Charlson comorbidity index and success of extracorporeal shock wave lithotripsy

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Introduction/objective: *We examined the potential correlation between Charlson comorbidity index (CCI) and stone free rate after extracorporeal shock wave lithotripsy (ESWL).*

Materials and methods: *Two hundred twenty-six adult patients were treated with 241 ESWL procedures for a renal or ureteral stone(s) over a 3 year period. Age, race, comorbidities, CCI, stone size and location, number of shocks and power level were determined. Treatment efficacies were evaluated at a mean of 56.1 days after each ESWL with computed tomography, abdominal x-ray, intravenous pyleography and/or renal ultrasound. Multivariate logistic regression analysis was performed.*

Results: *There was no correlation between CCI and any of the following: stone burden, number of shocks, or power level. There was no difference in stone burden, number of shocks or power level between those who were and were not stone free. Stone free rates for patients with CCI of zero, one, and two or greater were 44.7% (71/159), 27% (13/48) and 41.2% (14/34) respectively. Patients with an index of one were 2.1 times more likely to have a residual stone burden than patients with an index of zero (95% CI 0.99-4.42, p = 0.05). Patients with one comorbidity were 2.4 times more likely to have a residual stone burden than patients with none (95% CI 1.04-5.72, p = 0.04). Patients with upper ureteral stones were less likely to have a residual stone burden than patients with renal stones (RR = 0.52, 95% CI 0.27-0.98, p = 0.04). Those with lower ureteral stones were less likely to have a residual stone burden than those with renal stones (RR = 0.20, 95% CI 0.09-0.43, p < 0.0001). The only significant predictors of the stone free rate were stone location and number of comorbidities.*

Conclusions: *Stone location and number of comorbidities were significant predictors of ESWL outcome. The CCI may underestimate the magnitude of comorbidities and their effect on stone treatment efficacy.*

Key Words: treatment outcome, comorbidity, lithotripsy

Introduction

Extracorporeal shock wave lithotripsy (ESWL) is accepted as a first line treatment modality for urolithiasis.[1] ESWL is less invasive compared with other modalities such as transurethral ureterolithotripsy and percutaneous nephrolithotomy. Multiple previous studies have evaluated prognostic factors of success of ESWL in the treatment of renal and ureteral stones.[2,3] We incorporated an additional prognostic factor, the Charlson comorbidity index (CCI), which is a prospective method for classifying comorbid conditions that might alter the risk of mortality in longitudinal studies.[4,5] Charlson et al defined categories of diseases and assigned a weight to each category.[4] The following diseases were assigned a weight of one: myocardial infarction, congestive heart failure, peripheral vascular disease, cerebrovascular disease, dementia, chronic pulmonary disease, connective tissue disease, ulcer disease, mild liver disease and diabetes. Those

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diseases assigned a weight of two included hemiplegia, moderate to severe renal disease, diabetes with end organ damage, any tumor, leukemia and lymphoma. Moderate or severe liver disease was assigned a weight of three and any metastatic solid tumor or the acquired immunodeficiency syndrome was weighted six. The sum of the weights for all diseases determined the final index score.

This index has been evaluated to determine whether it could predict mortality among men with clinically localized prostate cancer.[6,7] It was found to be a highly significant predictor of mortality for patients dying of nonprostate cancer related causes after adjusting for age and Gleason score. To our knowledge, the CCI has not been applied to any other urologic conditions. The purpose of this study was to determine whether there is a correlation between the CCI and the stone free rate after ESWL.

Materials and methods

We performed a retrospective analysis of all adults who underwent an initial ESWL procedure for a renal or ureteral stone(s) with a Dornier Compact Delta Lithotripter between January 2004 and December 2006. Exclusion criteria included concomitant procedures to treat the stone(s), radiolucent stones, history of ipsilateral ureteral stricture or ureteropelvic junction obstruction, staghorn calculus, and the presence of coagulopathy or a nonfunctioning kidney. The study was approved by the institutional review board.

Two hundred twenty-six patients were treated with 241 ESWL procedures for a renal or ureteral stone(s) during the study period. Age, race, number of comorbidities, Charlson comorbidity index, stone size and location, number of shocks and power level were determined for each ESWL. Treatment efficacies were evaluated at a mean of 56.1 days after each ESWL with computed tomography, abdominal x-ray, intravenous pyelogram and/or renal ultrasound. We used the Pearson correlation coefficient to examine the correlation between a) Charlson Comorbidity Index (CCI) and stone burden, b) CCI and number of shocks, and c) CCI and power level. Multivariate logistic regression analysis was performed in order to determine whether any of the above variables (CCI, stone size and location, number of shocks and power level) affect the stone free rate after ESWL.

Results

There was no correlation between CCI and any of the following: stone burden, number of shocks, or power level. The Peason correlation coefficient was as follows: 0.06 for CCI and stone burden, 0.11 for CCI and number of shocks and 0.08 for CCI and power level. There was no difference in power level or number of shocks between those patients who were and were not stone free.

Stone free rates for patients with a CCI of zero, one, and two or greater were 44.7% (71/159), 27% (13/48) and 41.2% (14/34) respectively. Patients with an index of one were 2.1 times more likely to have a residual stone burden than patients with an index of zero (95% CI 0.99-4.42, p = 0.05). This difference approached statistical significance. There was no significant difference in the likelihood of residual stone burden in patients with an index of two or greater versus those with an index of zero (RR = 1.2, 95% CI 0.55-2.69, p = 0.63).

We also examined whether the absolute number of medical comorbidities affected the stone free rate after ESWL. Patients with one comorbidity were 2.4 times more likely to have a residual stone burden than patients with none (95% CI 1.04-5.72, p = 0.04). This difference achieved statistical significance. There was no significant difference in the likelihood of residual stone burden in patients with two or more comorbidities versus those with none.

Patients with upper ureteral stones were significantly less likely to have a residual stone burden than patients with renal stones (RR = 0.52, 95% CI 0.27-0.98, p = 0.04). Those with lower ureteral stones were significantly less likely to have a residual stone burden than those with renal stones (RR = 0.20, 95% CI 0.09-0.43, p < 0.0001). Age, race, stone size and side, power level, and number of shocks were not significant predictors of the stone free rate. The only predictors of the stone free rate were stone location and number of comorbidities. The complication rate was 6.2%. Complications included perinephric hematoma in five, postoperative flank pain, hydronephrosis +/- fever in nine, and pyelonephritis in one.

Discussion

The CCI is a prospectively applicable method for classifying comorbid conditions that might alter the risk of mortality. It is a weighted index, developed in medical patients, that accounts for the number and seriousness of comorbid diseases. We sought to extrapolate this index for use in surgical patients, as a predictor of efficacy of a particular surgical procedure. Our hypothesis was that stone free rates would be likely to decrease with increasing morbidity due to several factors: 1) tendency of physicians to recommend less invasive procedures in patients with multiple comorbidities even when a patient's

stone burden may not be best treated by ESWL, and 2) tendency of physicians to use a suboptimal number of shocks or power level during ESWL procedures in patients with multiple comorbidities.

We demonstrated, however, that patients with a higher CCI did not have a larger stone burden than patients with a lower CCI. Also, higher CCI patients did not receive fewer shocks and were not shocked at a lower power level as anticipated. This may explain why we were unable to demonstrate that patients with a higher CCI (of one or greater) consistently had a lower stone free rate.

The two predictors of stone free rate after ESWL in this study were stone location and number of comorbidities. Patients with upper ureteral stones had a 48% lower risk of having a residual stone burden while those with lower ureteral stones had an 80% lower risk compared to patients with renal stones. This is consistent with other studies in the literature that have demonstrated a higher stone free rate for ureteral versus renal stones.[2]

Patients with a CCI of one were 2.1 times more likely to have a residual stone burden after ESWL than those with an index of zero. This difference approached but did not reach statistical significance. Patients with one comorbidity, however, were 2.4 times more likely to have a residual stone burden than patients with none, a difference that did reach statistical significance. One explanation for this discrepancy between the CCI and the absolute number of comorbidities may be that the CCI does not include some comorbidities that impact preoperative decision making and ESWL efficacy. It is possible that physicians had a tendency to recommend less invasive procedures for patients in the cohort with one or more medical comorbidities even when indicators including stone burden or stone location may have directed treatment, from a clinical efficacy standpoint, to alternatives such as ureteroscopic stone lithotripsy or percutaneous nephrolithotomy.

It is unlikely that the difference in stone free rates between patients with zero and one comorbidity can be explained by the use of a suboptimal number of shocks or power level given that there was no significant difference in these variables between the groups as mentioned previously.

We hypothesized that patients with a lower CCI would have similar stone free rates while those patients with a higher CCI would also have similar stone free rates. We did not design the study, however, with a predetermined understanding of the outcome. A future prospective trial with greater statistical power might serve to further delineate these issues.

Conclusion

This study demonstrates that stone location and number of comorbidities were significant predictors of ESWL outcome. While the CCI has been used to predict therapeutic efficacy for other genitourinary disease conditions, this tool may underestimate the magnitude and effect of medical comorbidities in patients undergoing ESWL for renal and ureteral stones. □

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