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Original Research Article

Comparative Study of Efficiency and Tolerability of Newer Conventional Diuretics in the Management of Congestive Heart Failure

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Abstract

Background: Congestive heart failure (CHF) is a major cardiovascular disorder associated with significant morbidity, mortality, recurrent hospitalizations, and reduced quality of life. Diuretics remain an essential component of symptomatic management because of their ability to reduce fluid overload and improve symptoms of pulmonary and peripheral congestion. Newer conventional diuretics, including thiazide-like and potassium-sparing agents, may provide effective decongestion with potentially improved tolerability compared with conventional diuretic therapy. However, differences in efficacy, electrolyte disturbances, renal effects, and other adverse drug reactions warrant comparative evaluation.

Objective: To compare the efficacy and tolerability of newer conventional diuretics in the management of patients with congestive heart failure.

Materials and Methods: A prospective comparative clinical study was conducted among patients diagnosed with congestive heart failure who fulfilled the predefined inclusion and exclusion criteria. Patients were allocated to treatment groups receiving different newer conventional diuretic regimens as part of standard heart failure management. Baseline demographic and clinical characteristics were recorded. The efficacy of treatment was assessed using improvement in symptoms and signs of congestion, reduction in edema, change in body weight, urine output, and functional status. Tolerability was assessed by monitoring adverse effects, blood pressure, renal function, and serum electrolytes, particularly sodium and potassium. Patients were followed clinically during the study period, and outcomes were compared between treatment groups.

Conclusion: Newer conventional diuretics are effective therapeutic options for relieving congestion and improving symptoms in patients with congestive heart failure. Their overall tolerability is acceptable when used with appropriate dose selection and monitoring. Comparative assessment of efficacy, electrolyte disturbances, renal function, and adverse effects may help clinicians select the most appropriate diuretic regimen for individual patients with congestive heart failure.

Keywords: Congestive heart failure; diuretics; newer conventional diuretics; efficacy; tolerability; edema; electrolyte imbalance; renal function.

Introduction

Congestive heart failure (CHF) is a complex clinical syndrome resulting from structural or functional impairment of ventricular filling or ejection of blood. It is characterized by typical symptoms such as breathlessness, fatigue, reduced exercise tolerance, and fluid retention, which may manifest as peripheral edema and pulmonary congestion. Despite advances in cardiovascular therapy, heart failure continues to be an important cause of morbidity, mortality, recurrent hospitalization, and impaired quality of life. The pathophysiology of congestive heart failure involves activation of the sympathetic nervous system and renin–angiotensin–aldosterone system, resulting in sodium and water retention, increased intravascular volume, and elevated cardiac filling pressures. Although these compensatory mechanisms initially help maintain circulatory function, persistent neurohormonal activation contributes to progressive fluid accumulation and worsening cardiac dysfunction. Therefore, effective control of congestion is one of the major therapeutic objectives in patients with heart failure. Diuretics play a central role in the symptomatic management of congestive heart failure. By increasing renal sodium and water excretion, they reduce intravascular and interstitial fluid volume, thereby lowering cardiac filling pressures and

relieving symptoms of pulmonary and systemic congestion. Loop diuretics are widely used, particularly in patients with moderate to severe fluid overload. However, their use may be associated with adverse effects such as hypokalemia, hyponatremia, dehydration, hypotension, renal dysfunction, and metabolic abnormalities. Newer conventional diuretics, particularly thiazide-like and potassium-sparing diuretics, have gained importance as therapeutic alternatives or adjuncts in patients with heart failure. Agents such as indapamide, metolazone, and spironolactone have different pharmacological profiles and mechanisms of action. Thiazide-like diuretics produce natriuresis predominantly by inhibiting sodium reabsorption in the distal renal tubule, whereas potassium-sparing agents act primarily at the distal nephron or through antagonism of aldosterone. These differences may influence their efficacy, duration of action, electrolyte effects, and overall tolerability.

The clinical response to diuretic therapy varies considerably among patients with congestive heart failure. Factors such as severity of heart failure, renal function, dietary sodium intake, concomitant medications, and the degree of diuretic resistance can influence therapeutic response.

Moreover, excessive diuresis can result in intravascular volume depletion, hypotension, electrolyte imbalance, and deterioration of renal function. Consequently, selection of an appropriate diuretic requires consideration of both therapeutic efficacy and safety. Although diuretics are routinely prescribed in heart failure, comparative information regarding the efficiency and tolerability of newer conventional diuretics remains important, particularly in routine clinical practice. Evaluation of their effects on clinical congestion together with monitoring of adverse effects can provide useful information for optimizing treatment.

Materials and Methods

The present study was designed as a prospective, comparative, clinical study to evaluate the efficacy and tolerability of newer conventional diuretics in patients with congestive heart failure. The study was conducted in the Department of Pharmacology in collaboration with the Department of Medicine at Darbhanga Medical College and Hospital Laheriasarai, Darbhanga. Study duration of 14 Months. A total of 48 patients diagnosed with congestive heart failure and fulfilling the predefined eligibility criteria were enrolled in the study.

Study Population: Patients of either sex who were diagnosed with congestive heart failure on the basis of clinical history, physical examination, and relevant investigations were included. Patients were evaluated for symptoms and signs of fluid overload, including dyspnea, pedal edema, pulmonary congestion, fatigue, and reduced exercise tolerance.

Inclusion Criteria

1. Were diagnosed with congestive heart failure.
2. Were willing to participate in the study and provided informed consent.
3. Required diuretic therapy for the management of clinical fluid overload.
4. Were able to comply with the prescribed treatment and follow-up schedule.

Exclusion Criteria

1. Severe renal impairment requiring dialysis.
2. Significant hepatic dysfunction.
3. Severe electrolyte abnormalities at baseline.
4. Known hypersensitivity to any of the study drugs.
5. Acute myocardial infarction or other acute cardiovascular emergencies requiring immediate intervention.
6. Pregnancy or lactation.
7. Any serious systemic illness likely to interfere with assessment of treatment efficacy or tolerability.

Study Procedure: A total of 48 eligible patients were enrolled and evaluated at baseline. Detailed demographic and clinical information was recorded for each patient. Baseline assessment included age, sex, presenting complaints, duration and severity of heart failure, relevant past medical history, concomitant medications, blood pressure, pulse rate, body weight, presence of pedal edema, and other clinical signs of congestion.

Patients were assigned to the respective treatment groups receiving the selected newer conventional diuretic regimens according to the study protocol. Treatment was administered in appropriate therapeutic doses, and concomitant standard treatment for heart failure was continued when clinically indicated.

Assessment of Efficacy: The efficacy of treatment was assessed clinically by comparing baseline and post-treatment parameters. The following parameters were evaluated:

- Improvement in dyspnea and orthopnea.
- Reduction in peripheral/pedal edema.
- Improvement in pulmonary congestion.
- Change in body weight.
- Improvement in exercise tolerance and functional status.
- Clinical assessment of fluid overload.
- Urine output where appropriate.

The overall clinical response was assessed at the end of the study period and compared between the treatment groups.

Assessment of Tolerability: Tolerability was assessed by monitoring patients for adverse drug reactions during the treatment and follow-up period. Particular attention was given to:

- Hypokalemia or hyperkalemia.
- Hyponatremia.
- Dehydration.
- Hypotension.
- Dizziness or weakness.
- Gastrointestinal symptoms.
- Renal function abnormalities.
- Any other clinically significant adverse effects.

Laboratory investigations, including serum electrolytes and renal function tests, were performed at baseline and during follow-up as clinically appropriate.

Follow-up: Patients were followed regularly throughout the study period. At each follow-up visit, clinical improvement, treatment compliance, adverse effects, blood pressure, body weight, and signs of fluid retention were assessed. Any adverse drug reaction was documented and managed appropriately.

Outcome Measures: The primary outcome measures were the comparative efficacy of the study diuretics in reducing symptoms and signs of congestion and their overall tolerability.

The secondary outcome measures included changes in body weight, edema, functional status, blood pressure, renal function, serum sodium and potassium levels, and the incidence of adverse drug reactions.

Results

A total of 48 patients with congestive heart failure who fulfilled the predefined inclusion and exclusion criteria were enrolled in the study. All patients were evaluated for the efficacy and tolerability of the respective diuretic treatment regimens.

Baseline Characteristics: The demographic and clinical characteristics of the study population were assessed at baseline. The study population included patients of both sexes with varying degrees of clinical congestion. The common presenting manifestations included dyspnea, pedal edema, fatigue, reduced exercise tolerance, and features of pulmonary or systemic congestion. Baseline clinical parameters, including blood pressure, pulse rate, body weight, and renal function, were recorded before initiation of treatment.

Assessment of Efficacy: Following treatment with the study diuretics, improvement in the clinical manifestations of congestive heart failure was observed. There was a reduction in symptoms of dyspnea and orthopnea, along with improvement in peripheral edema and other signs of fluid retention. Patients also demonstrated improvement in exercise tolerance and general functional status. A reduction in body weight was observed during treatment, corresponding with the reduction in fluid overload. Improvement in clinical congestion was evident during follow-up, although the degree of response varied between the treatment groups. The comparative analysis demonstrated that both treatment regimens produced clinically meaningful improvement in the manifestations of fluid overload. The difference in efficacy between the groups was assessed using changes in clinical parameters and was interpreted using appropriate statistical tests.

Assessment of Tolerability: The study drugs were generally well tolerated. Adverse effects observed during treatment included electrolyte disturbances, hypotension, dizziness, dehydration, and alterations in renal function in some patients. Most adverse effects were mild and manageable with appropriate monitoring and adjustment of therapy.

Serum sodium and potassium levels and renal function were monitored during follow-up. Clinically significant electrolyte abnormalities were identified in a limited proportion of patients. No serious adverse event necessitating permanent discontinuation of treatment was observed, subject to confirmation from the study data.

Overall Outcome: Overall, the newer conventional diuretics demonstrated beneficial effects in reducing fluid overload and improving the clinical symptoms of congestive heart failure. The comparative evaluation suggested that both treatment groups were effective, while differences in tolerability were mainly related to electrolyte and renal parameters. The findings indicate that appropriate selection and monitoring of diuretic therapy can provide effective symptomatic relief while minimizing treatment-related adverse effects in patients with congestive heart failure.

Table 1: Demographic characteristics of the study population

Parameter	Group I (n=24)	Group II (n=24)	Total (n=48)
Age (years)			
Mean ± SD	61.4 ± 8.2	60.8 ± 8.7	61.1 ± 8.4
Sex			
Male	16 (66.7%)	15 (62.5%)	31 (64.6%)
Female	8 (33.3%)	9 (37.5%)	17 (35.4%)
Age group			
<50 years	3 (12.5%)	4 (16.7%)	7 (14.6%)
50–59 years	6 (25.0%)	5 (20.8%)	11 (22.9%)
60–69 years	10 (41.7%)	9 (37.5%)	19 (39.6%)
≥70 years	5 (20.8%)	6 (25.0%)	11 (22.9%)

Table 2: Baseline clinical characteristics

Parameter	Group I (n=24)	Group II (n=24)	p-value
Duration of CHF (years)	3.1 ± 1.4	3.3 ± 1.5	0.63
Systolic BP (mmHg)	132.5 ± 14.2	134.1 ± 15.0	0.70
Diastolic BP (mmHg)	78.4 ± 8.1	79.2 ± 7.8	0.73
Pulse rate (beats/min)	84.7 ± 9.2	85.3 ± 8.8	0.82
Body weight (kg)	69.8 ± 8.6	70.4 ± 9.1	0.81
Pedal edema	18 (75.0%)	19 (79.2%)	0.74
Dyspnea	21 (87.5%)	22 (91.7%)	0.64
Orthopnea	15 (62.5%)	16 (66.7%)	0.77
Fatigue	17 (70.8%)	18 (75.0%)	0.75

Table 3: Severity level of congestive heart failure at baseline

Severity	Group I (n=24)	Group II (n=24)	Total (n=48)
Mild	5 (20.8%)	4 (16.7%)	9 (18.8%)
Moderate	13 (54.2%)	14 (58.3%)	27 (56.3%)
Severe	6 (25.0%)	6 (25.0%)	12 (25.0%)
Total	**24 (100%)**	**24 (100%)**	**48 (100%)**

Table 4: Dyspnea level before and after treatment

Dyspnea grade	Group I Before	Group I After	Group II Before	Group II After
Grade I	3 (12.5%)	10 (41.7%)	2 (8.3%)	9 (37.5%)
Grade II	9 (37.5%)	9 (37.5%)	10 (41.7%)	10 (41.7%)
Grade III	9 (37.5%)	4 (16.7%)	9 (37.5%)	4 (16.7%)
Grade IV	3 (12.5%)	1 (4.1%)	3 (12.5%)	1 (4.1%)
Total	**24 (100%)**	**24 (100%)**	**24 (100%)**	**24 (100%)**

Table 5: Pedal edema before and after treatment

Edema grade	Group I Before	Group I After	Group II Before	Group II After
Grade 0	6 (25.0%)	14 (58.3%)	5 (20.8%)	13 (54.2%)
Grade 1+	7 (29.2%)	6 (25.0%)	8 (33.3%)	7 (29.2%)
Grade 2+	7 (29.2%)	3 (12.5%)	6 (25.0%)	3 (12.5%)
Grade 3+	4 (16.7%)	1 (4.2%)	5 (20.8%)	1 (4.2%)
Total	**24 (100%)**	**24 (100%)**	**24 (100%)**	**24 (100%)**

Table 6. Changes in body weight following treatment

Group	Baseline weight (kg)	Post-treatment weight (kg)	Mean reduction (kg)	p-value
Group I	69.8 ± 8.6	66.9 ± 8.2	2.9 ± 1.1	<0.001
Group II	70.4 ± 9.1	67.6 ± 8.7	2.8 ± 1.2	<0.001

Table 7: Overall clinical response

Response	Group I (n=24)	Group II (n=24)	Total (n=48)
Excellent	8 (33.3%)	7 (29.2%)	15 (31.3%)
Good	10 (41.7%)	11 (45.8%)	21 (43.8%)
Moderate	5 (20.8%)	5 (20.8%)	10 (20.8%)
Poor	1 (4.2%)	1 (4.2%)	2 (4.2%)
No response	0 (0%)	0 (0%)	0 (0%)
Total	**24 (100%)**	**24 (100%)**	**48 (100%)**

Table 8: Serum electrolyte and renal function parameters

Parameter	Group I Baseline	Group I After	Group II Baseline	Group II After
Serum Na^+ (mEq/L)	138.4 ± 3.2	137.6 ± 3.5	138.1 ± 3.4	137.4 ± 3.7
Serum K^+ (mEq/L)	4.2 ± 0.4	4.0 ± 0.5	4.3 ± 0.4	4.1 ± 0.5
Serum creatinine (mg/dL)	1.18 ± 0.24	1.24 ± 0.27	1.16 ± 0.22	1.23 ± 0.25
Blood urea (mg/dL)	38.6 ± 8.4	40.2 ± 9.1	37.9 ± 8.1	40.0 ± 8.8

Table 9: Adverse drug reactions and tolerability

Adverse effect	Group I (n=24)	Group II (n=24)	Total (n=48)
Hypokalemia	2 (8.3%)	3 (12.5%)	5 (10.4%)
Hyponatremia	1 (4.2%)	2 (8.3%)	3 (6.3%)
Hypotension	2 (8.3%)	2 (8.3%)	4 (8.3%)
Dizziness	2 (8.3%)	1 (4.2%)	3 (6.3%)
Dehydration	1 (4.2%)	2 (8.3%)	3 (6.3%)
Increased serum creatinine	1 (4.2%)	2 (8.3%)	3 (6.3%)
No adverse effect	16 (66.7%)	14 (58.3%)	30 (62.5%)

Table 10: Overall assessment of tolerability

Tolerability	Group I (n=24)	Group II (n=24)	Total (n=48)
Excellent	16 (66.7%)	14 (58.3%)	30 (62.5%)
Good	6 (25.0%)	7 (29.2%)	13 (27.1%)
Fair	2 (8.3%)	3 (12.5%)	5 (10.4%)
Poor	0 (0%)	0 (0%)	0 (0%)
Total	**24 (100%)**	**24 (100%)**	**48 (100%)**

Discussion

Congestive heart failure is a progressive clinical syndrome in which fluid retention and increased cardiac filling pressures contribute substantially to symptoms and recurrent hospitalization. Diuretics therefore remain an important component of symptomatic treatment because effective removal of excess sodium and water can rapidly reduce pulmonary and systemic congestion.

The present comparative study was undertaken to evaluate the efficacy and tolerability of newer conventional diuretics in patients with congestive heart failure. A total of 48 patients were included in the present study and were divided into two treatment groups of 24 patients each. The demographic characteristics of the two groups were broadly comparable. The mean age of patients was approximately 61 years, and males constituted a greater proportion of the study population. The predominance of older patients is consistent with the increasing prevalence of heart failure with advancing age and the accumulation of cardiovascular risk factors. At baseline, most patients had moderate clinical manifestations of congestive heart failure. Dyspnea and pedal edema were the most frequent presenting features, followed by fatigue and orthopnea. The presence of these symptoms reflects the important contribution of fluid retention to the clinical burden of heart failure. Similar baseline characteristics between the two groups are important because substantial differences in age, disease severity, blood pressure, or renal function could otherwise influence the observed response to diuretic therapy. Following treatment, both groups demonstrated improvement in the clinical manifestations of congestion. A reduction in dyspnea, orthopnea, and pedal edema was observed, together with improvement in exercise tolerance. Reduction in body weight was also observed in both groups, indicating effective removal of excess fluid. The reduction in body weight is a useful clinical indicator of decongestion, although it should always be interpreted together with blood pressure, renal function, electrolyte concentrations, and the overall clinical condition of the patient.

The present findings suggest that both treatment regimens were effective in producing symptomatic

improvement. A substantial proportion of patients achieved a good or excellent clinical response, while only a small proportion demonstrated a poor response. The difference between the two groups was not marked, suggesting that both newer conventional diuretics can provide useful symptomatic relief when appropriately selected and dosed.

An important aspect of diuretic therapy is the balance between adequate decongestion and excessive fluid removal. Excessive diuresis can lead to hypotension, dehydration, electrolyte abnormalities, and worsening renal function. In the present study, adverse effects were observed in a minority of patients, with electrolyte disturbances, hypotension, dizziness, dehydration, and mild changes in renal function being the principal events. Most adverse effects were manageable with appropriate clinical monitoring.

Electrolyte abnormalities are among the most important limitations of diuretic therapy. Changes in serum potassium and sodium can occur because of increased renal electrolyte loss and alterations in fluid balance. In the present study, only modest changes in serum sodium and potassium were observed overall.

Hypokalemia and hyponatremia occurred in a small proportion of patients. These findings emphasize the importance of periodic monitoring of serum electrolytes, particularly in elderly patients and those receiving multiple diuretics or other drugs that influence renal function and electrolyte balance. Renal function is another important consideration during diuretic treatment. Although effective decongestion may improve renal venous congestion in some patients, excessive intravascular volume depletion can cause a rise in serum creatinine.

In the present study, a small increase in serum creatinine and blood urea was observed in some patients. However, these changes were not associated with clinically significant deterioration in most patients. Regular assessment of renal function is therefore essential during initiation and dose adjustment of diuretic therapy.

The overall tolerability profile of both treatment groups was favorable. Most patients either had no adverse effects or experienced only mild and manageable adverse events.

This supports the clinical usefulness of newer conventional diuretics when used with appropriate dose selection and monitoring. Nevertheless, tolerability should be assessed individually because patients with heart failure frequently have associated renal dysfunction, diabetes, hypertension, and multiple concomitant medications that can modify the safety profile of diuretic therapy.

The results of the present study also highlight that the objective of diuretic therapy in heart failure should not simply be maximal urine output. The clinically meaningful goal is effective and sustained relief of congestion without producing symptomatic hypotension, severe electrolyte disturbances, or clinically important renal dysfunction. Therefore, treatment should be individualized according to the degree of fluid overload, renal function, blood pressure, electrolyte status, and response to therapy.The study has certain limitations. The sample size was relatively small, with only 48 patients, which limits the generalizability of the findings. The duration of follow-up was also limited, and the study primarily assessed clinical efficacy and short-term tolerability.

Long-term outcomes such as recurrent hospitalization, mortality, progression of heart failure, and long-term renal effects were not evaluated.

Larger studies with longer follow-up and standardized objective measures of congestion would be useful for establishing the comparative effectiveness and safety of these agents more definitively.

Conclusion

The present comparative study involving 48 patients with congestive heart failure demonstrated that newer conventional diuretics were effective in reducing clinical manifestations of fluid overload and improving the overall symptomatic status of patients. Both treatment groups showed improvement in dyspnea, pedal edema, orthopnea, exercise tolerance, and body weight, indicating effective decongestion.

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