Angiotensin II receptor blocker prevents upper gastrointestinal bleeding in hypertensive patients with chronic kidney disease not on dialysis

C.-Y. Chou,1,2 S.-M. Wang,1,2 P.-H. Chang,3 H.-L. Kuo,1,2 C.-T. Chang,1,2 J.-H. Liu,1,2 I.-K. Wang,1,2 Y.-F. Yang,1,3 C.-C. Liang,1,2 C.-C. Huang1,2

SUMMARY

Aims: Investigate if angiotensin II receptor blocker (ARB) decreases risk of upper gastrointestinal bleeding (UGIB) in hypertensive patients with chronic kidney disease (CKD) not on dialysis. Methods: All hypertensive patients with CKD not on dialysis in outpatient department of China Medical University Hospital from 2003 to May 2013 were enrolled. The risk of UGIB was analysed using Cox proportional hazard regression. Results: A total of 2744 hypertensive CKD patients including 1515 male and 1229 female, aged 64.9 ± 13.8 years old in a median of 1.9 (0.9–3.9) years were analysed. The incidence of UGIB was 4.5 per 100 patient-years. ARB was associated with a decreased risk of UGIB (p < 0.001) with an adjusted hazard ratio (HR) of 0.533 [95% confidence interval (CI) 0.404–0.703]. A history of UGIB, Helicobacter pylori infection, diabetes, lower estimated glomerular filtration rate, elevated blood urea nitrogen and decreased serum albumin were independently associated with an increased risk of UGIB. Conclusions: Angiotensin II receptor blocker is associated with a decreased risk of UGIB in hypertensive CKD patients not on dialysis, independent of their renal function, history of gastrointestinal bleeding and nutrition status.

Introduction

Overactivity of the renin-angiotensin-aldosterone system (RAAS) is linked to the development of chronic kidney disease (CKD), hypertension (HTN) and cardiovascular disease (1). RAAS may play a regulatory role in upper gastrointestinal injury induced by low-dose aspirin (2). The use of angiotensin II receptor blocker (ARB) or angiotensin converting enzyme inhibitor (ACEI) is associated with a decreased risk of upper gastrointestinal bleeding (UGIB) in patients who took low dose aspirin (3). Inhibition of RAAS is associated with a protective effect in cold-restraint gastric mucosal damage in animal model (4). It has never been investigated if inhibition of RAAS is associated with a decreased UGIB in human. In this study, we investigate the effect of ARB and ACEI on the risk of UGIB in hypertensive patients with CKD not on dialysis. The hypertensive patients with CKD were selected because ARB or ACEI were most commonly prescribed antihypertensives in hypertensive patients especially in patients with CKD; more importantly, the effect of ARB/ACEI on UGIB can be compared with other antihypertensives. Confounders of UGIB such as aspirin, warfarin, steroid and a history of UGIB were also taken into consideration.

Methods

This observational cohort study was approved by the Internal Review Board of China Medical University Hospital for the review of medical records (DMR 99-IRB-301) and the need for informed consent was waived for the review of medical records. All hypertensive patients with CKD in the outpatient department of China Medical University Hospital from June 2003 to May 2013 were analysed. CKD patients on dialysis or kidney transplant were excluded. All patients were followed from the date of enrolment to the date of first episode of UGIB, patient’s death, haemodialysis, peritoneal dialysis, kidney transplant, loss to follow-up, or May 2013. There were 132 (4.8%) patients died, 587 (21.4%) patients receiving haemodialysis, 233 (8.5%) patients receiving peritoneal

WHAT’S KNOWN
Angiotensin II receptor blocker prevents gastric mucosa damage in animal model.

WHAT’S NEW
Angiotensin II receptor blocker decreases risk of upper gastrointestinal bleeding in hypertensive patients with chronic kidney disease and not on dialysis.

Disclosure
The results presented in this paper have not been published previously in whole or part. The authors have no conflicts of interest regarding this study. There is no financial support for this study.
Data are reported as mean ± standard deviation, median (interquartile range) or frequency (%). All continuous variables were tested using skewness test and kurtosis test for their normality. Testing for statistical significance was conducted using Student’s t-test for parametric variables, Kolmogorov–Smirnov test for non-parametric variables, and χ² test for categorical variables. Possible confounders of UGIB were analysed using univariate Cox proportional hazard regression followed by multivariate Cox proportional hazard regression. A hazard ratio (HR) and 95% confidence interval (CI) were calculated. All analysis was performed using Stata version 12 SE (StataCorp, College Station, TX). A p < 0.05 was considered as statistical significant.

Results

A total of 2744 CKD stage 1–5 without renal replacement therapy (RRT) patients including 1229 female and 1515 male with an average of 64.9 ± 13.8 years old were analysed. In a median of 1.9 (0.9–3.9) years follow-up, 357 (12.2%) patients developed UGIB and the incidence of UGIB was 4.5 per 100 patient-years. ARB was prescribed in 1438 (52.4%) patients and ACEI was prescribed in 240 (8.8%) patients. As ARB was the most commonly used antihypertensives, patients’ characteristics were presented based on the prescription of ARB. Patients’ characteristics including age, gender, underlying disease, stage of CKD, H. pylori infection, comorbidity, blood pressure and biochemistry measurements were similar in patients with and without ARB treatment (Table 1). The prevalence of UGIB (p < 0.001) and RRT (p < 0.001) was lower in patients with ARB.

Patients who developed UGIB were older (Table 2) and more likely having CKD 5 (p < 0.001). Patients with UGIB had a higher prevalence of DM as underlying kidney disease (p < 0.002), a history of UGIB (p < 0.001), H. pylori infection (p < 0.001), and comorbid DM (p = 0.001). BUN (p < 0.001), creatinine (p < 0.001) were higher in UGIB patients and haemoglobin (p < 0.001), eGFR (p < 0.001), serum albumin (p < 0.001) were lower in UGIB patients. In the antihypertensives prescribed, the percentage of ARB was lower in UGIB patients (p < 0.001), but the percentage of CCB (p = 0.03) and BB (p < 0.001) was higher in UGIB patients.

In univariate Cox proportional hazard regression, ARB (p < 0.001), higher haemoglobin (p < 0.001), and higher serum albumin (p < 0.001) was associated with lower UGIB risk (Table 3). In contrast, patients’ age (p < 0.001), a history of UGIB (p < 0.001), H. pylori infection (p < 0.001), higher BUN (p < 0.001), BB (p < 0.001) and diuretics (p = 0.001) were associated with higher risks for UGIB. Possible confounders for UGIB and those with a p < 0.05 in univariate Cox proportional hazard regression were further analysed using multivariate
Table 1 Clinical characteristics of hypertensive chronic kidney disease patients with and without angiotensin II receptor blocker (ARB) treatment

|                        | ARB (−), n = 1306 | ARB (+), n = 1438 | p     |
|------------------------|-------------------|-------------------|-------|
| Age (year)             | 66.4 ± 13.4       | 65.9 ± 13.9       | 0.34  |
| Male gender, n (%)     | 727 (55.7)        | 788 (54.8)        | 0.65  |
| Upper GI bleeding (per 100 pts per year) | 5.9              | 3.3              | < 0.001 |
| Mortality (per 100 pts per year) | 4.7              | 3.8              | 0.06  |
| RRT (per 100 pts per year) | 18.5              | 15.2              | < 0.001 |
| Stage, n (%)           |                   |                   |       |
| 1                      | 20 (1.5)          | 33 (2.3)          | 0.15  |
| 2                      | 39 (3.0)          | 62 (4.3)          | 0.07  |
| 3                      | 309 (23.7)        | 380 (26.4)        | 0.10  |
| 4                      | 395 (30.3)        | 389 (27.1)        | 0.06  |
| 5                      | 543 (41.6)        | 574 (39.9)        | 0.38  |
| Follow-up (year)       | 2.7 (0.9–4.1)     | 2.8 (0.9–4.7)     | 0.23  |
| Underlying disease     |                   |                   |       |
| DM                     | 531 (40.7)        | 546 (38.0)        | 0.15  |
| CGN                    | 394 (30.2)        | 475 (33.0)        | 0.11  |
| HTN                    | 231 (17.7)        | 283 (19.7)        | 0.18  |
| History of upper GI bleeding | 102 (7.8)     | 99 (6.9)          | 0.35  |
| H. pylori              | 33 (2.5)          | 41 (2.9)          | 0.60  |
| Comorbidity            |                   |                   |       |
| CAD                    | 185 (14.2)        | 183 (12.7)        | 0.27  |
| DM                     | 612 (46.9)        | 635 (44.2)        | 0.16  |
| Medications            |                   |                   |       |
| PPI                    | 49 (3.8)          | 56 (3.9)          | 0.85  |
| Steroid               | 44 (3.4)          | 38 (2.6)          | 0.26  |
| NSAIDs                 | 67 (5.1)          | 82 (5.7)          | 0.51  |
| Aspirin                | 178 (13.6)        | 166 (11.5)        | 0.10  |
| Warfarin              | 33 (2.5)          | 22 (1.5)          | 0.06  |
| eGFR (ml/min/1.73 m²)  | 18.2 (9.9–32.2)   | 19.8 (9.4–36.3)   | 0.06  |
| BMI (kg/m²)            | 24.4 ± 4.0        | 24.6 ± 4.1        | 0.06  |
| SBP (mmHg)             | 139 ± 19          | 140 ± 20          | 0.12  |
| DBP (mmHg)             | 79 ± 12           | 79 ± 13           | 0.99  |
| Haemoglobin (g/dl)     | 10.6 ± 2.1        | 10.7 ± 2.3        | 0.09  |
| Platelet (1000/µl)     | 214 ± 68          | 216 ± 64          | 0.33  |
| BUN (mg/dl)            | 42 (26–63)        | 41 (24–62)        | 0.84  |
| Creatinine (mg/dl)     | 2.9 (1.9–4.9)     | 2.8 (1.8–5.0)     | 0.13  |
| Uric acid (mg/dl)      | 7.6 ± 1.8         | 7.4 ± 1.6         | 0.27  |
| Sodium (mEq/l)         | 139 ± 3.3         | 138 ± 3.0         | 0.41  |
| Potassium (mEq/l)      | 4.4 ± 0.7         | 4.4 ± 0.6         | 0.84  |
| Calcium (mg/dl)        | 8.7 ± 0.3         | 8.7 ± 0.2         | 0.47  |
| Phosphorus (mg/dl)     | 4.2 ± 0.4         | 4.2 ± 0.4         | 0.85  |
| Albunin (g/dl)         | 3.4 ± 0.6         | 3.4 ± 0.6         | 0.62  |
| Cholesterol (mg/dl)    | 191 ± 52          | 194 ± 48          | 0.07  |
| Triglyceride (mg/dl)   | 148 (99–166)      | 157 (103–170)     | 0.51  |
| FBG (mg/dl)            | 114 (96–160)      | 122 (104–154)     | 0.76  |

ARB, angiotensin II receptor blocker; RRT, renal replacement therapy including haemodialysis, peritoneal dialysis and kidney transplant; DM, diabetes mellitus; CGN, chronic glomerulonephritis; HTN, hypertension; CAD, coronary artery disease; H. pylori, Helicobacter pylori; PPI, proton pump inhibitor; NSAIDs, non-steroidal anti-inflammatory drugs; eGFR, estimated glomerular filtration rate using MDRD formula; BMI, body mass index; SBP, systolic blood pressure; DBP, diastolic blood pressure; BUN, blood urea nitrogen; FBG, fasting blood glucose.
Table 2  Clinical characteristics of patients with and without upper gastrointestinal (GI) bleeding

|                          | UGIB (−), n = 2380 | UGIB (+), n = 364 | p       |
|--------------------------|--------------------|-------------------|---------|
| Age (year)               | 64.5 ± 13.9        | 67.1 ± 12.5       | < 0.001 |
| Male gender, n (%)       | 1310 (55.0)        | 205 (56.3)        | 0.21    |
| Follow-up (year)         | 1.9 (0.9–4.0)      | 1.8 (1.0–3.9)     | 0.35    |
| CKD stage                |                    |                   |         |
| 1                        | 50 (2.1)           | 3 (0.8)           | 0.10    |
| 2                        | 96 (4.0)           | 5 (1.4)           | 0.012   |
| 3                        | 627 (26.3)         | 62 (17.0)         | < 0.001 |
| 4                        | 686 (28.8)         | 98 (26.9)         | 0.45    |
| 5                        | 921 (38.7)         | 196 (53.9)        | < 0.001 |
| Underlying disease       |                    |                   |         |
| DM                       | 908 (38.6)         | 169 (46.9)        | 0.002   |
| CGN                      | 761 (32.3)         | 108 (30.0)        | 0.38    |
| HTN                      | 462 (19.6)         | 44 (12.2)         | < 0.001 |
| History of upper GI bleed| 142 (6.0)          | 59 (16.2)         | < 0.001 |
| H. pylori                | 48 (2.0)           | 26 (7.1)          | < 0.001 |
| Comorbidity              |                    |                   |         |
| CAD                      | 315 (13.2)         | 53 (14.6)         | 0.49    |
| DM                       | 1053 (44.2)        | 194 (53.3)        | 0.001   |
| PPI                      | 58 (2.4)           | 23 (6.3)          | < 0.001 |
| Steroid                  | 75 (3.2)           | 7 (1.9)           | 0.20    |
| NSAIDs                   | 129 (5.4)          | 20 (5.5)          | 0.95    |
| Aspirin                  | 298 (12.5)         | 46 (12.6)         | 0.95    |
| Warfarin                 | 45 (1.9)           | 10 (2.7)          | 0.28    |
| eGFR (ml/min/1.73 m²)    | 20 (10.0–35.4)     | 14.1 (8.1–26.2)   | < 0.001 |
| BMI (kg/m²)              | 24.6 ± 4.0         | 24.2 ± 3.8        | 0.12    |
| SBP (mmHg)               | 140 ± 19           | 141 ± 20          | 0.11    |
| DBP (mmHg)               | 79 ± 13            | 79 ± 13           | 0.30    |
| Haemoglobin (g/dl)       | 10.7 ± 2.2         | 10.2 ± 2.2        | < 0.001 |
| Platelet (1000/μl)       | 215 ± 63           | 213 ± 84          | 0.62    |
| BUN (mg/dl)              | 38 (24–62)         | 49 (30–68)        | < 0.001 |
| Creatinine (mg/dl)       | 2.8 (1.8–4.9)      | 3.6 (2.1–5.9)     | < 0.001 |
| Uric acid (mg/dl)        | 7.5 ± 1.7          | 7.5 ± 1.8         | 0.94    |
| Sodium (mEq/l)           | 139 ± 3.1          | 138 ± 3.9         | 0.63    |
| Potassium (mEq/l)        | 4.3 ± 0.7          | 4.4 ± 0.7         | 0.67    |
| Calcium (mg/dl)          | 8.7 ± 0.2          | 8.7 ± 0.2         | 0.99    |
| Phosphorus (mg/dl)       | 4.2 ± 0.4          | 4.2 ± 0.3         | 0.44    |
| Albumin (g/dl)           | 3.4 ± 0.6          | 3.2 ± 0.6         | < 0.001 |
| Cholesterol (mg/dl)      | 192 ± 48           | 189 ± 60          | 0.19    |
| Triglyceride (mg/dl)     | 158 ± 99           | 162 ± 140         | 0.52    |
| FBG (mg/dl)              | 132 ± 48           | 151 ± 66          | 0.08    |
| Antihypertensives        |                    |                   |         |
| ARB                      | 1289 (54.2)        | 149 (40.9)        | < 0.001 |
| ACEI                     | 215 (9.0)          | 25 (6.9)          | 0.17    |
| CCB                      | 378 (15.9)         | 74 (20.3)         | 0.03    |
| BB                       | 327 (13.7)         | 76 (20.9)         | < 0.001 |
| Diuretics                | 777 (40.3)         | 127 (45.7)        | 0.09    |

DM, diabetes mellitus as primary kidney disease; CGN, chronic glomerulonephritis; HTN, hypertension; H. pylori, Helicobacter pylori; CAD, coronary artery disease; PPI, proton pump inhibitor; NSAIDs, non-steroidal anti-inflammatory drugs; eGFR, estimated glomerular filtration rate using CKD-EPI formula; BMI, body mass index; SBP, systolic blood pressure; DBP, diastolic blood pressure; BUN, blood urea nitrogen; FBG, fasting blood glucose; ARB, angiotensin II receptor blocker; ACEI, angiotensin converting enzyme inhibitors; CCB, calcium channel blocker; BB, beta blocker.
### Table 3 Hazard ratios of possible confounders for upper gastrointestinal bleeding in univariate Cox proportional hazard regression

|                           | HR   | 95% CI          | p    |
|---------------------------|------|-----------------|------|
| ARB                       | 0.613| 0.497–0.755     | < 0.001 |
| ACEI                      | 0.637| 0.424–0.957     | 0.030 |
| CCB                       | 0.905| 0.700–1.169     | 0.445 |
| BB                        | 1.625| 1.261–2.094     | < 0.001 |
| Diuretics                 | 1.483| 1.170–1.881     | 0.001 |
| Age (every 10 years older)| 1.163| 1.072–1.261     | < 0.001 |
| Male gender               | 0.939| 0.763–1.156     | 0.552 |
| History of upper Gl bleeding|     |                 |      |
| eGFR (every 5 ml/min/1.73 m² increment) | 2.681| 2.028–3.544     | < 0.001 |
| H. pylori                 | 2.754| 1.847–4.104     | < 0.001 |
| CAD                       | 1.156| 0.863–1.547     | 0.97  |
| DM                        | 0.999| 0.997–1.002     | 0.855 |
| PPI                       | 2.729| 1.772–4.202     | < 0.001 |
| Steroid                   | 0.508| 0.241–1.075     | 0.076 |
| NSAIDs                    | 1.061| 0.676–1.666     | 0.798 |
| Aspirin                   | 1.004| 0.737–1.368     | 0.979 |
| Warfarin                  | 1.521| 0.811–2.853     | 0.191 |
| Haemoglobin (every 1 mg/dl increment) | 0.750| 0.711–0.791     | < 0.001 |
| BUN (every 10 mg/dl increment) | 1.211| 1.184–1.238     | < 0.001 |
| Albumin (every 1 mg/dl increment) | 0.422| 0.359–0.495     | < 0.001 |

CI, confidence interval; eGFR, estimated glomerular filtration rate using CKD-EPI formula; H. pylori, Helicobacter pylori; DM, diabetes mellitus as primary kidney disease; PPI, proton pump inhibitor; NSAIDs, non-steroidal anti-inflammatory drugs; BUN, blood urea nitrogen; ARB, angiotensin II receptor blocker; ACEI, angiotensin converting enzyme inhibitors; CCB, calcium channel blocker; BB, beta blocker.

### Table 4 Adjusted hazard ratios (HRs) of possible confounders for upper gastrointestinal bleeding in multivariate Cox proportional hazard regression

|                           | HR   | 95% CI          | p    |
|---------------------------|------|-----------------|------|
| ARB                       | 0.533| 0.404–0.703     | < 0.001 |
| ACEI                      | 0.774| 0.504–1.187     | 0.240 |
| BB                        | 6.995| 4.144–11.806    | < 0.001 |
| Diuretics                 | 0.798| 0.618–1.029     | 0.082 |
| Age (every 10 years older)| 1.108| 0.998–1.230     | 0.054 |
| History of upper GI bleeding| 1.805| 1.235–2.637     | 0.002 |
| eGFR (every 5 ml/min/1.73 m² increment) | 0.906| 0.858–0.958     | < 0.001 |
| H. pylori                 | 1.828| 1.105–3.025     | 0.019 |
| CAD                       | 0.128| 0.071–0.233     | < 0.001 |
| DM                        | 1.541| 1.199–1.980     | 0.001 |
| PPI                       | 0.926| 0.533–1.608     | 0.783 |
| Steroid                   | 0.720| 0.314–1.652     | 0.439 |
| NSAIDs                    | 1.267| 0.770–2.085     | 0.352 |
| Aspirin                   | 1.017| 0.704–1.468     | 0.930 |
| Warfarin                  | 1.424| 0.746–2.720     | 0.284 |
| Haemoglobin (every 1 mg/dl increment) | 0.932| 0.868–1.001     | 0.053 |
| BUN (every 10 mg/dl increment) | 1.146| 1.090–1.205     | < 0.001 |
| Albumin (every 1 mg/dl increment) | 0.499| 0.405–0.614     | < 0.001 |

eGFR, estimated glomerular filtration rate using CKD-EPI formula; H. pylori, Helicobacter pylori; CAD, coronary artery disease; DM, diabetes mellitus; NSAIDs, non-steroidal anti-inflammatory drugs; BUN, blood urea nitrogen; ARB, angiotensin II receptor blocker; ACEI, angiotensin converting enzyme inhibitors; CCB, calcium channel blocker; BB, beta blocker.
Cox proportional hazard regression (Table 4). ARB treatment was associated with lower risks of UGIB with an adjusted HR of 0.533 (95% CI: 0.404–0.703, \( p < 0.001 \)). Patients with ARB had a better UGIB free survival compared with those not on ARB (\( p = 0.001 \), Figure 1). A history of UGIB (\( p < 0.001 \)), \textit{H. pylori} infection (\( p = 0.019 \)), DM (\( p = 0.001 \)), and BUN were independently associated with higher risks for UGIB. The adjusted HR was 1.805 (95% CI: 1.235–2.637) for patients with UGIB history, 1.828 (95% CI: 1.105–3.025) for patients with \textit{H. pylori} infection, 1.541 (95% CI: 1.199–1.980) for every 10 mg/dl higher of BUN. Patients with higher eGFR (\( p < 0.001 \)) and higher serum albumin (\( p < 0.001 \)) were independently associated with lower UGIB risks. The adjusted HR was 0.906 (95% CI: 0.858–0.958) for every 5 ml/min/1.73 m² higher of eGFR, and 0.499 (95% CI: 0.405–0.703) for every 1 mg/dl higher of serum albumin.

**Discussions**

In a cohort consisting of hypertensive patients with CKD and not on dialysis, ARB was associated with decreased risk of UGIB. This finding was supported by the Cox regression which demonstrated a 40% decrease of UGIB risk in patients with ARB treatment (Table 4). Meanwhile, ACEI but not CCB treatment was also associated with a decreased risk of UGIB in univariate Cox regression (Table 3). This finding supported our hypothesis that inhibition of RAAS is associated with a decreased risk of UGIB in hypertensive patients with CKD. The association between ARB and lower UGIB may be explained by the reduced mucosal damage (4) through the decrease in inflammatory cytokines such as tumour necrosis factor alpha (11). The renoprotective effect of ARB (12) may also play a role in the lower UGIB risks because lower eGFR was associated with higher UGIB risks (13,14). The risk of UGIB was not significantly lower in patients on ACEI because limited number (8.8%) of patients took ACEI in this study. The effect of ARB on decreasing UGIB risk was independent of the confounders of UGIB. The confounders for UGIB in this study included \textit{H. pylori} infection, lower renal function (14,15), comorbid diabetes (16), and a low serum albumin (17,18) that had also been reported in the previous studies.

Given the strong association between CKD and CAD, antithrombotic (19,20) or antiplatelet medications are commonly used in CKD patients. It is generally believed that antithrombotic or antiplatelet medications may increase the risk of UGIB in CKD patients. The use of aspirin (19,20) and warfarin (21) were analysed, but none of these medications were linked to UGIB. In this study, PPI treatment was associated with an increased UGIB risk (Table 3) because the cost of PPI treatment was covered by the health insurance of Taiwan only after a peptic ulcer was diagnosed using panendoscopy. Since most of the patients receiving PPI treatment had the history of peptic ulcer, these patients were more at risk for developing UGIB.

There are some potential limitations of this study. First, this is not a randomised control trial to investi-
gate the effectiveness of ARB in decreasing UGIB risk. As the basal characteristics of patients with and without ARB were not different at enrollment (Table 1), selection bias did not explain the beneficial effect of ARB on UGIB in this study. Second, the use of ARB or ACEI was recorded at enrollment and the use of these medications in follow-up was not recorded. We were not able to analyse the effect of ARB treatment duration on UGIB. Third, ARB or ACEI should be considered in all CKD patients with/without HTN based on the KDIGO guideline (4) and there were 50% patients receiving ARB or ACEI in this study. Most of the patients without ARB or ACEI may be treated by clinicians who are not physicians of nephrology, or have contraindication for ARB/ACEI treatment. Fourth, comprehensive suppression of the RAAS by adding spironolactone on ARB or ACEI may further hold the progression of CKD (22). We did not observe a superior benefit in adding spironolactone on ARB or ACEI for the risk of UGIB because spironolactone was prescribed in 0.8% of the patients in this study. Combination of ARB and ACEI was more effective in decreasing proteinuria than monotherapy (23); however, its clinical application can be limited by an increase in hyperkalemia risk (24,25). In this study, there were less than 1% of patients on the combination therapy (ARB + ACEI) and no significant association was found for its effect on UGIB. Despite these limitations, this study presented an extra clinical application for ARB, it not only decreases progression of CKD but also reduces UGIB risk in hypertensive patients with CKD.

In conclusion, ARB is associated with lower risk of UGIB in hypertensive patients with CKD and not on dialysis. Patients’ renal function, medical history, H. pylori infection, comorbidity and patients’ serum albumin are independently linked to UGIB risks.

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