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EFFECT OF ORAL SODIUM BICARBONATE THERAPY ON PROGRESSION OF CHRONIC KIDNEY DISEASE IN PATIENTS WITH METABOLIC ACIDOSIS

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ABSTRACT

Objective: To determine the effect of oral sodium bicarbonate therapy on the progression of chronic kidney disease in patients with metabolic acidosis and to evaluate its impact on renal function and clinical outcomes.

Methods: This prospective comparative study was conducted at Lady Reading Hospital Peshawar from 11 January 2025 to 11 December 2025. A total of 110 patients with chronic kidney disease and metabolic acidosis were included using nonprobability consecutive sampling. Fifty five patients received oral sodium bicarbonate therapy in addition to standard treatment while fifty five patients received standard medical management alone. Baseline demographic characteristics and biochemical parameters were recorded and patients were followed regularly to assess changes in serum bicarbonate concentration renal function and progression of kidney disease. Data were analyzed using Statistical Package for Social Sciences version 26 and a p value of less than 0.05 was considered statistically significant.

Results: The mean age of the study population was 54.6 ± 13.1 years and 68 patients were male. The mean baseline serum bicarbonate level was 18.5 ± 2.4 milliequivalents per liter. At the end of follow up the sodium bicarbonate group demonstrated significantly higher serum bicarbonate levels and better preservation of estimated glomerular filtration rate than the control group. Progression to stage five chronic kidney disease and requirement for dialysis were significantly lower among patients receiving bicarbonate therapy.

Conclusion: Oral sodium bicarbonate therapy was associated with improvement in metabolic acidosis and delayed progression of chronic kidney disease. Early correction of acid base abnormalities may contribute to preservation of renal function and reduction in dialysis dependence.

KEYWORDS: Chronic kidney disease. Metabolic acidosis. Sodium bicarbonate therapy. Renal function. Dialysis. Glomerular filtration rate.

INTRODUCTION

Chronic kidney disease is recognized as a major public health challenge that affects millions of individuals throughout the world and contributes substantially to morbidity mortality and healthcare expenditure. The disease is characterized by progressive and irreversible decline in renal function which ultimately results in end stage renal disease and the requirement for renal replacement therapy.[1] The burden of chronic kidney disease has increased during recent decades because of the growing prevalence of diabetes mellitus hypertension obesity and population aging. Patients with chronic kidney disease frequently develop several metabolic complications that accelerate deterioration of renal function and adversely affect quality of life.

Metabolic acidosis is one of the most common complications observed in patients with moderate and advanced chronic kidney disease. It develops because diseased kidneys lose their ability to excrete acid and regenerate bicarbonate effectively.[2] Persistent metabolic acidosis has been associated with numerous harmful consequences including muscle wasting bone demineralization endocrine disturbances inflammation and acceleration of renal injury. Acidosis stimulates ammoniagenesis and activation of complement pathways which promote tubulointerstitial damage and progressive nephron loss. Consequently correction of metabolic acidosis has become an important therapeutic target in the management of chronic kidney disease.

Oral sodium bicarbonate therapy has emerged as an inexpensive and widely available intervention for the treatment of metabolic acidosis in patients with chronic kidney disease. Administration of bicarbonate replenishes serum bicarbonate levels and restores acid base balance.[3] Experimental and clinical studies have suggested that correction of

metabolic acidosis may slow the progression of chronic kidney disease by reducing renal inflammation decreasing endothelin production and minimizing tubulointerstitial injury. Furthermore improvement in nutritional status and preservation of muscle mass have also been reported among patients receiving bicarbonate supplementation.

Several observational studies have demonstrated an association between low serum bicarbonate concentrations and accelerated decline in glomerular filtration rate.[4] Patients with persistent metabolic acidosis have been shown to experience more rapid progression to end stage renal disease and higher mortality rates than patients with normal bicarbonate levels. These findings have generated considerable interest regarding the potential renoprotective effects of bicarbonate therapy. Consequently oral sodium bicarbonate has been increasingly incorporated into treatment strategies for patients with chronic kidney disease and metabolic acidosis.

Despite the theoretical benefits of bicarbonate supplementation concerns remain regarding its long term efficacy and safety. Oral sodium bicarbonate administration increases sodium intake and therefore may contribute to fluid retention hypertension and cardiovascular complications particularly in patients with advanced renal dysfunction.[5] Some investigators have suggested that the benefits of bicarbonate therapy may vary according to the stage of kidney disease baseline bicarbonate concentration and presence of comorbid conditions. These uncertainties have resulted in variations in clinical practice and differences in treatment recommendations.

The pathophysiological relationship between metabolic acidosis and chronic kidney disease progression has been extensively investigated. Acidosis has been shown to stimulate production of angiotensin II aldosterone and endothelin which contribute to renal fibrosis and structural damage.[6] In addition increased acid retention may promote inflammation oxidative stress and activation of profibrotic pathways. Correction of acidosis through bicarbonate administration may attenuate these mechanisms and preserve residual renal function. Therefore understanding the therapeutic impact of oral sodium bicarbonate is of considerable importance in nephrology practice.

Current international guidelines recommend maintenance of serum bicarbonate concentrations within the normal range in patients with chronic kidney disease.[7] However evidence regarding the optimal timing dosage and duration of bicarbonate therapy remains limited. Clinical trials have reported varying results with some studies demonstrating significant slowing of renal function decline while others have shown only modest benefits. Differences in study design patient characteristics and outcome measures have contributed to these inconsistencies.

The prevalence of chronic kidney disease continues to increase in developing countries where access to renal replacement therapy remains limited and expensive.[8] Strategies capable of delaying progression of kidney disease are therefore of great clinical and economic importance. Oral sodium bicarbonate therapy represents a potentially simple and cost effective intervention that may reduce the burden of advanced kidney disease and improve patient outcomes. Evaluation of its effectiveness is particularly relevant in resource constrained healthcare systems where prevention of end stage renal disease is a major priority.

Although numerous studies have evaluated metabolic acidosis and bicarbonate therapy most investigations have been conducted in selected populations and have focused on short term biochemical outcomes.[9] Data regarding the long term effect of oral sodium bicarbonate therapy on the progression of chronic kidney disease remain limited particularly in populations from low and middle income countries. Furthermore variations in treatment protocols and differences in patient characteristics have restricted the generalizability of available findings. Evidence regarding the relationship between bicarbonate therapy and preservation of renal function therefore remains incomplete.

Another important limitation in the existing literature is the lack of comprehensive studies that correlate biochemical improvement with clinically meaningful outcomes such as decline in estimated glomerular filtration rate progression to advanced kidney disease and need for renal replacement therapy.[10] There is also insufficient information regarding the impact of bicarbonate therapy in patients with different stages of chronic kidney disease and varying degrees of metabolic acidosis.

The existing research gap emphasizes the necessity for further investigation into the effectiveness of oral sodium bicarbonate therapy in delaying progression of chronic kidney disease among patients with metabolic acidosis. A better understanding of the therapeutic role of bicarbonate supplementation may contribute to the development of evidence based treatment strategies and improve long term renal outcomes.

The objective of this study was to determine the effect of oral sodium bicarbonate therapy on the progression of chronic kidney disease in patients with metabolic acidosis and to evaluate its influence on renal function and clinical outcomes.

MATERIALS AND METHODS

Study Design

This study was designed as a prospective comparative study to determine the effect of oral sodium bicarbonate therapy on the progression of chronic kidney disease in patients with metabolic acidosis. The study was conducted at Lady Reading Hospital Peshawar from 11 January 2025 to 11 December 2025. A total of 110 patients diagnosed with chronic kidney disease and metabolic acidosis were enrolled in the study. Patients were followed during the study period to assess changes in renal function biochemical parameters and disease progression after administration of oral sodium bicarbonate therapy. A nonprobability consecutive sampling technique was employed and all eligible patients presenting during the study period were included.

Study Setting

The study was performed in the Departments of Nephrology and Internal Medicine at Lady Reading Hospital Peshawar which is a tertiary care teaching hospital and one of the largest referral centers in Khyber Pakhtunkhwa. The institution receives a substantial number of patients with chronic kidney disease from urban and rural areas and provides comprehensive nephrology services including laboratory investigations imaging studies and long term medical management. The availability of multidisciplinary facilities enabled regular patient follow up and monitoring throughout the study period.

Study Population

The study population consisted of adult patients with established chronic kidney disease who had evidence of metabolic acidosis on biochemical evaluation. Chronic kidney disease was diagnosed according to internationally accepted criteria including reduced estimated glomerular filtration rate or evidence of kidney damage persisting for more than three months. Metabolic acidosis was defined as a serum bicarbonate concentration of less than 22 milliequivalents per liter. Patients were recruited from outpatient clinics inpatient wards and nephrology referral services.

Sample Size and Sampling Technique

A total sample size of 110 patients was included in the study. The sample size was considered sufficient to determine the effect of oral sodium bicarbonate therapy on progression of chronic kidney disease and to evaluate changes in renal and biochemical parameters during follow up. Nonprobability consecutive sampling was utilized to ensure the inclusion of all eligible patients presenting during the study period and to minimize selection bias.

Patient Grouping and Intervention

After enrollment patients were divided into two groups according to treatment strategy. The intervention group received oral sodium bicarbonate therapy in addition to standard management of chronic kidney disease. The control group received standard medical treatment without bicarbonate supplementation. Oral sodium bicarbonate was administered at an initial dose of 0.5 milliequivalents per kilogram of body weight per day and the dose was adjusted according to serum bicarbonate concentrations during follow up. Both groups received routine management including dietary counseling blood pressure control and treatment of underlying comorbid conditions.

Inclusion Criteria

Patients aged eighteen years and above with chronic kidney disease stages three to five and documented metabolic acidosis were included in the study. Individuals with serum bicarbonate concentrations below 22 milliequivalents per liter and stable clinical condition were considered eligible. Patients willing to participate in the study and capable of attending regular follow up visits were enrolled after obtaining informed consent.

Exclusion Criteria

Patients with acute kidney injury or rapidly progressive glomerulonephritis were excluded from the study. Individuals receiving dialysis therapy or those with previous renal transplantation were not included. Patients with severe congestive heart failure uncontrolled hypertension decompensated liver disease active malignancy or severe electrolyte disturbances were excluded because these conditions could influence acid base balance and treatment response. Pregnant women and patients with poor compliance to treatment or follow up schedules were also excluded.

Data Collection Procedure

A structured data collection form was used to record demographic and clinical information. Variables including age gender body mass index duration of chronic kidney disease and underlying etiological factors were documented. Baseline laboratory investigations included serum creatinine blood urea nitrogen serum bicarbonate serum potassium hemoglobin and estimated glomerular filtration rate. Blood pressure and body weight were measured at each follow up visit. Patients were followed at regular intervals and repeat biochemical investigations were performed to assess treatment response and disease progression.

Outcome Measures

The primary outcome measure was progression of chronic kidney disease as determined by changes in estimated glomerular filtration rate and serum creatinine concentration during follow up. Secondary outcome measures included changes in serum bicarbonate levels incidence of progression to advanced kidney disease and requirement for renal replacement therapy. Additional outcomes included assessment of adverse effects related to oral sodium bicarbonate therapy including fluid overload hypertension and electrolyte disturbances.

Follow Up Protocol

Patients were evaluated at baseline and subsequently at monthly intervals throughout the study period. Clinical examination and laboratory investigations were performed during each visit. Compliance with oral sodium bicarbonate therapy was assessed through patient interviews and review of medication records. Any adverse events or complications were documented and managed according to standard clinical practice.

Ethical Consideration

Ethical approval for the study was obtained from the Institutional Review Board of Lady Reading Hospital Peshawar before commencement of data collection. The study was conducted according to the principles outlined in the Declaration of Helsinki and institutional ethical regulations. Written informed consent was obtained from all participants before enrollment. Confidentiality of patient information was maintained and all collected data were

anonymized before analysis. Participation in the study did not interfere with the routine treatment provided to the patients and participants retained the right to withdraw from the study at any stage without prejudice.

Statistical Analysis

Data were entered and analyzed using the Statistical Package for Social Sciences version 26. Quantitative variables including age serum creatinine estimated glomerular filtration rate and serum bicarbonate concentration were expressed as mean and standard deviation. Qualitative variables such as gender stage of chronic kidney disease and adverse events were presented as frequencies and percentages. Independent sample t tests and paired sample t tests were used to compare continuous variables between and within groups. The chi square test or Fisher exact test was applied for categorical variables whenever appropriate. A p value of less than 0.05 was considered statistically significant. The findings were presented in tables and descriptive summaries to facilitate interpretation and comparison with previously published studies.

RESULTS

Patient Demographics and Baseline Clinical Characteristics

A total of 110 patients with chronic kidney disease and metabolic acidosis were included in the study. The mean age of the study population was 54.6 ± 13.1 years with an age range of 24 to 81 years. There were 68 male patients and 42 female patients indicating a male predominance. Diabetes mellitus and hypertension were the most common underlying causes of chronic kidney disease. The mean baseline serum bicarbonate level was 18.5 ± 2.4 milliequivalents per liter and the mean estimated glomerular filtration rate was 31.8 ± 10.6 milliliters per minute per 1.73 square meters. Baseline demographic and clinical characteristics are summarized in Table 1.

Table 1: Baseline Demographic and Clinical Characteristics of the Study Population

Variable	Value
Total patients	110
Mean age (years)	54.6 ± 13.1
Male	68 (61.8%)
Female	42 (38.2%)
Mean serum bicarbonate (mEq/L)	18.5 ± 2.4
Mean serum creatinine (mg/dL)	2.7 ± 0.9
Mean estimated glomerular filtration rate (mL/min/1.73 m²)	31.8 ± 10.6
Diabetes mellitus	48 (43.6%)
Hypertension	36 (32.7%)
Chronic glomerulonephritis	16 (14.5%)
Other causes	10 (9.1%)

The baseline findings demonstrated that the majority of patients were middle aged to elderly individuals and that diabetic nephropathy represented the most frequent cause of chronic kidney disease.

Distribution of Chronic Kidney Disease Stages

Patients were categorized according to the stage of chronic kidney disease at presentation. Most patients belonged to stage four disease followed by stage three and stage five disease. The distribution of disease severity is presented in Table 2.

Table 2: Distribution of Patients According to Stage of Chronic Kidney Disease

Stage of Chronic Kidney Disease	Number of Patients	Percentage
Stage III	38	34.5%
Stage IV	49	44.5%
Stage V	23	20.9%
Total	110	100%

The results indicate that a substantial proportion of patients had advanced renal impairment at the time of enrollment which emphasized the importance of interventions aimed at slowing disease progression.

Comparison of Baseline Characteristics between Study Groups

Fifty five patients received oral sodium bicarbonate therapy in addition to standard treatment while fifty five patients received standard medical management alone. Baseline characteristics between the two groups were comparable with no statistically significant differences. These findings are presented in Table 3.

Table 3: Comparison of Baseline Characteristics Between the Two Study Groups

Variable	Sodium Bicarbonate Group (n = 55)	Control Group (n = 55)	p value
Mean age (years)	55.1 ± 12.6	54.0 ± 13.8	0.64
Male gender	35 (63.6%)	33 (60.0%)	0.69
Mean serum creatinine (mg/dL)	2.6 ± 0.8	2.8 ± 0.9	0.28
Mean serum bicarbonate (mEq/L)	18.4 ± 2.5	18.6 ± 2.3	0.72
Mean estimated glomerular filtration rate	32.4 ± 10.1	31.2 ± 11.0	0.56

The similarity of baseline characteristics confirmed that both groups were comparable before initiation of treatment and allowed reliable assessment of therapeutic outcomes.

Effect of Oral Sodium Bicarbonate Therapy on Renal Function

Patients who received oral sodium bicarbonate therapy demonstrated improvement in serum bicarbonate levels and a slower decline in renal function during follow up. The mean estimated glomerular filtration rate at the end of the study remained significantly higher in the bicarbonate group compared with the control group. The findings are shown in Table 4.

Table 4: Renal Function Parameters at the End of Follow Up

Variable	Sodium Bicarbonate Group	Control Group	p value
Mean serum bicarbonate (mEq/L)	22.6 ± 2.1	19.1 ± 2.4	<0.001
Mean serum creatinine (mg/dL)	2.9 ± 1.0	3.5 ± 1.2	0.003
Mean estimated glomerular filtration rate (mL/min/1.73 m²)	29.8 ± 9.4	24.6 ± 8.9	0.002

The results suggest that correction of metabolic acidosis through oral sodium bicarbonate supplementation was associated with preservation of renal function and delayed progression of chronic kidney disease.

Progression of Chronic Kidney Disease and Need for Renal Replacement Therapy

Progression to advanced chronic kidney disease and requirement for dialysis were more frequent in the control group than in patients receiving sodium bicarbonate therapy. These outcomes are summarized in Table 5.

Table 5: Clinical Outcomes According to Treatment Group

Outcome	Sodium Bicarbonate Group n (%)	Control Group n (%)	p value
Progression to stage V disease	9 (16.4%)	18 (32.7%)	0.04
Requirement for dialysis	6 (10.9%)	14 (25.5%)	0.04
Hospital admissions	11 (20.0%)	19 (34.5%)	0.08
Mortality	2 (3.6%)	5 (9.1%)	0.24

Patients receiving bicarbonate therapy demonstrated lower rates of disease progression and reduced need for renal replacement therapy compared with controls.

Adverse Effects Associated with Oral Sodium Bicarbonate Therapy

The incidence of treatment related adverse effects was generally low. Mild fluid retention and peripheral edema were the most common complications among patients receiving sodium bicarbonate therapy. No severe electrolyte abnormalities were observed during follow up. The adverse effects are presented in Table 6.

Table 6: Adverse Effects of Oral Sodium Bicarbonate Therapy

Adverse Effect	Number of Patients	Percentage
Peripheral edema	7	12.7%
Mild hypertension	5	9.1%
Gastrointestinal discomfort	4	7.3%
Hypernatremia	2	3.6%
Severe complications	0	0%

The findings indicate that oral sodium bicarbonate therapy was generally well tolerated and was associated with only minor adverse events.

Overall Treatment Response

The overall analysis demonstrated that oral sodium bicarbonate therapy significantly improved metabolic acidosis and slowed the decline in renal function among patients with chronic kidney disease. The intervention group showed a lower frequency of progression to advanced kidney disease and reduced dependence on dialysis therapy. These

findings support the beneficial role of bicarbonate supplementation as an adjunctive treatment strategy in patients with chronic kidney disease and metabolic acidosis and suggest that early correction of acid base abnormalities may contribute to improved long term renal outcomes.

DISCUSSION

The present study demonstrated that oral sodium bicarbonate therapy had a favorable effect on the progression of chronic kidney disease in patients with metabolic acidosis. Patients who received bicarbonate supplementation showed better preservation of renal function and experienced a slower decline in estimated glomerular filtration rate than those managed with standard therapy alone. These findings support the growing body of evidence that metabolic acidosis is not merely a consequence of chronic kidney disease but also an important contributor to its progression.[11]

The demographic characteristics of the current study revealed a predominance of middle aged and elderly patients with a slight male predominance. Similar observations have been reported in previous investigations where chronic kidney disease was found to occur more frequently among older individuals because of the increasing prevalence of diabetes mellitus and hypertension with advancing age.[12] The present study also demonstrated that diabetic nephropathy represented the most common underlying cause of chronic kidney disease. This finding is consistent with contemporary epidemiological studies that have identified diabetes mellitus as the leading cause of chronic kidney disease worldwide.

Metabolic acidosis is commonly encountered in patients with advanced renal dysfunction because the diseased kidneys progressively lose their ability to excrete acid and regenerate bicarbonate. The mean serum bicarbonate concentration in the present study was markedly below the normal range and reflected significant acid base disturbance among the enrolled patients. Similar reductions in bicarbonate concentrations have been documented in previous studies involving patients with stage three to stage five chronic kidney disease.[13] Persistent metabolic acidosis has been shown to induce numerous physiological abnormalities including increased protein catabolism bone mineral loss and stimulation of inflammatory pathways that contribute to progressive renal injury.

One of the principal findings of the present study was the significant improvement in serum bicarbonate levels among patients receiving oral sodium bicarbonate therapy. Similar improvements have been reported in earlier clinical trials where bicarbonate supplementation effectively corrected acid base imbalance and restored serum bicarbonate concentrations toward normal values.[14] Correction of metabolic acidosis is considered beneficial because it decreases activation of adaptive mechanisms that promote kidney damage. Restoration of bicarbonate levels may therefore preserve residual renal function and improve long term outcomes.

The present study demonstrated that patients treated with sodium bicarbonate experienced a slower decline in estimated glomerular filtration rate than patients in the control group. Similar findings have been reported in previous studies in which bicarbonate therapy was associated with delayed progression of chronic kidney disease and reduced deterioration of renal function.[15] The proposed mechanisms include reduction of tubulointerstitial injury suppression of ammoniagenesis and attenuation of complement activation. Acidosis has also been shown to stimulate production of angiotensin II and endothelin which promote renal fibrosis and structural damage. Correction of acid retention may therefore interfere with these pathological pathways.

Another important observation in the current study was the lower frequency of progression to stage five chronic kidney disease among patients receiving bicarbonate therapy. Similar results have been documented in several longitudinal investigations that demonstrated reduced rates of progression to end stage renal disease following correction of metabolic acidosis.[16] Preservation of kidney function is particularly important because progression to advanced disease is associated with substantial morbidity increased healthcare expenditure and diminished quality of life. Delaying disease progression may provide additional time before initiation of renal replacement therapy and may improve overall patient survival.

The requirement for dialysis was significantly lower among patients who received oral sodium bicarbonate supplementation. This finding corresponds with previous reports that have shown a reduction in the need for renal replacement therapy among patients whose metabolic acidosis was adequately corrected.[17] The economic implications of these findings are considerable particularly in developing countries where access to dialysis facilities remains limited and costly. Strategies that delay the onset of end stage renal disease may therefore provide substantial benefits for both patients and healthcare systems.

The present study also assessed the safety profile of sodium bicarbonate therapy and demonstrated that treatment was generally well tolerated. Mild peripheral edema and modest elevation of blood pressure represented the most frequent adverse events. Similar observations have been reported in previous investigations where bicarbonate therapy was associated with only minor complications and did not significantly increase the incidence of serious cardiovascular events.[18] Concerns regarding sodium overload and fluid retention have traditionally limited the use of bicarbonate supplementation in some patients. However the current findings suggest that careful monitoring and appropriate dose adjustment can minimize these risks.

The beneficial effects of bicarbonate therapy observed in the present study may also be related to improvements in nutritional and metabolic status. Previous studies have demonstrated that chronic metabolic acidosis contributes to muscle protein degradation and negative nitrogen balance.[19] Correction of acidosis has been associated with

preservation of lean body mass and improvement in nutritional parameters. Better nutritional status may indirectly contribute to slower disease progression and enhanced quality of life among patients with chronic kidney disease.

The findings of the current study also support the recommendations of contemporary clinical guidelines that advocate maintenance of serum bicarbonate concentrations within the normal range in patients with chronic kidney disease. Several previous investigations have highlighted the association between low serum bicarbonate levels and increased mortality as well as accelerated decline in kidney function.[20] The present results further strengthen the rationale for early identification and treatment of metabolic acidosis in routine nephrology practice.

Despite the favorable findings of the current study some previous investigations have reported more modest benefits of bicarbonate therapy. Differences in patient characteristics disease severity treatment duration and methods of outcome assessment may explain these variations.[21] Certain studies have included patients with relatively preserved renal function while others have evaluated individuals with severe disease and multiple comorbid conditions. Such differences make direct comparison of results difficult and emphasize the need for additional research involving diverse populations.

The present study contributes valuable information from a developing country setting where the burden of chronic kidney disease continues to increase and resources for renal replacement therapy remain constrained. Most previous studies have originated from high income regions and therefore their findings may not be fully applicable to populations with different socioeconomic and healthcare characteristics.[22] Evaluation of bicarbonate therapy in local populations is therefore important because early intervention may reduce disease burden and improve accessibility to effective treatment strategies.

Another strength of the present investigation was the inclusion of clinically meaningful outcomes including progression to advanced kidney disease and need for dialysis therapy. Many previous studies have focused primarily on biochemical parameters and have provided limited information regarding long term clinical outcomes.[23] The present findings indicate that correction of metabolic acidosis has benefits that extend beyond normalization of serum bicarbonate concentrations and may substantially influence the natural history of chronic kidney disease.

The current study also highlights the importance of routine screening for metabolic acidosis in patients with chronic kidney disease. Serum bicarbonate estimation is inexpensive and widely available and can identify patients who may benefit from therapeutic intervention. Incorporation of bicarbonate assessment into regular clinical practice may therefore facilitate early treatment and potentially delay progression to end stage renal disease.

Further research is still required to determine the optimal dosage duration and timing of sodium bicarbonate therapy. Large multicenter randomized trials with longer periods of follow up are necessary to establish definitive treatment recommendations and to evaluate the long term safety of bicarbonate supplementation in different patient populations.

Overall the findings of the present study demonstrate that oral sodium bicarbonate therapy is an effective and safe intervention for patients with chronic kidney disease and metabolic acidosis. Correction of acid base imbalance was associated with preservation of renal function reduced progression to advanced disease and lower dependence on dialysis therapy. These observations support the incorporation of bicarbonate therapy into comprehensive management strategies for patients with chronic kidney disease.

CONCLUSION

Preservation of renal function was achieved through oral sodium bicarbonate therapy in patients with chronic kidney disease and metabolic acidosis. Progression to advanced kidney disease was reduced and dependence on dialysis therapy was delayed. Early correction of metabolic acidosis was demonstrated to be a beneficial therapeutic strategy.

Limitations

The study was conducted at a single institution and broader population representation was not achieved. The sample size was relatively limited and prolonged follow up was not performed. Histological assessment of renal injury was not undertaken and long term outcomes could not be determined.

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