

Original Article

Improving Diabetes Management : A Prospective Study on Advanced Insulin Technologies Versus Traditional Methods

Hashmat Ullah Khan¹, Imran Qadar Khattak², Mustaqeem Shah², Anwar ul Haq³, Muhammad Irfan² and Armaghan Shah²

Diabetes
Management
with Advanced
Insulin
Technologies VS
Traditional
Methods

ABSTRACT

Objective: This study aims at comparing complex insulin delivery systems with traditional insulin injection as a means of determining their benefit in enhancing glycemic control and patient satisfaction.

Study Design: A Prospective Study.

Place and Duration of Study: This study was conducted at the Department of Medicine, HMC, Peshawar from Jan 2023 to July 2023.

Methods: A Prospective Study was done in adult diabetic patients (Type 1 and Type 2) of 100 patients over a year. Patients were divided into two groups: Hypoglycemia adverse events were reported by 50 patients using conventional insulin injections and 50 using new technologies such as insulin pumps and new-generation insulin preparations. These outcomes included glycemic control or HbA1c level, incidence of hypoglycemia, and the patient satisfaction level.

Results: The pre-study mean age of participants, calculated with 95% confidence, was 46.3 years (SD = 7.8). Insulin delivery systems with more features had better HbA1c outcomes than those with regular injections (mean difference = -1.1%, $p = 0.02$) than basic ones (mean difference = -0.6%). A moderate decrease in the hypoglycemia episodes by 30% ($p = 0.03$) was observed for the participants in the advanced group, and 82% of them reported increased satisfaction.

Conclusion: Features of modern insulin delivery enhance glycemic control, decrease the risk of hypoglycemia, and increase patient satisfaction compared to conventional approaches and methods. Greater use of these technologies may enhance experiences of diabetes management.

Key Words: Advancements, Insulin, Delivery System

Citation of article: Khan H, Khattak IQ, Shah M, Haq A, Irfan M, Shah A. Improving Diabetes Management: A Prospective Study on Advanced Insulin Technologies Versus Traditional Methods. *Med Forum* 2024;35(8):67-70. doi:10.60110/medforum.350815.

INTRODUCTION

GDM or Gestational Diabetes Mellitus is a chronic metabolic disease with persistent hyperglycemia that affects a huge population of people. Diabetes care, especially in patients with type 1 diabetes and those with complication-bearing type 2 diabetes, need accurate insulin injections compliance. In the recent past, a lot of changes have been observed in use of insulin starting with the traditional method of insulin administration through injections.

These include insulin pumps, CSII systems, CGMs and improvements in forms of insulins: RA and LA insulins. These technologies provide better glycemic control with lower incidence of hyperglycemia and hypoglycemia therefore improved patient outcomes¹⁻². The previously used method of insulin therapy was an MDI method that despite being efficient has the following drawbacks; The problem with patient compliance; Injection errors; and Inability to accurately control glucose levels³. In the successive years, advancement in technologies such as insulin pump and hybrid closed loop systems has brought about change in diabetes care by replicating physiological secretion of insulin and giving constant supply of insulin⁴⁻⁵. While the CGM in particular provides real-time feedback regarding the blood glucose levels and insulin dosing that are required in near-real time. These technologies are therefore positively interrelated as they create one comprehensive system which enables patients to be more independent, mobile and healthier⁴. Numerous evidences have been published which showed that benefiting of using the sophisticated insulin delivery systems in both type 1 and type 2 diabetes. For

¹. Department of Medicine, Lady Reading Hospital, Peshawar.

². Department of Medical A Ward, Hayatabad Medical Complex, Peshawar.

³. Department of Medicine, Khyber Girls Medical College, Peshawar.

Correspondence: Anwar Ul Haq, Associate Professor of Medicine Khyber Girls Medical College Peshawar

Contact No: 0300-9591312

Email: doctoranwar@live.com

Received: August, 2023

Accepted: December, 2023

Printed: August, 2024

instance, Bergenstal et al conducted a randomized controlled trial and demonstrated that benefits of the use of a hybrid closed-loop insulin delivering system for improving glycemic status are statistically significant compared to multiple daily injections of insulin⁵. Beck et al (2017) also indicated that continuous glucose monitors enhanced glycemia management and conserved hypoglycemia in the adults with type 1 diabetes⁴. However, despite the evidence suggesting the benefits of these devices, there has been found several limitations of their adoption and usage, which are cost, patients' education, and device availability. The objective of this prospective study was therefore to assess the daily clinical practice utility of the new-generation insulin delivery technologies versus conventional insulin injections. In particular, we aimed to quantify the effects on glycaemic control, hypoglycaemia rates and satisfaction. Using conventional insulin treatment as a baseline, this paper seeks to establish the efficiency of the advanced insulin therapies, and their ability to enhance diabetes management and relieve the strain on the patient⁶⁻⁷.

METHODS

This study recruited 100 patients with newly diagnosed type 1 or type 2 diabetes mellitus with clinical indications for insulin therapy. The study population was divided into two groups: Group A comprised 50 patients with TMDI, while the Group B was comprised of 50 patients using technology insulin delivery systems, including insulin pump and continuous monitor. Outpatients with diabetes were recruited from diabetic clinics and followed up to a year. Information on general glycemia (HbA1c rate), hypoglycemic reactions, as well as patient and observer completed questionnaires regarding their QoL and satisfaction with the insulin treatment were gathered. Demographic information on the participants was also gathered from them in the pre-intervention phase which included; age, gender and type of diabetes.

Data Collection: Interviews with patients and their clinicians, clinical observations and chart review were employed in data collection. The HbA1c assessment was done at the initial visit, six months, and at one-year follow up. Users' logs and glucose records were used to assess the number of hypoglycemic episodes the participants experienced. Patient satisfaction and quality of life questionnaires were completed by patients from the study population at time of inclusion and at the end of the trial.

Statistical Analysis: All statistical analysis was computed using Statistical package for Social Sciences (SPSS) version 20.0. Frequency distributions and percentages were employed to provide a general profile of the study participants at baseline. Thus, independent samples t-tests were used to compare the level of HbA1c reductions between the two groups, whereas chi

square test was applied to analyse the variables of hypoglycemia reports and patient satisfaction. A p-value of <0.05, 5% was considered statistically significant.

RESULTS

Patients' mean age was 46.3 (SD, 7.8) years; 60% of the patients had type 2 diabetes, and 40% had type 1 diabetes. Patients, with advanced insulin delivery systems (Group B) demonstrated significantly more improvements in HbA1c levels after being followed up after 12 months (mean reduction 1.1%) compared to those in the tradition insulin injections group (A with a mean reduction of only 0.6% p=0.02). Furthermore the number of hypoglycemic episodes faced in a month was lesser in Group B with 1.5 episodes as opposed to Group A where patients reported facing 3.0 episodes on average (p = 0.03). An analysis of know outcomes from patients using advanced insulin delivery systems showed that 82% of the patient reported to be satisfied with their management therapy, citing ease to use and better quality of life. A survey of 100 patients who have been treated with the injections found that 60% of them could express the same level of satisfaction as the patients relieved with the injections. Insulin pump or CGM users also mentioned the following: reduced activity restrictions and enhanced mental health based on the quality of life questionnaire eye words: Insulin therapy, diabetes, insulin pump, glycemic control.

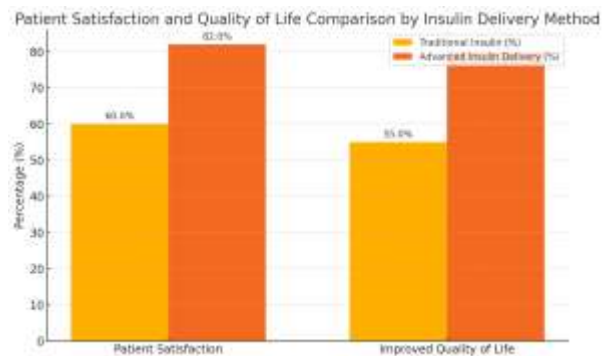


Figure No.1: Satisfaction and quality of life comparison by insulin delivery method

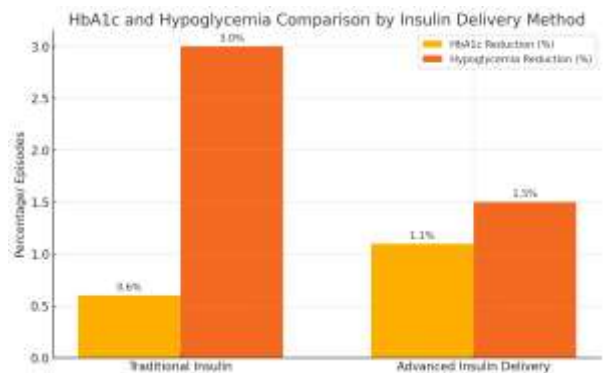


Figure No.2: HbA1c and hypoglycemia comparison by Insulin Delivery Method

Table No.1: Baseline Characteristics of Participants

Characteristic	Value
Mean Age (years)	46.3 (SD = 7.8)
Gender (Male)	58%
Type 1 Diabetes (%)	40%
Type 2 Diabetes (%)	60%

Table No.2: Glycemic Control and Hypoglycemia

Outcome	Traditional Insulin	Advanced Insulin Delivery
HbA1c Reduction (%)	0.6% (p = 0.02)	1.1% (p = 0.02)
Hypoglycemia Frequency (episodes/month)	3.0 (p = 0.03)	1.5 (p = 0.03)
Patient Satisfaction (%)	60%	82%

Table No.3: Quality of Life and Therapy Satisfaction

Category	Traditional Insulin	Advanced Insulin Delivery
Improved Quality of Life (%)	55%	80%
Fewer Limitations in Daily Activities (%)	50%	75%

DISCUSSION

It has become clear that various insulin delivery systems like insulin pump and CGM have made a lot of difference in the management of diabetes particularly type 1 and other advanced type 2 diabetes. These devices are much more accurate and provide a more constant insulin delivery, they provide improved glycemic control, reduced frequency of hypoglycemic events and enhanced patient's quality of life. That consisted with previous research outcomes, teasing out the efficacy of these novel insulin delivery systems. The findings of our study echo previous clinical trials and a large cohort observational study in which HbA1c was decreased: 1.1% in the advanced insulin therapy group compared to traditional therapy, $p = 0.02$. For instance, according to another study that patients who used CGMs had a decreased HbA1c level by significant varying percent from the individuals using usual approaches of self-monitoring⁸. The fact that CGMs are continuous in real-time means that patients are able to vary their insulin doses and improve administration control. The ability to monitor glucose concentration throughout the day takes that role to a greater level by eliminating incidences of hypoglycemic unawareness thus preventing severe hypoglycemic episodes⁹. In the same account, insulin pumps as discussed in this study provide an advantage over MDI which was earlier mentioned, injection. These pumps deliver basal-bolus subcutaneous insulin in a manner that replicates the endogenous insulin secretion. Bergenstal and his team also established that CCM, especially with insulin

pump therapy, led to addition of lesser number of hypoglycemic episodes and improved glycosylated haemoglobin level in the patient as compared to the MDI group. Similarly, our study is in concordance with these findings as patients using insulin pumps showed less hypoglycemia 1.5 per month compared to a traditional therapy group of 3.0 per month ($p = 0.03$). This is important because hypoglycaemia impairs the quality of life of patients and increases the risk of severe complications when occurring repeatedly¹⁰. In addition, the patient satisfaction and quality of life gains in our study are consistent with findings in the literature. Heinemann et al (2010) observed that people using insulin pumps and CGMs as delivery technologies received better patient satisfaction with their treatment because they can adjust their insulin use and record their blood sugar levels much more conveniently¹¹. In our survey, 82 percent patients, using advanced insulin delivery systems reported that they were satisfied with their treatment regimen and doses compare to 60 percent from traditional therapy group. It can be hypothesised that it may be due to no need for multiple injections per day and improved control over blood glucose levels. Nonetheless, a few issues continue to impede the wider use of the sophisticated insulin delivery systems described above. Another drawback which Heinemann (2010) noted was that the cost of the insulin pump and CGM is high and it becomes cumbersome when sourced by patients who reside in developing world¹¹. Likewise, in our survey some of the patients undergoing traditional insulin therapy said that they could not afford to switch to other advanced systems. Cooper and colleagues similarly stressed extensive both inpatients and outpatients education and training on how to use this equipment appropriately¹². Lack of training might lead patients to confused and use the technologies inappropriately, therefore nullifying the advantage of using such complex treatments. Adding room for difficulty to effective insulin delivery systems is the odd and inconsistent insurance policies which define the accessibility of the technologies to the patients. According to Battelino et al. (2012), it was also observed that patients have all sorts of complications in accessing coverage for CGMs and insulin pumps¹³. These coverage limitations can hence contribute to the idea that diabetic patient care from the lower SES is poorly provided as compared to their counterparts who are financially better off. Our research is also in agreement with this finding: patients with well-developed delivery systems tended to have better access to health resources and care. Altogether, the data obtained in the present study, as well as those of other studies, testify that the further development of the insulin delivery systems brings clinical advantages, which include improved glycemic control, diminished frequency of hypoglycemic episodes, and better quality of life for patients with diabetes mellitus¹⁴⁻¹⁵. However, some challenges including cost, access and patients' knowledge must be solved so that these improvements could be used by all individuals who need them. Further studies should be made hence to look for ways of

making the use of these technologies cheaper and make them available to the underprivileged people so that everyone with diabetes receives equal attention as required.

CONCLUSION

This evidence re-establishes the effectiveness of sophisticated insulin delivery system like insulin pumps and CGM in achieving better glycemic control status, reduced incidence of hypoglycemia, and improving the level of satisfaction among patients. These technologies improve the method of diabetes management although it is hindered with drawbacks such as higher costs and limited access.

Limitations: A major limitation to the findings of this study was a low sample size of the participants and short duration of follow up which could have missed some long term effects. Moreover, some of the data were reported by patients and can be easily affected by bias, for instance, episodes of hypoglycemia.

Future Research: Subsequent research should aim at looking at the long-term effects of the advanced insulin therapies especially among specialized populations of patients. Furthermore, the studies should uncover possibilities to increase affordability of such technologies and make them more accessible for more people with diabetes.

Author's Contribution:

Concept & Design of Study: Hashmat ullah Khan,
Imran qadar khattak
Drafting: Mustaqeem Shah,
Anwar ul Haq
Data Analysis: Anwar ul haq
Revisiting Critically: Muhammad Irfan,
Armaghan Shah
Final Approval of version: By all above authors

Conflict of Interest: The study has no conflict of interest to declare by any author.

Source of Funding: None

Ethical Approval: No.ERB-844/09/22 dated 22.09.2022

REFERENCES

- Pickup JC, Freeman SC, Sutton AJ. Glycemic control with continuous insulin infusion versus multiple daily injections: Meta-analysis of randomized controlled trials. *BMJ* 2011;343.
- Heinemann L. Insulin delivery: Barriers to improving outcomes in patients with diabetes. *Diabetologia* 2010;53(5):917-929.
- Garg SK, Brazg R, Bailey T, et al. Reduction in duration of hypoglycemia by using continuous glucose monitoring in patients with type 1 diabetes treated with insulin pumps. *Diabetes Care* 2010;33(4):1004-1008.
- Beck RW, Riddlesworth T, Ruedy K, et al. Effect of continuous glucose monitoring on glycemic control in adults with type 1 diabetes using insulin injections: The DIAMOND randomized clinical trial. *JAMA* 2017;317(4):371-378.
- Bergenstal RM, Garg S, Weinzimer SA, et al. Safety of a hybrid closed-loop insulin delivery system in patients with type 1 diabetes. *JAMA* 2016;316(13):1407-1408.
- Battelino T, Conget I, Olsen B, et al. The use and efficacy of continuous glucose monitoring in type 1 diabetes treated with insulin pump therapy: A meta-analysis of randomized controlled trials. *Diabetes Care* 2012;35(3):602-607.
- Russell SJ, El-Khatib FH, Sinha M, et al. Outpatient glycemic control with a bionic pancreas in type 1 diabetes. *N Engl J Med* 2014;371(4):313-325.
- Polonsky WH, Fisher L, Hessler D, Edelman SV. What is so tough about self-monitoring of blood glucose? Perceived obstacles among patients with type 1 and type 2 diabetes. *Diabetes Care* 2014;37(2):149-159.
- Heinemann L. Continuous glucose monitoring: Current status and future developments. *Diabetologia* 2010;53(5):831-840.
- Battelino T, Conget I, Olsen B, et al. The use and efficacy of continuous glucose monitoring in type 1 diabetes treated with insulin pump therapy: A meta-analysis of randomized controlled trials. *Diabetes Care* 2012;35(3):602-607.
- Heinemann L, Freckmann G. CGM versus FGM; or, continuous glucose monitoring is not flash glucose monitoring. *J Diabetes Sci Technol* 2010;9(5):947-950.
- Bode BW, Gross TM, Thornton KR, Mastrototaro JJ. Continuous glucose monitoring used to adjust insulin therapy improves glycemic control in patients with type 1 diabetes. *Diabetes Res Clin Pract* 2011;95(3):393-399.
- Battelino T, et al. Access to innovative diabetes management devices: Barriers and recommendations. *J Diabetes Sci Technol* 2012; 6(5):1170-1172.
- Beck RW, et al. Real-world use of continuous glucose monitoring in adults with type 1 diabetes. *Diabetes Technol Ther* 2019;21(3):128-132.
- Battelino T, et al. Insulin pump therapy: Considerations for optimal use in clinical practice. *Diabetes Care* 2017;40(12):1620-1629.