Absorption of Irrigation Fluid Occurs Frequently during High Power 532 nm Laser Vaporization of the Prostate

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Purpose: Absorption of irrigation fluid was not detected during GreenLight™ laser vaporization of the prostate using the first generation 80 W laser. However, data are lacking on intraoperative irrigation fluid absorption using the second generation 120 W high power laser. We assessed whether fluid absorption occurs during high power laser vaporization of the prostate.

Materials and Methods: We performed this prospective investigation at a tertiary referral center in patients undergoing 120 W laser vaporization for prostatic bladder outlet obstruction. Normal saline containing 1% ethanol was used for intraoperative irrigation. The expired breath ethanol concentration was measured periodically during the operation using an alcometer. The volume of saline absorption was calculated from these concentrations. Intraoperative changes in hematological and biochemical blood parameters were also recorded.

Results: Of 50 investigated patients 22 (44%) had a positive breath ethanol test. Median absorption volume in the absorber group was 725 ml (range 138 to 3,452). Ten patients absorbed more than 1,000 ml. Absorbers had a smaller prostate, more capsular perforation, higher bleeding intensity and more laser energy applied during the operation. Three patients (13%) had symptoms potentially related to fluid absorption. Hemoglobin, hematocrit and serum chloride were the only blood parameters that changed significantly in the absorber group. The changes were significantly different than those in nonabsorbers.

Conclusions: Fluid absorption occurs frequently during high power laser vaporization of the prostate. This should be considered in patients who present with cardiopulmonary or neurological symptoms during or after the procedure.

Key Words: prostate, laser therapy, therapeutic irrigation, intraoperative complications, ethanol

Abbreviations and Acronyms

LV = laser vaporization

TURP = transurethral prostate resection

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Study received local ethics committee approval.

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LASER vaporization of the prostate using the 532 nm GreenLight HPS Laser System is a minimally invasive treatment option in patients with lower urinary tract symptoms secondary to prostatic bladder outlet obstruction.[1] The technique has several advantages over conventional TURP, which make the procedure particularly appealing for cardiovascular patients at high risk.[2] The laser coagulation properties minimize bleeding complications even in patients undergoing anticoagulation or platelet inhibition treatment.[3] Furthermore, intraoperative irrigation with isotonic saline prevents

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classic transurethral resection syndrome, a result of excess influx of electrolyte-free glycine solution into the vascular system during transurethral surgery.[4] Finally, it was postulated that synchronous tissue coagulation during LV inhibits irrigation fluid absorption in general.[5] Extensive absorption of irrigation fluid, even isotonic fluid, carries the risk of cardiopulmonary complications, particularly in patients with preexisting cardiovascular risk factors.[4,6]

Fluid absorption was not detected during LV using the first generation low power (80 W) 532 nm laser.[7] However, data are lacking on irrigation fluid absorption during LV using the second generation high power (120 W) laser. We assessed whether and to what extent intraoperative fluid absorption occurs during high power LV of the prostate.

MATERIALS AND METHODS

We performed this prospective study at a tertiary referral center in a consecutive series of patients undergoing routine LV of the prostate for symptomatic prostatic bladder outlet obstruction between July 2011 and August 2012. Patients with known alcoholism or liver disease were excluded from study because the irrigation solution contained ethanol. The local ethics committee approved the study and all patients provided written informed consent.

The decision to perform LV was based on preoperative clinical assessment, and patient comorbidities and preferences. Preoperative assessment included history, physical examination and specific investigations such as uroflowmetry, post-void residual volume measurement, transrectal ultrasound of the prostate and laboratory studies (complete blood count, coagulation parameters, serum electrolytes, creatinine, prostate specific antigen test, urinalysis and urine culture). The I-PSS (International Prostate Symptom Score)/quality of life questionnaire was also part of the preoperative assessment.

All operations were performed by 4 experienced staff surgeons or 3 senior residents, the latter as a supervised teaching operation. Surgery was done with the patient under general anesthesia with tracheal intubation or spinal anesthesia. For the procedure we used the 120 W GreenLight HPS Laser System and a 24Fr continuous flow Iglesias laser resectoscope (Karl Storz, Tuttlingen, Germany) coupled to an automated irrigation suction pump system (ENDO FMS®). Vaporization was performed until the appearance of a TURP-like cavity as described previously.[8]

The noninvasive expired breath ethanol test was used to detect and quantify intraoperative absorption of irrigation fluid.[9,10] Intraoperative irrigation was performed using isotonic saline containing 1% ethanol as a tracer for absorption (B. Braun Medical, Sempach, Switzerland). At the beginning and at every 10 minutes throughout the procedure we measured the end expiratory breath ethanol concentration using an AlcoQuant® 6020 alcometer as described previously.[11] In patients under general anesthesia the alcometer was connected to the endotracheal tube. Patients under spinal anesthesia were asked to breathe directly into the alcometer. The alcometer was calibrated regularly according to manufacturer guidelines.

The breath ethanol concentration was converted into the blood ethanol concentration using the nomogram of Hahn to estimate the amount of fluid absorbed during the operation.[10] Surgeons were blinded to the results of ethanol measurements but informed if the estimated absorption volume exceeded a critical volume of 2 L. At that point the surgeons were advised to terminate the procedure expeditiously and ethanol-free saline was used for further irrigation to minimize the risk of ethanol intoxication.[10] For final analysis we calculated total absorption volumes and absorption with time using the formula of Hahn.[9]

Hematological (hematocrit and hemoglobin) and biochemical (sodium, potassium and chloride) serum parameters as well as venous pH were measured preoperatively, 30 minutes into the operation and at the end of the operation to assess whether absorption caused changes in these parameters and whether the changes could be used to detect absorption. The most pronounced change from baseline was used for statistical analysis.

Postoperatively the surgeons were asked to report intraoperative events that were known risk factors for fluid absorption, ie capsular perforation, injury to prostatic sinuses or deep bladder neck incision. The surgeons also rated bleeding intensity during the operation on a scale of 1 to 5, including 1—no bleeding, 2—nondisturbing bleeding, 3—impaired visibility due to bleeding, 4—prolonged operative time as a consequence of bleeding and 5—termination of surgery due to uncontrollable bleeding.

Statistical analysis was done with SPSS® Statistics, version 22. Differences between blood tests at baseline and throughout the operation were compared using the Wilcoxon signed rank test. The Mann-Whitney U-test was used to compare differences in changes in these blood tests between absorbers and nonabsorbers. Statistical significance was considered at $p < 0.05$.

RESULTS

A total of 50 patients were investigated in this study. The table lists patient baseline characteristics. Median operative time was 70 minutes (range 30 to 170) and median applied laser energy was 230 kJ (range 65 to 400). Experienced staff surgeons performed 36 procedures (72%) while 14 LVs (28%) were done by senior residents as a teaching operation.

A positive ethanol breath test was detected in 22 patients (44%). In these cases measured blood ethanol values ranged from 0.04 to 1.03 mg/ml. Figure 1 shows the calculated volume of absorbed irrigation fluid in each of the 22 patients. Median absorption volume in the absorber group was 725 ml (range 138 to 3,452). Ten patients absorbed more

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