

Efficacy of Narrow Band Imaging (NBI) for bladder cancer inspection and treatment

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NBI is already considered beneficial for detecting early-stage gastroenterological cancer and is an established and widespread method of screening.

More recently, in the field of urology, the benefit of NBI for bladder cancer screening is being proposed.

This presentation is based on an interview with Associate Professor Katsunori Tatsugami, who has presented his findings and has written a clinical paper on diagnosing bladder cancer using NBI. We hope this presentation will help more professionals understand the procedure and the efficacy of using NBI for urological patients.

Doctor's Profile

After graduating Ehime University Graduate School of Medicine in 1993, he joined Department of Urology, Graduate School of Medical Sciences at Kyushu University. Having worked in Kyushu University Hospital, National Kyushu Medical Center, Moji Medical Center and Harasanshin Hospital, he went to U.S. to study at Memorial Sloan Kettering Cancer Center, before assuming the current position of Associate Professor at Department of Urology, Graduate School of Medical Sciences, Kyushu University. He specializes in Genitourinary cancer and has profound knowledge in minimally invasive surgical treatment such as robot-assisted surgery, laparoscopic surgery, and endourological surgery

Characteristics of images seen with NBI

NBI is an optical image enhancement technology that utilizes the characteristics of two specific light bands (415 nm and 540 nm), which are strongly absorbed by hemoglobin and enhance the contrast between blood vessels and other tissues on the mucosal surface (Fig. 1).

Unlike white light imaging (WLI), the short wavelength of blue

light (415 nm) penetrates only the superficial layers of the mucosa and is then absorbed by capillary vessels, whereas the longer wavelength of green light (540 nm) penetrates deeper and is absorbed by blood vessels such as veins. As a result, capillaries on the mucosal surface are displayed in brown on the monitor, and veins in the submucosa are displayed in blue (Fig. 2).

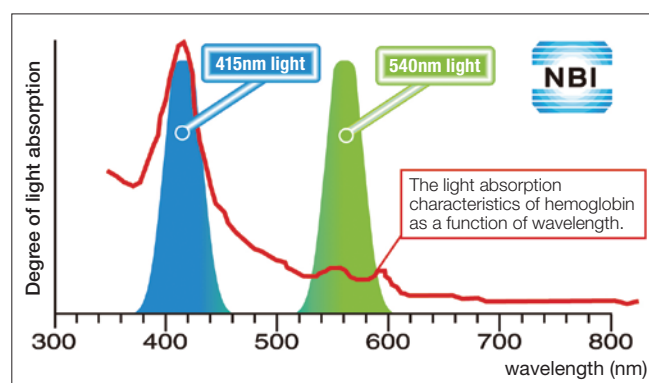


Fig. 1. NBI wavelengths. The narrow-band light is composed of two specific bands that are strongly absorbed by hemoglobin.

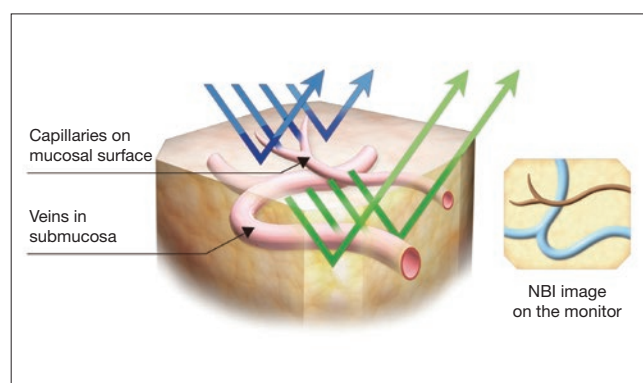


Fig. 2. Left. NBI wavelength being absorbed by tissue. Right. NBI image as seen on the monitor.

NBI Use at Kyushu University

NBI application during outpatient cystoscopic examination

NBI provides higher sensitivity than WLI (Table³) for detecting bladder tumors and is said to be beneficial for carcinoma in situ (CIS) diagnosis. However, highly inflammatory lesions also appear abnormal, even though no tumor may be found. Because NBI provides a high negative predictive value (NPV) and low negative likelihood ratio (NLR), it is considered valuable for excluding a diagnosis of a bladder tumor, including CIS, especially during bladder cancer screening when urinary cytology results are negative. At our hospital we use NBI whenever possible for outpatients and those requiring post-TURBT follow-up with a cystoscopic evaluation.

NBI during cystoscopy can be achieved by simply pushing a button on the camera head or light source to switch from WLI to NBI. Hence, invasiveness for the patient is the same as that experienced with cystoscopy performed under WLI.

After switching to NBI, the whole bladder must be evaluated again. For experienced surgeons, the extra time needed for NBI may be only 1-2 min. If NBI use is incorporated into routine cystoscopic inspection during a bladder tumor diagnosis, it will not be a stressful process.

I am often asked: "What does an abnormal lesion look like under NBI?" I believe, however, that it is more important to recognize normal tissue under NBI in our daily practice. Then, when an abnormal lesion appears under NBI, one can distinguish a tumor from an inflammatory lesion.

NBI application during TURBT

During TURBT, you may find the margins of the tumor more clearly depicted using NBI than with WLI. As this increased

clarity helps to resect the tumor as completely as possible, without leaving residual tissue, I believe NBI assists in performing an adequate TURBT.

At our hospital, it is mandatory to perform NBI during TURBT to confirm the demarcation line between the tumor and surrounding tissue, which is more accurate than with WLI. When undertaking TURBT to remove a bladder tumor, we confirm the abnormal lesion by WLI first and then change to NBI to re-confirm it, as we do with the cystoscopic inspection. In this instance, however, we mark the area required for resection by coagulating the area with a loop electrode under NBI observation.

When using NBI observation, however, bleeding from the resected area may result in a poor view of the field. When this occurs, we revert to WLI after the marking is completed and start the TURBT. After the surgery and the bleeding has stopped, we change back to NBI for a final inspection of the whole bladder to confirm that we left no residual tumor tissue.

Equipment required for NBI

NBI requires a video processor/light source with NBI function (Fig. 3) and a flexible cystoscope (Fig. 4) or camera head (Fig. 5) that are compatible with the NBI system.

NBI function is already standardized in the Olympus HD imaging platform. Therefore, if the system is available, it is highly recommended to use to proactively conduct NBI observation in addition to conventional WLI cystoscopy.



Fig. 3. VISERA ELITE imaging platform with NBI function.



Fig. 4. CYSTO-NEPHRO VIDEOSCOPE OLYMPUS CYF-VHA



Fig. 5. HD CAMERA HEAD OLYMPUS CH-S190-08-LB

Table Detection of bladder tumors by white light imaging (WLI) and narrow-band imaging (NBI) cystoscopy³

Series	No. cases	Cystoscopy	Sensitivity	Specificity	PPV	NPV
Bryan ⁴	29	WLI NBI	82% 96%	79% 85%	70% 61%	81% 92%
Herr and Donat ⁵	427	WLI NBI	87% 100%	85% 82%	66% 63%	96% 100%
Cauberg ⁶	95	WLI NBI	79% 95%	75% 69%	— —	— —
Tatsugami ²	104	WLI NBI	57% 93%	86% 71%	69% 63%	79% 95%
Shen ⁷	78	WLI NBI	77% 92%	82% 73%	— —	79% 87%
Xiaodong ⁹	64	WLI NBI	79% 97%	76% 68%	— —	— —
Geavlete ⁹	95	WLI NBI	84% 95%	— —	— —	— —
Zhu ¹⁰	12	WLI NBI	50% 78%	91% 80%	— —	— —
Chen ¹¹	179	WLI NBI	79% 97%	81% 79%	— —	— —

Note, PPV, positive predictive value; NPV, negative predictive value

Clinical application of NBI

Scene
1

NBI facilitates identification of subtle abnormalities

NBI makes it easier to identify a subtle abnormal lesion that may be difficult to identify with WLI. Superficial carcinoma is seen as brown or blue areas. Even abnormal lesions that tend to be overlooked under WLI can be seen clearly with NBI. Some abnormal lesions are identified only by NBI and later confirmed to be tumors after pathological examination (Fig. 6).

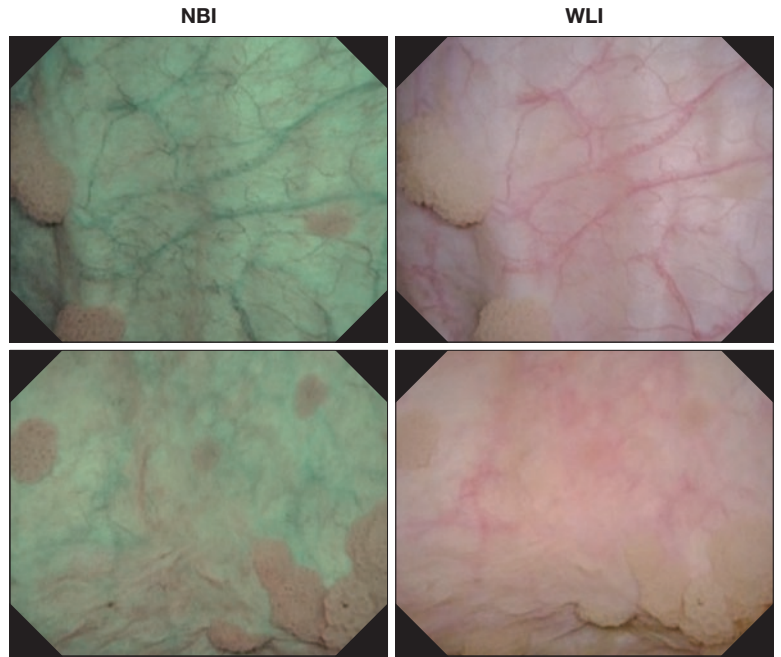


Fig. 6. Papillary tumor: NBI clearly identifies the flat papillary sessile tumor.

Scene
2

NBI can more clearly identify tumor margins than WLI

For TURBT, we mark the outside edge of the tumor before resection to identify the minimum area for resection. NBI helps determine the area for resection by clearly showing the tumor margins.

When viewing a tumor with associated lesions by WLI, lesions at the edge of tumor may be overlooked. After marking the tumor margins with WLI, switching to NBI sometimes allows us to find suspicious lesions outside the demarcated area. (Fig. 7, top). Therefore, we mark the area for resection under NBI observation before resection (Fig. 7, bottom).

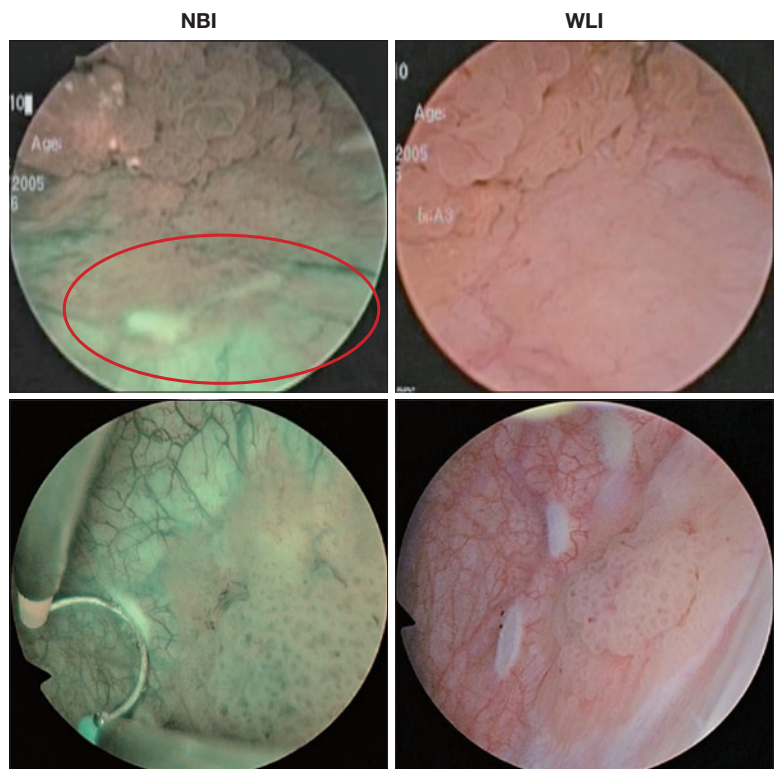


Fig. 7. Top: White area observed with NBI is the margin marked under WLI observation. It is obvious that the papillary tumor extends outside the marked area. Bottom: Marking the edge of the tumor for the abnormal lesion identified with NBI. The area looks wider than the actual tumor when seen with WLI.

Bleeding, residual urine, and equipment trouble are factors that may require attention when using NBI.

① Bleeding

When there is a bleeding, the whole field of view becomes colored and unclear because NBI light bands are easily absorbed by hemoglobin (Fig. 8). Therefore, special attention is required during insertion of the cystoscope to avoid bleeding due to manipulation.

② Residual urine

When urine is left in a bladder, the field of view sometimes

becomes yellow under conventional WLI, but it also has a significant effect on NBI observation (Fig 9). It is recommended that the urine be aspirated and replaced with saline if residual urine is apparent.

③ Equipment trouble

Reduced brightness is one of the common equipment problems that can occur. It may be due to age-related deterioration of the light-guide cable or telescope. Because equipment deteriorates over time, to avoid poor field of view during an operation, it is important to perform daily maintenance on the equipment.

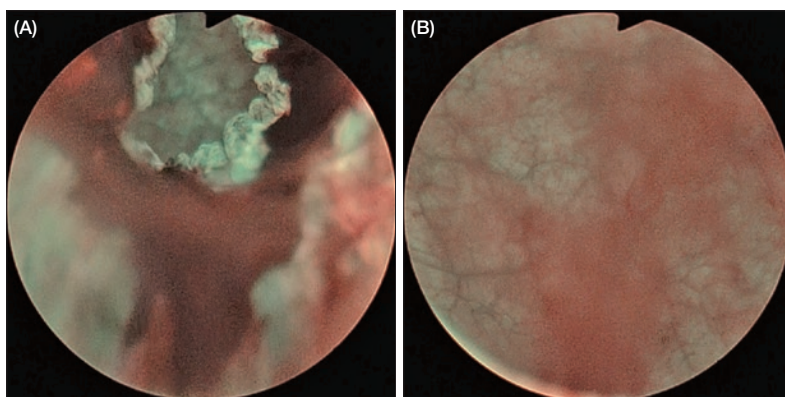


Fig. 8. NBI observations. (A) Bleeding from prostatic urethra by cystoscopic manipulation (posterior part is the bladder neck). (B) Inside the bladder. Bleeding makes the field of view dark and unclear.

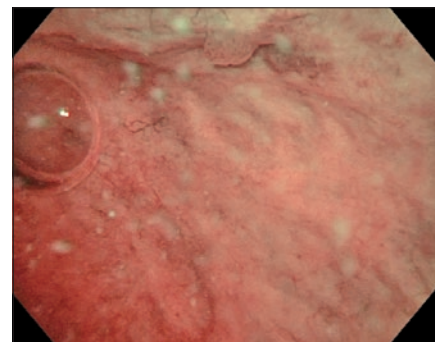


Fig. 9. NBI observation. Entire field of view becomes reddish due to urine, making it difficult to identify any abnormal lesions from a distance. In such cases, it is advisable to inspect the area without residual urine.

Conclusion

Observation using NBI reportedly detects more bladder tumors than conventional WLI cystoscopy³⁾. To utilize this characteristic effectively in the clinical setting, it is suggested that NBI be used as much as possible. By gaining experience inspecting normal lesions, it becomes possible to identify abnormal lesions quickly and accurately. Because NBI application does not require a special drug

or additional equipment other than the cystoscope, there is almost no burden for the patient. Considering the benefit of identifying abnormal lesions and having the chance to reduce bladder cancer recurrences and reoperations, NBI should be performed more actively during evaluations and treatment in the urological field.

Reference]

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