga: American Cancer Society; 2022.
2. Richters A, Aben KKH, Kiemeny LALM. The global burden of urinary bladder cancer: an update. *World J Urol*. 2020; 38:1895-1904.
3. Rozanec JJ, Secin FP. Epidemiología, etiología, prevención del cáncer vesical (Epidemiology, etiology and prevention of bladder cancer). *Arch Esp Urol*. 2020; 73:872-878.
4. Cumberbatch MGK, Foerster B, Catto JWF, et al. Repeat transurethral resection in non-muscle-invasive bladder cancer: a systematic review. *Eur Urol*. 2018; 73:925-933.
5. Territo A, Bevilacqua G, Meneghetti I, et al. En bloc resection of bladder tumors: indications, techniques, and future directions. *Curr Opin Urol*. 2020; 30:421-427.
6. Mao X, Zhou Z, Cui Y, et al. Outcomes and complications of bipolar vs. monopolar energy for transurethral resection of bladder tumors: a systematic review and meta-analysis of randomized controlled trials. *Front Surg*. 2021; 8:583806.
7. Burke N, Whelan JP, Goeree L, et al. Systematic review and meta-analysis of transurethral resection of the prostate versus minimally invasive procedures for the treatment of benign prostatic obstruction. *Urology*. 2010; 75:1015-22.
8. Puppato P, Bertolotto F, Introini C, et al. Bipolar transurethral resection in saline (TURis): outcome and complication rates after the first 1000 cases. *J Endourol*. 2009; 23:1145-9.
9. Xu J, Wang C, Ouyang J, et al. Efficacy and safety of transurethral laser surgery versus transurethral resection for non-muscle-invasive bladder cancer: a meta-analysis and systematic review. *Urol Int*. 2020; 104:810-823.
10. Korn SM, Hübner NA, Seitz C, et al. Role of lasers in urology. *Photochem Photobiol Sci*. 2019; 18:295-303.
11. Enikeev D, Shariat SF, Taratkin M, et al. The changing role of lasers in urologic surgery. *Curr Opin Urol*. 2020; 30:24-9.
12. Long G, Zhang Y, Sun G, et al. Safety and efficacy of thulium laser resection of bladder tumors versus transurethral resection of bladder tumors: a systematic review and meta-analysis. *Lasers Med Sci*. 2021; 36:1807-1816.
13. Razzaghi MR, Mazloomfard MM, Yavar M, et al. Holmium LASER in comparison with transurethral resection of the bladder tumor for non-muscle invasive bladder cancer: randomized clinical trial with 18-month follow-up. *Urol J*. 2021; 18:460-465.
14. Hashem A, Mosbah A, El-Tabey NA, et al. Holmium Laser En-bloc resection versus conventional transurethral resection of bladder tumors for treatment of non-muscle-invasive bladder cancer: a randomized clinical trial. *Eur Urol Focus*. 2021; 7:1035-1043.
15. Mithani MH, Khalid SE, Khan SA, et al. Outcome of 980 nm diode laser vaporization for benign prostatic hyperplasia: A prospective study. *Investig Clin Urol*. 2018; 59:392-398.
16. Leonardi R. The LEST technique: Treatment of prostatic obstruction preserving antegrade ejaculation in patients with benign prostatic hyperplasia. *Arch Ital Urol Androl*. 2019; 91:35-42.
17. Zhang J, Li J, Wang X, et al. Efficacy and safety of 1470-nm diode laser enucleation of the prostate in individuals with benign prostatic hyperplasia continuously administered oral anticoagulants or antiplatelet drugs. *Urology*. 2020; 138:129-133.

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