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Light Microscopy and Electron Microscopy to Assess Thermal Effects on Prostatic Tissue after Monopolar & Bipolar Transurethral Resection of Prostate – A Pilot Study

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Abstract:

Background: Light microscopy and electron microscopy were conducted with the objective of assessing thermal effects on prostatic tissue after monopolar and bipolar Transurethral Resection of the Prostate (TURP).

Methods: This pilot study was conducted at the Department of General Surgery and Department of Pathology, King George's Medical University, Lucknow. Light microscopic study of prostatic tissue was conducted with the objective of assessing any differences in the thermal changes between Monopolar TURP and Bipolar TURP prostatic specimens, with additional observations of a few cases under electron microscopy.

Results: No significant difference in the International Prostate Symptom Score (IPSS) was observed postoperatively in both groups. On light microscopy, cytological atypia and coagulation artefacts with a score of 2 were observed in the specimens of monopolar TURP. Cytological atypia, basement membrane detachment, and cellular spindling with an artefact score of 3 were observed in bipolar TURP. Upon comparing the slides of prostate specimens under electron microscopy, coagulation defects were pronounced in both groups.

Conclusion: On light microscopy, in monopolar TURP, cytological atypia and coagulation artefacts were observed with a score of 2, which was more pronounced in Bipolar TURP, i.e., cytological atypia, basement membrane detachment, and cellular spindling with an artefact score of 3. In electron microscopy, coagulation defects are more pronounced and the field of view is smaller compared to light microscopy, so the results are not validated.

Keywords: Prostate tissue, Light microscopy, Electron microscopy

INTRODUCTION

Benign prostatic hyperplasia (BPH) is a disease that leads to bladder outlet obstruction. Voiding symptoms and storage symptoms are the lower urinary tract symptoms (LUTS) symptoms of BPH.[1] Several symptom scoring systems are available to assess the degree of the severity of the disease. The most widely used scoring system is the International Prostate Symptom Score (IPSS), developed by the American Urological Association and adopted by the World Health Organization.[2,3] This scoring system is based on the answers to seven questions related to urinary symptoms and one question is related to quality of life.

Surgical treatment is considered the gold standard procedure for BPH when pharmacological treatment is ineffective. Different surgical procedures are available. Of them, monopolar TURP is the gold standard technique. Bipolar TURP is cost-effective with certain advantages such as the possible use of isotonic irrigating fluid, which eliminates the risk of TUR syndrome and possibly improved haemostasis, resulting in better intraoperative visualization.[4,5]

Based on the clinical diagnosis of BPH/BPE, prostate resection can be performed and the final diagnosis of the disease can be done by histopathological analysis. TURP is a minimally invasive procedure for prostate resection with some drawbacks such as the small size of the specimen and the current produces artefacts. These artefacts can cause difficulty in interpretation in prostatic intraepithelial neoplasia or carcinoma in situ, early cancer with stage T1a and T1b.[6,7] Electrophysiological behaviour of bipolar and monopolar current are different thus artefacts should follow the same. Some studies report that monopolar produces less artefacts while others advocate bipolar current results in less artefacts.[8-10]

In this study, we employed both light microscopy and electron microscopy to evaluate the thermal effects on prostatic tissue after monopolar and bipolar TURP.

METHODS

The study was conducted at the Department of General Surgery and Department of Pathology, King George's Medical University, Lucknow, with the aim of assessing the histopathological differences between monopolar and bipolar TURP, with some samples observed under electron microscopy as a pilot study. The study was conducted from September 2016 to September 2018.

After getting approval from the institutional ethics committee and obtaining informed consent from the patients, 68 patients enrolled in the study in which 60 patients underwent TURP with no loss to follow-up in the whole period of study.

Randomly patients were selected for the study in which each group consisted of 30 patients. The group of patients who underwent monopolar TURP was considered as Group-1 and those who underwent bipolar TURP were considered as Group-2. Patients with prostate size of 30-90 g were included in the study and patients with prostatic size less than 30 g or more than 90 g, proven prostate cancer, raised PSA, voiding disorders not related to BPH, irreversible bleeding diathesis, bladder tumours, bladder stones and patients with IPSS score less than 8 and patients not willing to participate in the study were excluded.

Prostatic specimens were collected during surgery and evaluated using light microscopy by two senior pathologists blinded to the surgical technique. Both prostatic tissue specimens are evaluated with haematoxylin-eosin staining under a light microscope. Some prostatic chips were also observed under a transmission electron microscope. For electron microscopy, the specimen was collected in a glutaraldehyde vial and specimen cut into 1-2 mm pieces using a clean sharp blade and stored in a 4-degree C refrigerator. On light microscopy, four types of thermally induced artefacts were being looked for viz. cellular spindling, basement membrane detachment, atypical cytological changes, and coagulation artefacts. The presence of any of these artefacts was awarded the value of 1 and accordingly, the total artefact score was evaluated that ranged from 0-4 (0= No artefact, 1= Mild, 2= Moderate, 3, 4= Severe).

Transmission electron microscopy of a few randomly selected samples was also done. Expected findings at the ultrastructural level were disrupted organelles with granules of thermally denatured nuclear and cytoskeleton precipitated within the cell.

Quantitative variables were compared using unpaired t-tests, while qualitative variables were compared using chi-square tests or Fisher's exact tests. A p-value < 0.05 was considered statistically significant.

RESULTS

The mean age of the patients in Group 1 was 63.5 years, and in Group 2 was 65.8 years. The mean preoperative IPSS score in group 1 was 18.90 and in group 2 was 19.77. Postoperatively after 7 days, 1 month and 6 months, no significant difference in IPSS score was observed in both the groups (Table 1).

Table 1: Comparison of IPSS between the groups across the time periods.

Time periods	Group 1 (n=30)	Group 2 (n=30)	P value
Pre-op	18.90±2.95	19.77±3.18	0.27
After 7 days	3.60±0.72	3.63±0.71	0.85
1 month	3.53±0.62	3.47±0.62	0.68
6 months	3.47±0.62	3.53±0.63	0.68

As shown in Table 2, a significant difference in artefacts between both groups with more artefacts in the bipolar group.

Table 2: Artefact score in both the groups.

Groups	Score of artifact (Mean±SD)
Group 1	2.1±0.79
Group 2	2.66±0.64
P-value	0.001

Figures 1a and 1b showed light microscope photographs of the specimen of monopolar TURP and bipolar TURP respectively. Cytological atypia and coagulation artefacts with score 2 were seen in Figure 1a and cytological atypia, basement membrane detachment and cellular spindling with artefacts score 3 were seen in Figure 1b.

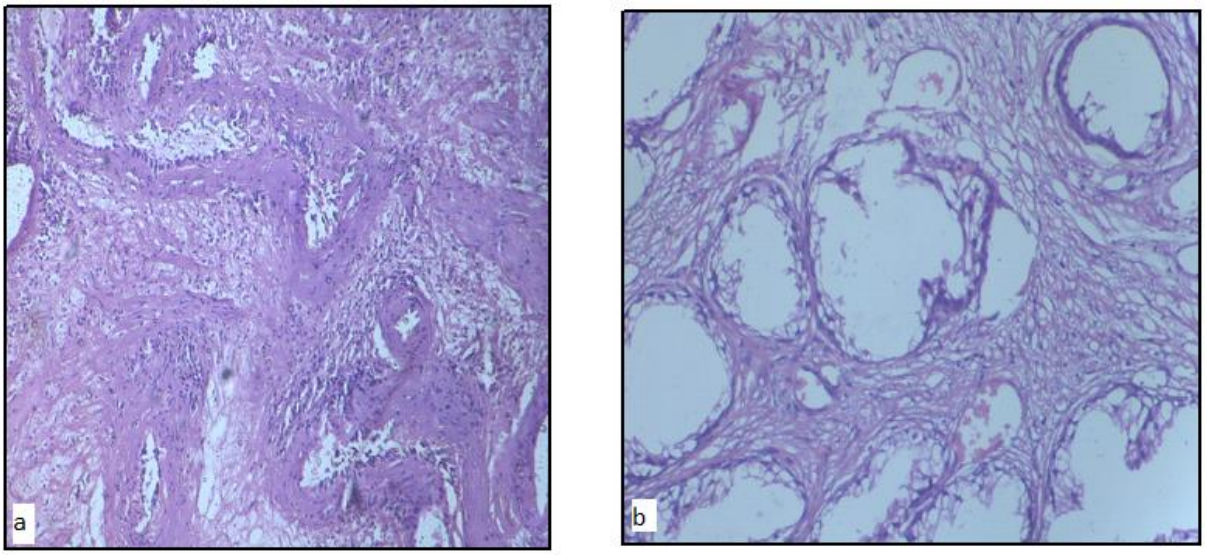

Figure 1: Light microscopic photograph: high power field (a) monopolar TURP group showing cytological atypia and coagulation artefacts (score 2);(b) bipolar TURP group showing cytological atypia, basement membrane detachment and cellular spindling (score 3).

On comparing the prostate specimens under transmission electron microscope coagulation artefacts were seen pronounced in both the groups (Figure 2a and b). No definite outline of any of the organelles could be traced in any of the groups.

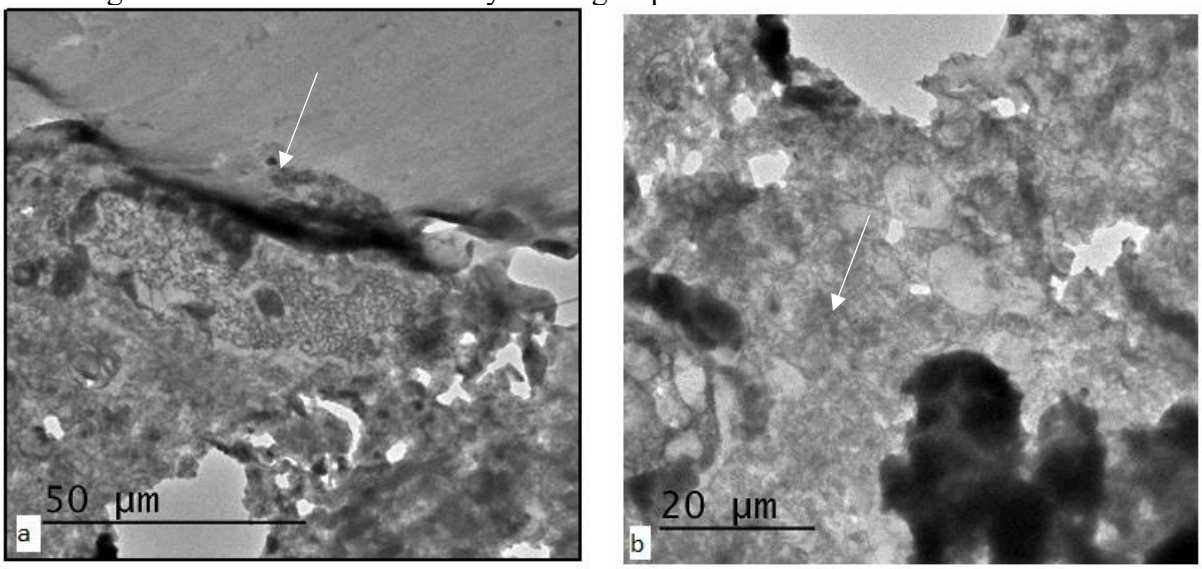

Figure 2: Transmission electron microscope (a) monopolar TURP group, (b) bipolar TURP group (white arrow showing area of coagulation in both groups).

DISCUSSION

BPH is a pathologic condition is one of the causes of LUTS in ageing men.[11] Initially pharmacological treatment with α1-receptor antagonists and 5-α reductase inhibitors will be given. The most commonly used first-line medication for BPH was α1-receptor antagonists and an improvement of approximately 30~45% in the IPSS total score has been reported. However, surgical treatment is required in patients with serious symptoms.[12,13] Patients with severe IPSS score (≥17) and with larger prostate size are at more risk for surgery. This statement suggests that IPSS score and prostate volume are important predictors for the patients to undergo surgery.[14] In the present study, the IPSS score was reduced in both the treatment groups but the difference was not significant statistically.

The important aspect of our study is to know the effect of current on prostatic tissue. For this purpose, we used light microscopy and transmission electron microscopy to comment on artefacts produced by monopolar and bipolar cautery. Light microscopy was done in all patients (n=30 in both groups) while transmission electron microscopy was done only in 16 patients to see any advantage, as a pilot project. In our study, it was found that bipolar electrocautery (2.66±0.64) caused more artefacts to prostate tissue compared to monopolar TURP (2.1±0.79 group and the artefacts produced in bipolar TURP are statistically significant (p=0.001). Our results are similar to the study conducted by Arturo et al.[7] This damage can result in a decrease in some incidental cancers due to difficulty in carrying out histopathological analysis and potentially prevent patients from receiving adequate treatment.

Several other studies performed like Poh et al concluded that bipolar TURP seems to result in a lesser degree of cautery artefacts when compared to conventional monopolar TURP, albeit statistically insignificant, compared to monopolar TURP same results are also concluded in a study performed in a canine model, Ko et al who analysed temperature elevation and thermal burns produced by both types of current. Both studies contradict the results of the present study.[10,15]

When we examine some (a total of 16 samples with 8 in each group) samples of tissue under electron microscopy. We found that light microscopy has an advantage over electron

microscopy in this particular regard that it enables visualization of cautery-induced changes over a larger extent, whereas in electron microscopy the field of vision is quite narrow as compared to light microscopy. As such the histological features in toto as included in the grading of specimens are better perceived on light microscopy, which is highly likely to be missed on electron microscopy because of a very limited area of visualization as well as disruption of organelles, which imparts a uniform coagulation depicting image.

In terms of Light microscopic analysis present study shows a significant difference in monopolar and bipolar TURP showing more artefacts in the bipolar group. Very few studies are performed that focus on histopathological analysis. These results lead to opening a view to focus on a better way to analyse T1a and T1b lesions preoperatively so that despite the use of electrocautery these stages can't missed.

BPH is a common cause of LUTS in ageing men, often necessitating surgical intervention when pharmacological treatment fails. The study aimed to assess the effect of different currents on prostatic tissue using light and electron microscopy.

Our findings indicated that bipolar TURP resulted in more artefacts compared to monopolar TURP, which could impact histopathological analysis. These results align with previous studies reporting similar findings.

However, electron microscopy had limitations compared to light microscopy, including a narrow field of vision and disruption of organelles, potentially affecting the interpretation of results.

CONCLUSION

In conclusion, our study found that bipolar TURP produced more artefacts compared to monopolar TURP, as observed through light and electron microscopy. While electron microscopy provided additional insights, its limitations should be considered. Further research is needed to validate these findings and optimize histopathological analysis in TURP specimens.

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