African Journal of Urology (2018) **24**, 387–391

**African Journal of Urology**

Official journal of the Pan African Urological Surgeon's Association
web page of the journal

www.ees.elsevier.com/afju
www.sciencedirect.com

**Laparoscopy and Robotics**
*Original article*

# The relationship of Charlson comorbidity index and postoperative complications in elderly patients after partial or radical nephrectomy

**E. Becher [1,*], P.García Marchiñena, J. Jaunarena, D. Santillán, L. Pérez, B. Boietti, A. Jurado, G. Gueglio**

*Hospital Italiano de Buenos Aires, Argentina*

Received 19 February 2018; received in revised form 28 June 2018; accepted 30 September 2018; Available online 11 December 2018

**KEYWORDS**
Outcomes for partial/radical nephrectomy;
Charlson comorbidity index;
Postoperative complications;
Active surveillance;
Kidney cancer on the elderly

**Abstract**
*Objectives:* To compare preoperative Charlson comorbidity Index (CCI) and postoperative complications after oncologic kidney surgery in patients aged 70 or older. To compare CCI and need for interdisciplinary evaluation, consults to the emergency department and need of readmission are secondary objectives.
*Patients and methods:* This is a retrospective cohort study. Patients aged 70 or older who underwent partial or radical nephrectomy were collected from an institutional database. Period: February 2012–June 2014. Association between CCI and complications was estimated using $Chi^2$.
*Results:* Final population: 143 (male: 65%). Age median was 75. Minor postoperative complications were 33.88% (n = 41) for patients CCI ≤ 4 versus 9.09% (n = 2) for patients CCI > 4 (p > 0.05), and major postoperative complications were 9.91% (n = 12) versus 45.45% (n = 10), respectively (p < 0.01). Interdisciplinary evaluation was required for 30.6% (n = 37) of patients CCI ≤ 4 versus 59% (n = 13) of patients CCI > 4 (p = 0.01). Readmission was needed for 9.09% (n = 11) and 40.1% (n = 11) respectively (p < 0.01).
*Conclusions:* Patients with high comorbidity presented more major postoperative complications. These patients also required more interdisciplinary evaluation after surgery. A higher CCI was not associated with further consults to the emergency department or readmission.



*Abbreviations:* CCI, Charlson comorbidity index; DC, Dindo-Clavien; SRM, small renal mass; FHSF, ramingham heart study.

* Corresponding author at: Juan D. Perón 4190, C1181ACH Buenos Aires, Argentina.
E-mail addresses: ezequiel.becher@hospitalitaliano.org.ar, ezebecher@gmail.com (E. Becher).
[1] Home address: Av. del Libertador 7766 (C1429BMX), apt 1101, Buenos Aires, Argentina.

Peer review under responsibility of Pan African Urological Surgeons' Association.

https://doi.org/10.1016/j.afju.2018.09.004

## Introduction

The incidence of kidney cancer is growing worldwide [1,2]. It accounts for 2% of all cancers diagnosed yearly, and it comprises one of the most lethal cancers in urology, with a 35% 5-year cancer specific mortality [1].

Partial or radical nephrectomy (either laparoscopic or open) are the standard of care for clinically localized kidney cancer. Even though these procedures have a relatively low risk for complications, that risk increases if the patient is older, or has a larger comorbidity burden [3–5].

There are numerous validated scores and models to analyze objectively the patient's comorbidities. The Charlson Comorbidity Index (CCI) is a robust and strongly validated tool for stratifying subjects according to their comorbidities [6,7].

The CCI was originally developed to serve as a simple, readily applicable and valid method of estimating risk of death from comorbid disease, for use in longitudinal studies [6]. It is also useful as a predictive tool for postoperative complications in several surgical scenarios [8–10].

There are numerous articles associating CCI with complications after other oncologic or non-oncologic procedures [11]. Nevertheless, the association between CCI and complications after surgery for renal cancer has not yet been established.

Our primary objectives were to compare preoperative CCI and presence of postoperative complications after partial or radical nephrectomy in patients over 70 years old.

Secondary objectives were to compare CCI and the need for interdisciplinary evaluation, consults to the emergency department and/or need of readmission.

## Patients and methods

### *Study design*

This is a retrospective cohort study.

### *Patient population*

The study included patients aged 70 years or older who underwent partial or radical nephrectomy at our institution between February 2012 and June 2014 as initial treatment for kidney tumors considered to be malignant. All patients were identified using the institutional, prospectively collected database.

Patients were excluded if they underwent additional surgical procedures simultaneously or had less than 3 months of follow-up.

### *Definition of variables*

Age; sex; type of nephrectomy (partial/radical); and technique (open/laparoscopic) were obtained from the database. Comorbid conditions prior to surgery were queried retrospectively using preoperative clinical records. Complications; consults to the emergency department; readmissions; and need for interdisciplinary evaluation were assessed retrospectively from electronic clinical records.

The CCI was assessed using the definition by Charlson et al. [12], where different grades are assigned for specific conditions and the grades are added to find the index for a specific patient (Table 1).

Postoperative evolution was evaluated studying postoperative complications, need for interdisciplinary evaluation, readmission, or consult to the emergency department.

Postoperative complications were assessed using the Dindo-Clavien (DC) classification. All complications that occurred within the first 3 months after the intervention were included.

Interdisciplinary evaluation was defined as the need for a clinical evaluation by other specialties (i.e: internal medicine, nephrology, cardiology) due to postoperative events. Cases which had stipulated evaluation by another specialty previous to the intervention were not considered.

Patients categorized as 'need for readmission' or 'need for consult at the emergency department' were included if the event occurred within the first 3 months after the intervention.

### *Outcome definition*

Our primary outcome was presence of postoperative complications.

Secondary outcomes were need for interdisciplinary evaluation; need for readmission, and need for consult at the emergency department.

### *Statistical analysis*

Patients were divided into two groups according to their CCI. Patients were categorized as 'low comorbidity' if they had a CCI of

**Table 1** Grading system of the CCI.

| Chronic disease | Grade | Chronic disease | Grade | Chronic disease | Grade |
|---|---|---|---|---|---|
| Cerebrovascular disease | 1 | Myocardial infarction | 1 | Skin ulcers/cellulitis | 2 |
| Congestive heart failure | 1 | Peripheral Vascular disease | 1 | Takes warfarin | 1 |
| COPD/asthma | 1 | Rheumatic disease | 1 | Leukemia | 2 |
| Dementia | 1 | Ulcer disease | 1 | Lymphoma | 2 |
| Depression | 1 | Hemiplegia | 2 | Moderate/severe liver disease | 3 |
| Diabetes without end organ | 1 | Moderate/severe renal disease | 2 | Metastatic solid tumor | 6 |
| Hypertension | 1 | Diabetes with end organ damage | 2 | HIV/AIDS | 6 |
| Mild liver disease | 1 | Any tumor | 2 | | |

**Table 2** Baseline patient characteristics. Small renal mass (SMR).

| | Low CCI | High CCI | p Value |
|---|---|---|---|
| Total | 121 | 22 | p > 0.05 |
| Age median | 79 | 72 | p > 0.05 |
| Male | 65% | 63% | p > 0.05 |
| Surgical approach | | | |
| • Open | 38 | 8 | p > 0.05 |
| • Laparoscopic | 83 | 14 | p > 0.05 |
| Type of surgery | | | |
| • Radical | 67 | 12 | p > 0.05 |
| • Partial | 54 | 10 | p > 0.05 |
| Patients with SMR | 65% | 52% | p = .5 |

4 or less, and as 'high comorbidity' if they had a CCI of more than 4. The CCI was estimated prospectively during the preoperatory evaluation.

It is important to state that as the CCI gives a score of 2 to patients having any kind of localized non-skin malignancy, and that all the patients in the study underwent the procedure due to malignant renal masses, there were no patients with a CCI lower than 2.

Association between CCI and presence of postoperative complications; need for readmission; need for interdisciplinary evaluation; and need for consult to the emergency department was estimated by Chi square test. A *p* value of less than 0.05 was considered to be statistically significant.

## Results

The study population was 170 patients. A total of 16 patients underwent simultaneous procedures along the nephrectomy, thus they were excluded. Those procedures included: Renal vein thrombectomy (n = 4), ureterectomy (n = 2), cholecystectomy (n = 2), gastrectomy (n = 2), urethrectomy (n = 1), aortic aneurism surgery (n = 1), colectomy (n = 1), spleno-pancreatectomy (n = 1), resection of metastases in the fibula (n = 1), bank surgery and autotransplant (n = 1). Ten patients were also excluded due to loss of follow up.

One additional patient was excluded because the nephrectomy could not be completed due to the local extent of the tumor. A total of 143 patients were finally included in the study (Fig. 1).

Baseline patient characteristics are shown on Table 2. Postoperative complications were found in 42.1% (n = 53) of patients in the 'low comorbidity' group, and in 63% (n = 14) of the patients in the 'high comorbidity' group (p < 0.05).

For those patients who presented complications, it was found that 33.88% (n = 41) in the 'low comorbidity' group versus 9.09% (n = 2) in the 'high comorbidity' group (p > 0.05) had complications grade DC I–II, and that 9.91% (n = 12) versus 45.45% (n = 10), respectively (p < 0.01; 95% CI 2.17–9.00) presented complications DC IIIa or more.

Interdisciplinary evaluation was required for 30.6% (n = 37) of patients in the 'low comorbidity' group versus 59% (n = 13) in the 'high comorbidity' group (p = .01; 95% CI 1.19–2.91). Readmission was needed for 9.09% (n = 11) in the 'low comorbidity' group versus 40.1% (n = 11) in the 'high comorbidity' group (p < 0.01; 95% CI 2.00–9.27).

Consults to the emergency department were registered for 23.77% (n = 29) patients in the 'low comorbidity' versus 36.36% (n = 8) in the 'high comorbidity' group (p > 0.05). These results are summarized on Table 3.

## Discussion

The CCI is a robust and well validated score used to categorize patients according to their comorbidities. Even though there are many studies that establish a relation between its score and higher postoperative complications in different surgical scenarios [8–10], its association with outcomes in surgery for kidney tumours has not yet been established.

The index used in the study was conceived as a tool that would help quantify the serious illnesses of inpatients. Nonetheless, this score has an inherent limitation, the fact that it does not include many conditions that are common in elderly patients (i.e.: coronary artery disease without myocardial infarction; smoking status; history of transient ischemic attacks). Further studies should evaluate the use

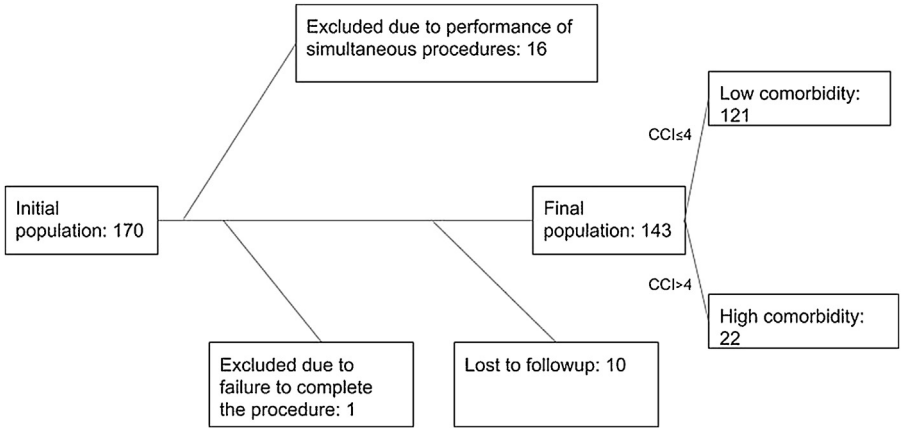


**Figure 1** Flow of patients in the study.

**Table 3** Postoperative outcomes.

| | Low CCI | High CCI | p Value |
|---|---|---|---|
| Total complications[a] | 54 (42,1%) | 14 (63%) | **p < 0.05** |
| • Minor | 41 (33,88%) | 2 (9,09%) | p > 0.05 |
| • Major | 12 (9,91%) | 10 (45,45%) | **p < 0,01** |
| Need for interdisciplinary evaluation | 37 (30,6)% | 13 (59%) | **p = 0,01** |
| Need for readmission | 11 (9,09%) | 11 (40,1%) | **p < 0,01** |
| Consult to the emergency department | 29 (23,77%) | 8 (36,36%) | p > 0.05 |

[a] Final population was n = 143.

of a complementary score that contemplates other conditions. Patel et al. [13] showed that cardiovascular risk has a significant impact on overall survival in elderly patients diagnosed with small renal masses (SRM). Future attempts to evaluate risk of intervention in elderly patients could include the application of the Framingham Heart Study (FHS) to help stratify said risk.

It has been well established that laparoscopic approach offers less probabilities of complications than open partial or radical nephrectomy [14]. Also, that even though partial nephrectomy has greater chances of postoperative complications, it leads to better outcomes in renal function and thus improved quality of life [14,15] in the long term. Nevertheless, there are few articles in the literature that associate a single patient-related variable to postoperative outcomes. A recent article by Isharwal et al.[16] compared patients comorbidities to functional recovery after partial or radical nephrectomy. On this study the authors used a multivariable linear regression to find positive associations of single patient comorbidities (such as obesity, diabetes mellitus, hypertension) to recovery of renal function after surgery, which were not found. The authors of this study did not use a validated index that has been proved to be a predictor of adverse events, and they did not assess any other plausible complications after surgery. The present article is novel in that matter, as it positively associates a widely validated index (the CCI) to a wide range of postoperative complications, readmission, and need for interdisciplinary evaluation.

This study shows some limitations, such as the inability to discriminate between the single impact of each variable of the CCI. Froehner et al. [17] showed that for patients who underwent radical prostatectomy, congestive heart failure was the single most important contributing condition for prediction of survival after this procedure.

The fact that the study was carried out retrospectively in a single center, should also be considered a limitation. Nevertheless, the results that were achieved in the study, and the low budget needed to carry it out may serve as a kickstarter to create a new protocol to prospectively include patients, expand the age inclusion criteria, and perhaps add other scores to measure the implication of other comorbidity burdens using other validated scores (i.e: stratifying cardiovascular risk via FHS [13] in outcomes for renal oncologic surgery).

Management of small renal masses in elderly patients is a relevant and controversial issue [18–20]. The focus of the controversy is set on whether or not these patients benefit from an intervention, and how to properly select the patients that do. In this study we demonstrated that patients with a higher CCI are at higher risk of suffering a complication from said intervention. Other studies revealed that the CCI is a useful prognostic indicator of mortality in patients with SRM [21,22]. These studies revealed that patients with a CCI > 4 (taking into account the 2 points given by the presence of a solid localized cancer) are at higher risk of dying from other non oncologic causes. We found that using the tumour size as an independent factor, patients with a CCI > 4 are at higher risk of suffering major complications from an intervention on their renal tumour.

We do not believe that this fact should disencourage an intervention on a patient that could benefit from it (i.e: a patient with a larger tumour), but we propose that the CCI could play an important role in the decision making, and that it is an important tool that could help the patient and the professional understand his/her risks before making the decision.

## Conclusion

Patients with a CCI higher than 4 (high comorbidity) presented a significantly higher postoperative complications rate and readmissions. These patients also required significantly more interdisciplinary evaluation after surgery. A higher CCI was not associated with further emergency consults.

## Conflicts of interest

Authors have no conflict of interest to declare.

## Authors' contributions

Ezequiel Becher: Corresponding author, Confection of manuscript.
ezebecher@gmail.com.

Patricio A García Marchiñena: Writing of manuscript.
patricio.garcia@hospitalitaliano.org.ar.

Diego Santillán: Data gathering.
diego.santillan@hospitalitaliano.org.ar.

Jorge H Jaunarena: Data gathering.
jorge.jaunarena@hospitalitaliano.org.ar.

Lucía G Pérez: Statistical analysis.
lucia.perez@hospitalitaliano.org.ar.

Bruno R Boietti: Gerontology advisor.
bruno.boietti@hospitalitaliano.org.ar.

Alberto M Jurado: Project coordinator.
alberto.jurado@hospitalitaliano.org.ar.

Guillermo Gueglio: Project coordinator.
guillermo.gueglio@hospitalitaliano.org.ar.

### Consent from the patient

Not required, since it is a retrospective outcomes study.

### Ethical Committee Approval

This study has been approved by the Ethics Committee of the institution where it was carried out (protocol number 4152). The latter study also conforms to the provisions of the Declaration of Helsinki (as revised in Fortaleza, Brazil, October 2013).

### Source of funding

None.

### References

[1] Lipworth L, Tarone RE, McLaughlin JK. The epidemiology of renal cell carcinoma. J Urol 2006;176:2353–8.
[2] Ferlay J, Steliarova-Foucher E, Lortet-Tieulent J, Rosso S, Coebergh JWW, Comber H, et al. Cancer incidence and mortality patterns in Europe: estimates for 40 countries in 2012. Eur J Cancer 2013;49:1374–403.
[3] Larcher A, Trudeau V, Dell'Oglio P, Tian Z, Boehm K, Fossati N, et al. Prediction of competing mortality for decision-making between surgery or observation in elderly patients with T1 kidney cancer. Urology 2017;102:130–7.
[4] Larcher A, Capitanio U, Terrone C, Volpe A, De Angelis P, Dehó F, et al. Elective nephron sparing surgery decreases other cause mortality relative to radical nephrectomy only in specific subgroups of patients with renal cell carcinoma. J Urol 2016;196:1008–13.
[5] Larcher A, Fossati N, Tian Z, Boehm K, Meskawi M, Valdivieso R, et al. Prediction of complications following partial nephrectomy: implications for ablative techniques candidates. Eur Urol 2016;69:676–82.
[6] Charlson ME, Pompei P, Ales KL, MacKenzie CR. A new method of classifying prognostic comorbidity in longitudinal studies: development and validation. J Chronic Dis 1987;40:373–83.
[7] Quan H, Li B, Couris CM, Fushimi K, Graham P, Hider P, et al. Updating and validating the Charlson comorbidity index and score for risk adjustment in hospital discharge abstracts using data from 6 countries. Am J Epidemiol 2011;173:676–82.
[8] Chang C-M, Yin W-Y, Wei C-K, Wu C-C, Su Y-C, Yu C-H, et al. Adjusted age-adjusted Charlson comorbidity index score as a risk measure of perioperative mortality before cancer surgery. PLoS One 2016;11:e0148076.
[9] Krarup P-M, Nordholm-Carstensen A, Jorgensen LN, Harling H. Association of comorbidity with anastomotic leak, 30-day mortality, and length of stay in elective surgery for colonic cancer: a nationwide cohort study. Dis Colon Rectum 2015;58:668–76.
[10] O'Grady G, Hameed AM, Pang TC, Johnston E, Lam VT, Richardson AJ, et al. Patient selection for oesophagectomy: impact of age and comorbidities on outcome. World J Surg 2015;39:1994–9.
[11] Kastner C, Armitage J, Kimble A, Rawal J, Carter PG, Venn S. The Charlson comorbidity score: a superior comorbidity assessment tool for the prostate cancer multidisciplinary meeting. Prostate Cancer Prostatic Dis 2006;9:270–4.
[12] Charlson ME, Charlson RE, Peterson JC, Marinopoulos SS, Briggs WM, Hollenberg JP. The Charlson comorbidity index is adapted to predict costs of chronic disease in primary care patients. J Clin Epidemiol 2008;61:1234–40.
[13] Patel HD, Kates M, Pierorazio PM, Allaf ME. Balancing cardiovascular (CV) and cancer death among patients with small renal masses: modification by CV risk. BJU Int 2015;115:58–64.
[14] Autorino R, Zargar H, Butler S, Laydner H, Kaouk JH. Incidence and risk factors for 30-day readmission in patients undergoing nephrectomy procedures: a contemporary analysis of 5276 cases from the National Surgical Quality Improvement Program database. Urology 2015;85:843–9.
[15] MacLennan S, Imamura M, Lapitan MC, Omar MI, Lam TBL, Hilvano-Cabungcal AM, et al. Systematic review of perioperative and quality-of-life outcomes following surgical management of localised renal cancer. Eur Urol 2012;62:1097–117.
[16] Isharwal S, Ye W, Wang A, Abraham J, Zabell J, Dong W, et al. Impact of comorbidities on functional recovery from partial nephrectomy. J Urol 2018;199:1433–9.
[17] Froehner M, Koch R, Litz R, Oehlschlaeger S, Wirth MP. Which conditions contributing to the Charlson score predict survival after radical prostatectomy? J Urol 2004;171:697–9.
[18] Celtik KE, Shah PH, Patel VR, Moreira DM, George AK, Iacovelli V, et al. Active surveillance for incidental renal mass in the octogenarian. World J Urol 2017;35:1089–94.
[19] Quivy A, Daste A, Harbaoui A, Duc S, Bernhard J-C, Gross-Goupil M, et al. Optimal management of renal cell carcinoma in the elderly: a review. Clin Interv Aging 2013;8:433–42.
[20] Lane BR, Abouassaly R, Gao T, Weight CJ, Hernandez AV, Larson BT, et al. Active treatment of localized renal tumors may not impact overall survival in patients aged 75 years or older. Cancer 2010;116:3119–26.
[21] O'Connor KM, Davis N, Lennon GM, Quinlan DM, Mulvin DW. Can we avoid surgery in elderly patients with renal masses by using the Charlson comorbidity index? BJU Int 2009;103:1492–5.
[22] Santos Arrontes D, Arrontes DS, Aceñero MJF, González JIG, Muñoz MM, Andrés PP. Survival analysis of clear cell renal carcinoma according to the Charlson comorbidity index. J Urol 2008;179:857–61.