Research Article

# A Study to Evaluate the Role of Bun/Creatinine Ratio as a Discriminator Factor in Azotemia

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**ABSTRACT**

Azotemia is a medical condition characterized by abnormally high levels of nitrogen-containing compounds in the blood. It can lead to uremia if not controlled. The three classification of azotemia namely, pre-renal, renal and post-renal have different causes and treatment but all three have some common features. The discrimination of azotemia is very important because only earlier diagnosis and treatment helps in recovery and survival of the patients. Blood Urea and serum creatinine levels are usually elevated but in different proportions due to the causative origin of azotemia. So the blood urea nitrogen(BUN) and serum creatinine ratio may be helpful in discrimination of azotemia. We have taken total 309 cases of abnormal urea and creatinine values. BUN/creatinine ratios were calculated by dividing the BUN and creatinine values. BUN is calculated by dividing blood urea by 2.14. Then we divided the ratios into 4 groups namely ratios >20, ratios <10, ratios 10-15 & ratios 15-20. The history of the patient was clearly taken and the cause of the azotemia whether prerenal, renal or postrenal was noted. 5 non-renal cases were taken. 18 Gastrointestinal bleeding patients were included in the prerenal azotemia. Then for each of the 4 group ratios, number of cases of prerenal, renal, postrenal or non-renal cause was calculated. The aim of the current study is to determine whether the BUN/CREATININE ratio can be used to discriminate the cause of azotemia.

**Keywords:** Azotemia, BUN/creatinine ratio, nitrogen-containing compounds, blood.

## INTRODUCTION

**Azotemia** (*azot*, "nitrogen" + *-emia*, "blood condition") is a medical condition characterized by abnormally high levels of nitrogen-containing compounds (such as urea, creatinine and other nitrogen-rich compounds) in the blood. It is largely related to insufficient or dysfunctional filtering of blood by the kidneys. It can lead to uremia if not controlled[1-3]. Azotemia has three classifications, depending on its causative origin, but all three types share a few common features. All forms of azotemia are characterized by a decrease in the glomerular filtration rate (GFR) of the kidneys and increases in blood urea nitrogen (BUN) and serum creatinine concentrations. The BUN-to-creatinine ratio (BUN:Cr) is a useful measure in determining the type of azotemia[1-3]. From Ask Dr WikiJump to: navigation, search.

| BUN/creatinine ratio | Urea:creatinine ratio | Causative origin |
|---|---|---|
| >20:1 | >100:1 | Prerenal |
| 10-20:1 | 40-100:1 | Normal or postrenal |
| <10:1 | <40:1 | renal |

The BUN/creatinine ratio (BUN:Cr) is the ratio of two serum laboratory values, the blood urea nitrogen (BUN) and serum creatinine. This terminology is used in the United States. In Canada and Europe, urea is used instead of BUN, so it is termed urea/creatinine ratio. The interpretation and significance of the ratio is identical[1-3].

Prerenalazotemia is caused by hypoperfusion in which there is no inherent kidney disease. The common causes are hemorrhage, shock, burns, volume depletion, congestive heart failure, adrenal insufficiency and narrowing of the renal artery. Expand Section, It can be reversed if corrected within 24 hours and damage to the kidney (acute tubular necrosis) can be prevented. The BUN:Cr in prerenal azotemia is greater than 20. The reason for this lies in the mechanism of filtration of BUN and creatinine. Renal Plasma Flow (RPF) is decreased due to hypoperfusion which results in a proportional decrease in GFR. BUN reabsorption is increased. BUN is disproportionately elevated relative to creatinine in serum[4].

Renal azotemia (acute renal failure) typically leads to uremia is an intrinsic disease of the kidney, generally the result of renal parenchymal damage. The common causes are renal failure, glomerulonephritis, acute tubular necrosis, or any other kind of renal disease.[2] The BUN:Cr in renal azotemia is less than 10. Renal damage causes reduced reabsorption of BUN therefore lowering the BUN:Cr ratio[4,5].

Postrenalazotemia is usually caused by conditions that cause blockage of urine flow in an area below the kidneys like congenital abnormalities such as vesicoureteral reflux, blockage of the ureters by kidney stones, pregnancy, compression of the ureters by cancer, prostatic hyperplasia, or blockage of the urethra by kidney or bladder stones[6]. Like in prerenalazotemia, there


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is no inherent renal disease. The increased resistance to urine flow can cause back up into the kidneys, leading to hydronephrosis. BUN reabsorption is within normal limits. Post renal azotemia has normal ratio.

Blood urea levels are increased in gastrointestinal bleeding because the blood, which consists largely of the proteinhemoglobin, is broken down by digestive enzymes of the upper GI tract into amino acids[7-9]. The amino acids, which originate from the hemoglobin, are re-absorbed by the lower GI tract. Urea is the end product of protein metabolism and therefore, the "protein meal" from an upper GI bleeds shows up in the blood as urea[7-9].

The high ratios with high urea and normal creatinine indicate prerenal causes.[10] The high ratios with high urea and high creatinine suggest post renal obstruction and prerenalazotemia superimposed on chronic kidney disease (CKD)[10]. The common causes for the increased ratios are dehydration/prerenal failure, corticosteroids, GI hemorrhage, protein-rich diet severe catabolic state. The common causes for the decreased ratios are severe liver dysfunction, intrinsic renal damage, starvation, malnutrition, pregnancy, low protein diet, SIADH, rhabdomyolysis. Because of decreased muscle mass, elderly patients may have an elevated bun-to-creatinine ratio at baseline[1,2,10].

An elevated BUN:Cr due to a low or low-normal creatinine and a BUN within the reference range are unlikely to be of clinical significance. The aim of the current study is to determine the role of BUN/CREATININE ratio as a discriminator factor in different types of azotemia.

## MATERIALS AND METHODS

We collected 309 abnormal blood urea and serum creatinine values in our laboratory in last month. The age group was 18-80 years both male and female included. Blood urea was estimated by Bertholet method. Serum creatinine was estimated by Jaffe's method. Blood urea nitrogen (BUN) was calculated by the formulae

**Blood urea =2.14 * BUN**

BUN values were calculated by dividing the blood urea level by 2.14.BUN/CREATININE ratio was calculated by dividing the BUN and serum creatinine levels. The calculated ratios are divided into 4 groups namely ratios >20, ratios <10, ratios 10-15 & ratios 15-20. The history of the patient was clearly taken and the cause of the azotemia whether prerenal, renal or post renal was noted. Gastrointestinal bleeding patients are included in the prerenalazotemia. Then for each of the 4 group ratios, number of cases of prerenal, renal, post renal or non-renal cause was calculated.

## RESULTS

**Table 1:** Number of Cases in Each Group

| Causes | Ratio > 20 | Ratio < 10 | Ratio 10-15 | Ratio 15-20 | Total |
|---|---|---|---|---|---|
| **Pre-Renal** | 50 (18 cases are GIB) | Nil | Nil | 17 | 67 |
| **Renal** | Nil | 80 | 18 | 3 | 101 |
| **Post-Renal** | 6 | Nil | 82 | 48 | 136 |
| **Non-Renal** | 3 | 2 | Nil | Nil | 5 |
| **Total** | 59 | 82 | 100 | 68 | 309 |
| **Total** | 309 | | | | |

**Table 2:** % of Cases in Pre-Renal, Renal and Post Renal

| Causes | Ratio > 20 | Ratio < 10 | Ratio 10-15 | Ratio 15-20 | Total |
|---|---|---|---|---|---|
| Pre-Renal | 50 (74.6%) | Nil | Nil | 17 (25.4%) | 67 |
| Renal | Nil | 80 (79.2%) | 18 (17.8%) | 3 (3%) | 101 |
| Post-Renal | 6 (4.4%) | Nil | 82 (60.3%) | 48 (35.3%) | 136 |

**Table 3:** % of Cases in Each Group

| Causes | Ratio >20 | Ratio <10 | Ratio 10-15 | Ratio 15-20 |
|---|---|---|---|---|
| Pre-Renal | 50 (84.7%) | Nil | Nil | 17 (25%) |
| Renal | Nil | 80 (97.6%) | 18 (18%) | 3 (4.4%) |
| Post-Renal | 6 (10.2%) | Nil | 82 (82%) | 48 (70.6%) |
| Non-Renal | 3 (5.1%) | 2 (2.4%) | Nil | Nil |
| Total | 59 | 82 | 100 | 68 |


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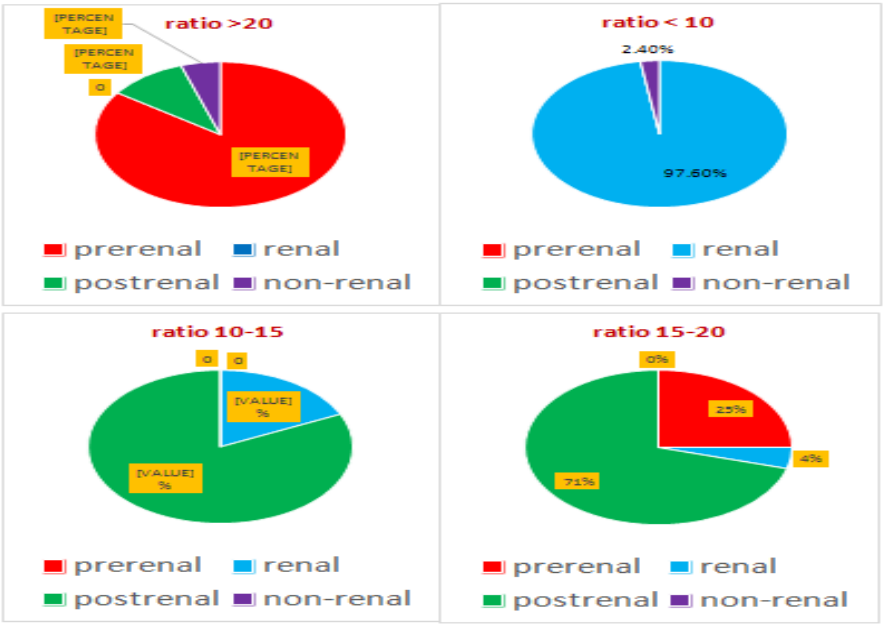


**Figure 1:** BUN/CREATININE RATIOS of the 4 groups

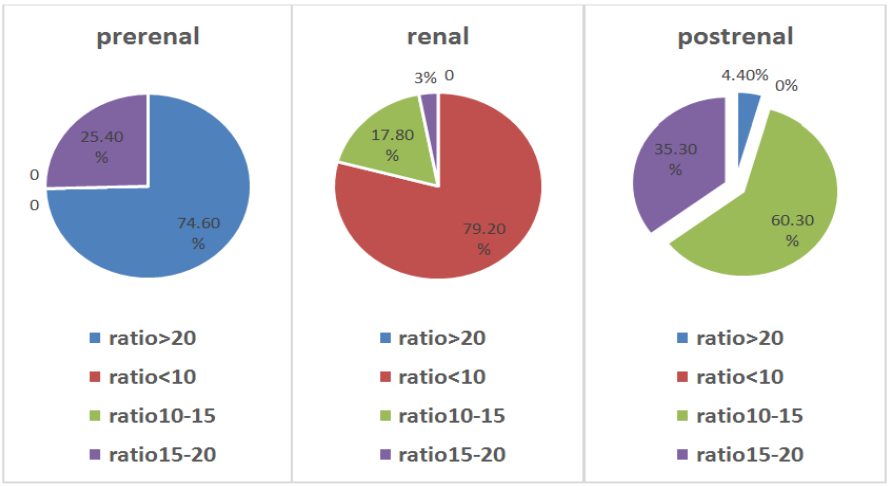


**Figure 2:** % of cases in each group for pre renal, renal and post renal cases

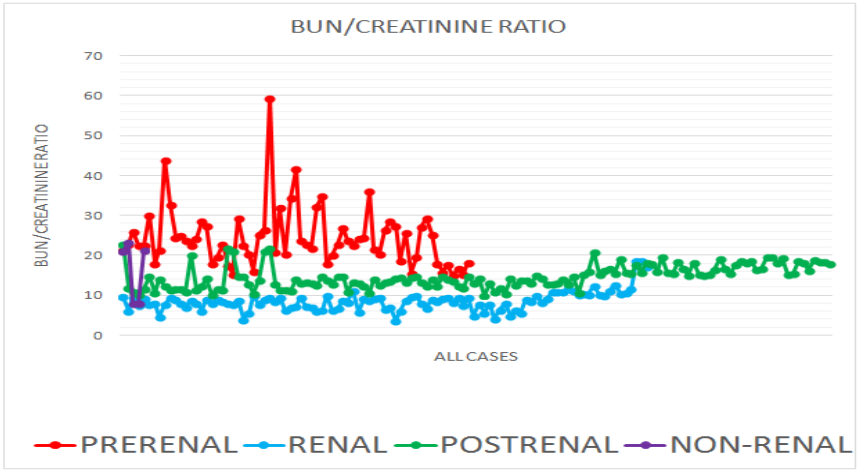


**Figure 3:** BUN/Creatinine Ratios (all 309 cases) line diagram

## DISCUSSION

The application of BUN/creatinine ratios in the discrimination of various causes of azotemia namely pre-renal, renal and post-renal has been previously studied[1-6]. Its application in the differentiation of cause of gastrointestinal bleeding whether upper or lower is also studied[7-9].


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Numerous previous publications have shown that the ratios has some value but at the same time there is no clear cut-off value for the differentiation, because some cases are overlapping.

The current study was conducted to evaluate the role of BUN/creatinine ratio in our hospital setup as the estimation of BUN/creatinine is very easy, simple and can be applied quickly so that the early prediction of the cause of azotemia may help in faster management because the treatment for each type of azotemia is different.

We have taken 309 abnormal urea & creatinine values. BUN/creatinine ratio was calculated using formula. Then we divided the ratios into 4 groups namely ratios >20, ratios <10, ratios 10-15 & ratios 15-20.

The history of the patient was clearly taken and the cause of the azotemia whether prerenal, renal or post renal was noticed.[18] Gastrointestinal bleeding patients are included in the prerenal azotemia.

Then for each of the 4 group ratios, number of cases of prerenal, renal, post renal or non-renal cause was calculated.

Total number of cases in each group in clearly shown in Table 1. Of the total 309 cases 67 are prerenal, 101 are renal, and 136 are post renal & 5 non renal cases. All the gastrointestinal bleeding patients had ratios > 20. The percentage of cases in pre-renal, renal and post-renal cases are shown in Table 2 and the percentage of cases in each of the four groups are clearly shown in Table 3.

BUN/creatinine ratios of the four groups were shown in Figure 1 and the percentage of cases in each group for pre-renal, renal and post-renal cases were clearly shown in Figure 2 using pie-charts. The BUN/creatinine values of all the 309 cases are plotted in the line diagram which is shown in Figure 3. The pre-renal cases are usually in the upper part, renal cases are in the lower part and the post-renal cases are in the middle with some cases overlapping.

From the Tables 1, 2 and 3 and Figures 1, 2 and 3 it is clearly visible that there is no clear cut-off point to differentiate and discriminate the different types of azotemia because some cases are overlapping.

## CONCLUSION

BUN/creatinine ratios have poor discriminatory ability in accurate differential diagnosis of pre -renal, renal and post renal causes.

Since the BUN/Creatinine ratio is a calculated parameter that is easy and readily available, application of this ratio can be done because early detection of the cause of azotemia help in prompt and timely management of the patient.

We conclude our study by saying that BUN/Creatinine ratio alone does not provide an accurate differential diagnosis but it provide us a rough guide to interpret the cause of azotemia along with the blood urea, serum creatinine and detailed clinical history of the patient.

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