MODERATED POSTER

Hematuria Meter Application as a Diagnostic Tool in the Assessment of the Degree of Hematuria Among Post-TURP and Post-TURBT Patients

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Introduction: Hematuria is a common complication of transurethral electrosurgical procedures in the postoperative period. Presently, there is no standard diagnostic tool that will determine the degree of hematuria among postoperative catheterized patients. An innovative way of assessing the degree of hematuria is through the use of the Hematuria Meter Application, a mobile device software program.
Objective: The objective of this study was to determine the reliability of the Hematuria Meter Application as a diagnostic tool to assess the degree of hematuria in post-TURP and post-TURBT patients. This study aimed to determine if there is agreement between the Hematuria Meter Application readings and the RBCs counted per high power field by Direct Manual Quantitative Microscopy method and to determine if there is inter-observer agreement in using the Hematuria Meter Application between the patient or relative, nurse, intern and resident urologist
Methods: Using the Hematuria Meter Application, the color of the urine was graded by the patient or relative, resident, intern and nurse. Urine was then collected and sent to the laboratory for quantitative manual RBC counting under the microscope. Intraclass correlation coefficient (ICC) was used to determine the agreement of the application readings with RBC/hpf and inter-observer agreement among the observers.
Results: From July 2014 to December 2015, a total of 159 eligible patients were included in this study. The average age was 69. Majority were males (91%). 118 patients out of 159 (74%) underwent TURP, while 41 patients (26%) underwent TURBT. The median age of patients who underwent TURP was 68 while the median age was 66 for patients who underwent TURBT.
The agreements of the Hematuria Meter Application readings with RBCs/hpf counted by Direct Manual Quantitative Microscopy method were almost perfect. ICC was 0.743 (p-value 0.000) in day 0 post-operative and 0.985 (p-value 0.000) in day 2 post-operative. Similarly, inter observer agreement was almost perfect and increasing at each period of assessment. In the immediate post-operative period, ICC was 0.832 (p-value 0.000). On second post-operative day, ICC was 0.999 (p-value 0.000).
Conclusion: The Hematuria Meter Application is a reliable diagnostic tool in assessing the degree of hematuria in post-TURP and post-TURBT patients. There is inter-observer agreement in using this application.

Key words: hematuria, transurethral resection of the prostate (TURP), transurethral resection of the bladder tumor (TURBT)

Introduction

Hematuria is defined as the presence of blood in the urine. It is said to be significant when there is a finding of more than 3 red blood cells per high power field under the light microscope.[1]

Post-operatively, hematuria is a common complication of urological procedures especially in transurethral electrosurgical procedures like Transurethral Resection of the Prostate (TURP) and Transurethral Resection of Bladder Tumor (TURBT).[1]

Immediately after the resection, a French 24 3-way catheter is inserted inside the urethra and continuous bladder irrigation with distilled water is started. While the patient is still at the operating table, the attending urologist makes sure that the color of the urine output is clear before transferring the patient to the recovery room. Reddish or bloody urine output may denote bleeding most commonly coming from the resection site. It is imperative for the physician to re-evaluate the patient by urethrocystoscopy to search and fulgurate bleeders once found.

After full assessment, the patient is transferred to the recovery room. The attending urologist along with the recovery room nurses will note the amount and color of the urine output and vital signs hourly. The patient is then checked by the anesthesiologist before conducting the patient to the ward. Once the patient is transferred to the ward, the physician and ward nurses will record the amount and color of the urine output hourly. Reporting of degree of hematuria is difficult and subjective. It is almost always confusing when an observer relays the color of the urine to the attending physicians. One may describe the color of the urine as light pink, strawberry-like, salmon or pinkish and another observer may see it differently.

Presently, there is no standard diagnostic tool that will determine the degree of hematuria among post-operative catheterized patients. In this age of high technology and portable gadgets, an application that will suit the needs of the end user is inevitable since almost all the medical personnel especially the physicians and nurses alike are equipped with smart phones and tablets. With this in mind, the Hematuria Meter Application was conceptualized.

The term application is a shorter form of application program. An application program is a program designed to perform a specific function directly for the user or, in some cases, for another application program.[2]

The Hematuria Meter Application is a digitized version of the Hematuria Color Meter Chart (Figure 1) initially described by Dr. Frederick Agtarap. The colors that were used in the Hematuria Meter Application were based in his study completed last 2011 entitled "The Accuracy of the Hematuria Color Meter in the Assessment of the Degree of Hematuria Among Post-operative Urological Patients".[3]

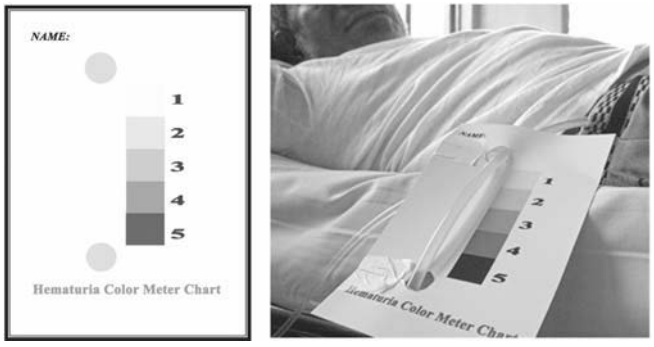

Figure 1. Hematuria color meter chart

According to Dr. Agtarap's study, one can estimate the number of red blood cells per high power field (RBCs/hpf) depending on the color of the urine. Grade 1 hematuria had an estimate of 0-300 RBCs/hpf, grade 2 hematuria had 301-500 RBCs/hpf, grade 3 hematuria had 501-1000 RBCs/hpf, grade 4 hematuria had 1001-2500 RBCs/hpf and grade 5 hematuria had >2500 RBCs/hpf. It is said that the Hematuria Color Meter Chart has shown an overall accuracy of 86.15% in determining the degree of hematuria.[3]

The color of the urine inside the tubing of the urine bag was compared to colors in the Hematuria Meter Application by the different observers namely the patient/relative, a urology resident, a post-graduate intern and a registered nurse.

The main goal of this study is to determine the reliability of this application to assess the degree of hematuria in post-TURP and post-TURBT patients.

The objective of this study was to determine the reliability of the Hematuria Meter Application as a diagnostic tool to assess the degree of hematuria in post-TURP and post-TURBT patients.

Materials and Methods

Study Design: Analytical, Cross sectional, Prospective

Study Population and Setting: Patients who underwent Transurethral Resection of Prostate (TURP) and Transurethral Resection of Bladder Tumor (TURBT) in the East Avenue Medical Center, from July 2014 to December 2015

Inclusion Criteria: Adult males who underwent TURP and adult males and females who underwent TURBT

Exclusion Criteria: Hematuria secondary to trauma, stones, infections, glomerular in origin and tumors which were non prostate and non bladder in origin

Study Procedure

A day prior the contemplated procedure, consent to participate in the research was obtained from the patient. Post-operatively, the color of the urine coming out of the tubing of the urine bag was noted against a white background in a well-lit room by the patient or patient's relative, Urology resident, postgraduate intern and registered nurse on duty in the wards. The hematuria was graded using the Hematuria Meter Application downloaded to a Samsung Galaxy J2 mobile device at 100% brightness level. The readings were recorded in the data collection sheet immediately at the nurse station.

The Hematuria Meter Application is a digitized version of the Hematuria Color Meter Chart made and verified by Dr. Frederick Agtarap in his study entitled "The Accuracy of the Hematuria Color Meter in the Assessment of the Degree of Hematuria Among Post-operative Urological Patients". It is numbered 1 to 5: 1 for the lightest color or clear, 2 for blood-tinged, 3 for pinkish, 4 for bright red and 5 for dark red. The method to identify the colors used in the Hematuria Meter Application was replicated as described by Dr. Agtarap.[3]

Figure 2. Screenshots of hematuria meter application; A. Hematuria meter application icon and home page as seen upon opening the application, B. Hematuria color meter.

The urine samples were collected from each patient and sent to the laboratory for determination of red blood cell count per high power field using the Direct Manual Quantitative Microscopy method. A total of two urine examinations were done per patient. One urine specimen sent immediately post-operative (day 1 post-operative) and another specimen on the second post-operative day (day 2 post-operative).

The grade of hematuria as observed by the patient or relative, nurse, intern, and resident using the Hematuria Meter Application was compared to the RBC counting under the microscope.

Justification of Sample Size

To determine the reliability of the Hematuria Meter Application in assessing the degree of Hematuria in post-TURP and post-TURBT patients, a minimum of 184 patients satisfying the inclusion/exclusion criteria are needed to achieve an 80% power of detecting an observed 86.15% overall accuracy at 95% reliability and at most 5% precision. Adjusted to the actual census of post-TURP and TURBT patients in East Avenue Medical Center, the minimum required sample size is 84.

Table 1. Computation of needed sample size.

Inputs	
Estimated Proportion	0.8615
Confidence level	0.95
Desired precision of estimate	0.05
Population size	1000
Results	
	Sample Size
Infinite	184
Population = 1000	156

Statistical Methods

All valid data from evaluable subjects were included in the analysis. Missing values were not replaced or estimated during the statistical analysis of outcome variables. Summary statistics were presented in tables and reported as median (IQR) on age and n (%) on gender, indications for surgery, type of surgery and ranges of RBC/high power field (hpf). Intraclass correlation coefficient (ICC) was used to determine inter-observer agreement among the a Urology resident, post-graduate intern and registered nurse and agreement of color meter readings with RBC/hpf. Friedman test was used to test for differences in rater bias. Conclusions were based on a 5% level of significance. SPSS v20 was used in data processing and analysis.

Results

From July 2014 to December 2015, there were a total of 159 consecutive eligible patients who underwent transurethral procedures in East Avenue Medical Center and who were included in this study. The average age of patients was 69 years (range: 47 to 83 years). Majority were males (91%, p=0.000). While 74% (118 of 159) underwent Transurethral electrosurgical Resection of Prostate (TURP), 26% (41 patients) underwent Transurethral Resection of Bladder Tumor (TURBT). Patients were diagnosed with benign prostate hyperplasia (115 patients), bladder tumor (41 patients) and prostate cancer (3 patients). The median age of patients who underwent TURP was 68 (range of 53-83 years) while the median age was 66 (range was 47-79) for patients who underwent TURBT as depicted in Table 2.

The agreements with Red Blood Cells/high power field (RBCs/hpf) were almost perfect. Intraclass correlation coefficient (ICC) was 0.743 (p-value 0.000) in day 0 post-operative and 0.985 (p-value 0.000) in day 2 post-operative. Similarly, interobserver agreement was almost perfect and increasing at each period of assessment. In day 0 or immediate post-operative period, Intraclass correlation coefficient (ICC) was 0.832 (p-value 0.000). On day 2 or second post-operative day, ICC was 0.999 (p-value 0.000). Rater bias showed no significant difference between results in day 0 and day 2 post-operative days with p-values of 0.322 and 0.368, respectively. (Table 3)

Table 2. Baseline characteristics of patients who underwent TURP and TURBT.

	N = 159	
Gender	144 males (91%) 15 females (9%)	
Indications for surgery	N= 159	%
Benign Prostatic Hyperplasia	115	72%
Bladder Tumor	41	26%
Prostate Cancer	3	2%

Table 3. Agreement between observers and with RBCs/hpf.

Agreement with RBC/hpf	Rater bias		Inter observer agreement		
	ICC	p-value	p-value	ICC	p-value
Day 0 or immediately post-operative	0.743	0.000*	0.322	0.832	0.000*
Day 2 or second post-operative day	0.985	0.000*	0.368	0.999	0.000*

*ICC - Intraclass correlation coefficient

Discussion

At present, there is no reliable clinical data supporting the accurate assessment of the degree of hematuria in patients undergoing TURP/ TURBT. Monitoring the amount of blood in urine has been most challenging especially in the first few hours post operatively. Relaying of colors in the urine bag tubing to the attending physician and resident doctors has become a source of confusion among the referring medical staff. Description of what is seen on the urine bag tubing and relaying the findings to the doctors is somewhat subjective and sometimes vague.

In this study, the authors proved that the Hematuria Meter Application is a reliable diagnostic tool to assess the degree of hematuria in post-TURP and post-TURBT patients because the agreements between the interpretation of the Hematuria Color Meter and RBC/high power field were almost perfect as shown in table 2. Also depicted in the table is the interobserver agreement between the readings of the Urology resident, postgraduate intern and registered nurse in using the Hematuria Meter Application.

Conclusion and Recommendations

The study revealed that the Hematuria Meter Application showed good correlation with the urine microscopy as well as with the estimated blood in the urine of these patients, thus, the Hematuria Meter Application is a reliable diagnostic tool in assessing the degree of hematuria. It can be used as an objective tool by the attending physician and the patients'/relatives in the assessment of the degree of hematuria in post-TURP and post-TURBT patients. This application can serve as a reliable and accurate guide of quantifying the volume of blood released into the urine. There is interobserver agreement in using the Hematuria Meter Application.

The authors recommend that the Hematuria Meter Application be tested with varying urine flow rate. It is expected that if the rate of clysis will be increased, the urine will appear clearer. If the application will be downloaded in another mobile device, the brightness of the screen display of the mobile device may affect the colors of the application. Instead of the conventional manual urine microscopy, the authors recommend the use of an automated urine analyzer. In that way, the variables are more controlled and the processing of the specimens would be faster.

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