CLINICAL VIGNETTE

Dump the Pump?
Geriatric Considerations with Diabetic Technology in Type 1 Diabetes

Erin A. Cook, MD and Lucia L. Dattoma, MD

- Diabetes technology can be safely used in carefully selected older adults leading to improved diabetes outcomes
- Older adults using diabetes technology must be routinely assessed for cognitive and physical impairments
- Training and education must be offered to family members and caregivers of older adults using diabetes technology and the social support of these patients should be routinely assessed.

Case Report

An 86-year-old female with type 1 diabetes (DM1) was admitted to the hospital due to inability to self-manage her insulin pump. She had major neurocognitive disorder, and her insulin pump and continuous glucose monitor (CGM) were managed by her 88-year-old husband and a part-time caregiver. Her husband was hospitalized for an acute illness and her main caregiver and daughter were infected with COVID-19. The patient had excellent home support and employed three caregivers who provided 24-hour care. Her daughter, husband, and one caregiver had received education on how to manage her diabetes using diabetes technology. The other caregivers were not allowed to manage her insulin pump based on their contract with the caregiver agency. The patient was asymptomatic and admitted with a blood glucose level of 455 mg/dl. There was no evidence of diabetic ketoacidosis. During the hospitalization, her glucose levels were well managed with subcutaneous insulin with guidance from endocrinology. Her husband had worsening vision from glaucoma and was deemed to no longer be appropriate to manage her pump. She remained in the hospital for 5 days waiting for an available caregiver to be trained on her insulin pump. Limited availability of a diabetes educator to provide the time intensive training also contributed to her lengthy hospital stay.

Discussion

Adults with DM1 are living longer even though they continue to have shorter life expectancy of almost 8 years compared with those without the disease.[1] As the population ages, clinicians care for more older adults with DM1. Physicians should appreciate that diabetes self-management may decline with aging due to the burdens of comorbidities and changes in psychosocial support.[2,3]

Diabetic technology, including CGMs and insulin pumps have revolutionized the management of DM1. Insulin pumps provide a continuous flow of short-acting insulin, known as the basal rate, through a tiny subcutaneous cannula. Insulin pumps are convenient as they eliminate the need for multiple insulin injections a day. CGMs measure interstitial glucose and provide real-time assessment of glucose levels. CGMs are easy to apply, and sensors need to be changed every 7 to 14 days depending on the model. Sensor augmented insulin pumps (SAPs) are advanced insulin pumps that can communicate with CGMs and can adjust the basal insulin rate according to glucose levels. Manual inputs are still required from the user for meal-time insulin boluses. Finally, closed-loop insulin pump systems are an emerging technology. Closed-loops systems communicate with CGMs and adjust the basal rate and bolus rate based on real-time glucose levels.

Insulin pumps and CGMs are considered safe and effective technology for young adults with type 1 diabetes, but few studies have examined the safety and efficacy of these technologies in older adult and even fewer have considered the impact of geriatric syndromes on the continued use in geriatric patients. Insulin pumps have been shown to have better outcomes in adults with DM1 when compared to treatment with multiple daily insulin injections including lower HbA1c, reduced hypoglycemia, and reduced cardiovascular mortality.[4,5] The landmark Diabetes Control and Complications Trial (DCCT) led to an increased use in insulin pump therapy[6] to prevent the diabetic complications of retinopathy, neuropathy, nephropathy, and cardiovascular disease more effectively via stringent glycemic control. In older adults, SAPs are particularly advantageous when hypoglycemia is detected and can improve overall glycemic control, reduce severe hypoglycemia, hypoglycemic unawareness, and hospitalizations.[7] Two recent trials have looked at closed-loop insulin pump technology use in older adults. The Older Adult Closed Loop (ORACL) trial was done at two tertiary hospitals in Australia and included older adults independent with diabetes self-management as well as those dependent on caregiver assistance. The ORACL trial found that hybrid closed-loop systems reduce time spent in hypoglycemia range overnight and resulted in better glycemic control when compared to SAP.[8] A second study yielded similar results when comparing hybrid closed-loop glucose systems to SAP in older adults independent in diabetes self-management.[9] While these trials specifically targeted adults >60 years, the sample sizes were small, and the patients were relatively “young” for the geriatric population with a mean age

of 67 years and 68 years. The patients also did not meet criteria for frailty. Further trials are needed to assess the safety, efficacy, and challenges of insulin pumps in frail older adults with cognitive or physical impairments.

The Wireless Innovation for Seniors with Diabetes Mellitus (WISDM) trial showed that CGMs improve glycemic control and reduce hypoglycemia in older adults with DM1 when compared with standard blood glucose monitoring.[10,11] This is important as aging is associated with reduced hypoglycemic awareness[12,13] and older adults are at greater risk for hypoglycemia as well as complications associated with hypoglycemia. Hypoglycemia can lead to falls, fractures, cognitive impairment, seizures, and acute changes in mentation. Guidelines recommend looser glycemic control in older adults and higher hemoglobin A1c targets given these complications.[14] CGMs can improve the care of cognitively and functionally impaired older adults with diabetes given the ability for family members and caregivers to monitor glucose levels remotely. Additionally, eliminating fingerstick glucose monitoring improves patient satisfaction, reduces pain, and could even reduce agitation in those with mood or cognitive disorders. Unfortunately, acetaminophen, a commonly used medication in the geriatric population, may interfere with the accuracy of some CGMs causing false hyperglycemia.[15] Additionally, CGMs may be less accurate in chronic kidney disease (CKD) stages 4-5 of which many older adults have.

Bluetooth enabled Insulin pens, often referred to as smart pens, can record the dose and time of insulin delivery and provide downloaded data for patients and physicians.[16] This technology is easier to use then a typical syringe and vial for older adults with reduced hand dexterity from arthritis. Caregivers or physicians can also readily monitor missed or extra doses in older adults, especially if there is concern for cognitive impairment or non-compliance. Unfortunately, the technology may pose challenges to those with cognitive impairment due to charging requirements and cartridge changes and those with age associated vision changes may find the small print on smart pens difficult to read.[5]

The Centers of Medicare and Medicaid services (CMS) covers the cost of CGMs, insulin pumps and associated supplies. Refills require a face-to-face visit with a physician every 3 months per CMS and these frequent visits can be challenging for older adults, especially those who rely on others for transportation. Older adults surveyed with DMI on Medicare reported challenges obtaining supplies for their pump and challenges seeing a health care provider every 90 days.[17] CMS does not cover the cost of smart pens. These devices are more expensive and many older adults on a fixed income would be unable to afford them.

Insulin pumps can be used safely and effectively in independent older adults who are cognitively able to understand how to program the pump and are physically able to manage the pump. Age related diseases lead to changes in vision, reduced dexterity, tremors, physical disability, and cognitive impairment which hinder safe independent use of an insulin pump. Those with hearing impairment may not hear the device alarm. Those with vision impairment may have challenges reading the screens, which do not have magnification ability.[5] Those with cognitive impairment have reduced ability to be involved in diabetes self-care.[18] Older adults with cognitive, functional, or sensory impairments are thus reliant on a family member or caregiver to manage the pump. Insulin pump training is time intensive, requiring several hours with a diabetic educator. There are further administrative challenges many caregiver agencies do not authorize their staff to manage insulin pumps and employing consistent caregivers is often not feasible. Training new or rotating caregivers on insulin pump use could be barrier for many patients. Finally, caregivers and family members experience their own health and family emergencies and will at times need to “call in sick”. When this happens, older adults on insulin pumps are left in a vulnerable and dangerous situation. In our case, the patient had to be hospitalized as she did not have access to an adequately trained caregiver and needed to stay in the hospital several days waiting for an available diabetes educator to train a new caregiver on the diabetic technology. Adults on insulin pumps should routinely be monitored for their ongoing cognitive and physical ability to self-manage insulin pumps and education needs to involve family and caregivers. Additionally, physicians should routinely assess the support system of an older adult using diabetes technology.

REFERENCES

1. **Heald AH, Stedman M, Davies M, Livingston M, Alshames R, Lunt M, Rayman G, Gadsby R**. Estimating life years lost to diabetes: outcomes from analysis of National Diabetes Audit and Office of National Statistics data. *Cardiovasc Endocrinol Metab*. 2020 Jun 2;9(4):183-185. doi: 10.1097/XCE.0000000000000210. PMID: 33225235; PMCID: PMC7673790.
2. **McCarthy MM, Grey M**. Type 1 Diabetes Self-Management From Emerging Adulthood Through Older Adulthood. *Diabetes Care*. 2018 Aug;41(8):1608-1614. doi: 10.2337/dc17-2597. Epub 2018 May 25. PMID: 29802144.
3. **Ikegami H, Hiromine Y, Noso S**. Insulin-dependent diabetes mellitus in older adults: Current status and future prospects. *Geriatr Gerontol Int*. 2022 Aug;22(8):549-553. doi: 10.1111/ggi.14414. Epub 2022 Jun 16. PMID: 35711119; PMCID: PMC9542793.
4. **Steineck I, Cederholm J, Eliasson B, Rawshani A, Eeg-Olofsson K, Svensson AM, Zethelius B, Avdic T, Landin-Olsson M, Jendle J, Gudbjörnsdóttir S; Swedish National Diabetes Register**. Insulin pump therapy, multiple daily injections, and cardiovascular mortality in 18,168 people with type 1 diabetes: observational study. *BMJ*. 2015 Jun 22;350:h3234. doi: 10.1136/bmj.h3234. PMID: 26100640; PMCID: PMC4476263.
5. **Toschi E, Munshi MN**. Benefits and Challenges of Diabetes Technology Use in Older Adults. *Endocrinol Metab Clin North Am*. 2020 Mar;49(1):57-67. doi:

10.1016/j.ecl.2019.10.001. Epub 2019 Nov 18. PMID: 31980121; PMCID: PMC6983469.

6. **Berget C, Messer LH, Forlenza GP**. A Clinical Overview of Insulin Pump Therapy for the Management of Diabetes: Past, Present, and Future of Intensive Therapy. *Diabetes Spectr*. 2019 Aug;32(3):194-204. doi: 10.2337/ds18-0091. PMID: 31462873; PMCID: PMC6695255.
7. **Morros-González E, Gómez AM, Henao Carrillo DC, Ursida V, Serrano S, Rondón Sepúlveda MA, Muñoz Velandia OM**. Efficacy and safety of sensor augmented insulin pump therapy with low-glucose suspend feature in older adults: A retrospective study in Bogota, Colombia. *Diabetes Metab Syndr*. 2021 May-Jun;15(3):649-653. doi: 10.1016/j.dsx.2021.02.029. Epub 2021 Feb 24. PMID: 33813236.
8. **McAuley SA, Trawley S, Vogrin S, Ward GM, Fourlanos S, Grills CA, Lee MH, Alipoor AM, O'Neal DN, O'Regan NA, Sundararajan V, Colman PG, MacIsaac RJ**. Closed-Loop Insulin Delivery Versus Sensor-Augmented Pump Therapy in Older Adults With Type 1 Diabetes (ORACL): A Randomized, Crossover Trial. *Diabetes Care*. 2022 Feb 1;45(2):381-390. doi: 10.2337/dc21-1667. PMID: 34844995.
9. **Boughton CK, Hartnell S, Thabit H, Mubita WM, Draxlbauer K, Poettler T, Wilinska ME, Hood KK, Mader JK, Narendran P, Leelarathna L, Evans ML, Hovorka R**. Hybrid closed-loop glucose control compared with sensor augmented pump therapy in older adults with type 1 diabetes: an open-label multicentre, multinational, randomised, crossover study. *Lancet Healthy Longev*. 2022 Mar;3(3):e135-e142. doi: 10.1016/S2666-7568(22)00005-8. Epub 2022 Mar 7. PMID: 35359882; PMCID: PMC8967297.
10. **Pratley RE, Kanapka LG, Rickels MR, Ahmann A, Aleppo G, Beck R, Bhargava A, Bode BW, Carlson A, Chaytor NS, Fox DS, Goland R, Hirsch IB, Kruger D, Kudva YC, Levy C, McGill JB, Peters A, Philipson L, Philis-Tsimikas A, Pop-Busui R, Shah VN, Thompson M, Vendrame F, Verdejo A, Weinstock RS, Young L, Miller KM; Wireless Innovation for Seniors With Diabetes Mellitus (WISDM) Study Group**. Effect of Continuous Glucose Monitoring on Hypoglycemia in Older Adults With Type 1 Diabetes: A Randomized Clinical Trial. *JAMA*. 2020 Jun 16;323(23):2397-2406. doi: 10.1001/jama.2020.6928. PMID: 32543682; PMCID: PMC7298607.
11. **Miller KM, Kanapka LG, Rickels MR, Ahmann AJ, Aleppo G, Ang L, Bhargava A, Bode BW, Carlson A, Chaytor NS, Gannon G, Goland R, Hirsch IB, Kiblinger L, Kruger D, Kudva YC, Levy CJ, McGill JB, O'Malley G, Peters AL, Philipson LH, Philis-Tsimikas A, Pop-Busui R, Salam M, Shah VN, Thompson MJ, Vendrame F, Verdejo A, Weinstock RS, Young L, Pratley R**. Benefit of Continuous Glucose Monitoring in Reducing Hypoglycemia Is Sustained Through 12 Months of Use Among Older Adults with Type 1 Diabetes. *Diabetes Technol Ther*. 2022 Jun;24(6):424-434. doi: 10.1089/dia.2021.0503. Epub 2022 Apr 11. PMID: 35294272; PMCID: PMC9208859.
12. **Bremer JP, Jauch-Chara K, Hallschmid M, Schmid S, Schultes B**. Hypoglycemia unawareness in older compared with middle-aged patients with type 2 diabetes. *Diabetes Care*. 2009 Aug;32(8):1513-7. doi: 10.2337/dc09-0114. Epub 2009 Jun 1. PMID: 19487634; PMCID: PMC2713637.
13. **Matyka K, Evans M, Lomas J, Cranston I, Macdonald I, Amiel SA**. Altered hierarchy of protective responses against severe hypoglycemia in normal aging in healthy men. *Diabetes Care*. 1997 Feb;20(2):135-41. doi: 10.2337/diacare.20.2.135. PMID: 9118760.
14. **LeRoith D, Biessels GJ, Braithwaite SS, Casanueva FF, Draznin B, Halter JB, Hirsch IB, McDonnell ME, Molitch ME, Murad MH, Sinclair AJ**. Treatment of Diabetes in Older Adults: An Endocrine Society* Clinical Practice Guideline. *J Clin Endocrinol Metab*. 2019 May 1;104(5):1520-1574. doi: 10.1210/jc.2019-00198. PMID: 30903688; PMCID: PMC7271968.
15. **Maahs DM, DeSalvo D, Pyle L, Ly T, Messer L, Clinton P, Westfall E, Wadwa RP, Buckingham B**. Effect of acetaminophen on CGM glucose in an outpatient setting. *Diabetes Care*. 2015 Oct;38(10):e158-9. doi: 10.2337/dc15-1096. Epub 2015 Aug 12. PMID: 26269199; PMCID: PMC4876736.
16. **American Diabetes Association Professional Practice Committee**. 7. Diabetes Technology: Standards of Medical Care in Diabetes-2022. *Diabetes Care*. 2022 Jan 1;45(Suppl 1):S97-S112. doi: 10.2337/dc22-S007. PMID: 34964871.
17. **Argento NB, Liu J, Hughes AS, McAuliffe-Fogarty AH**. Impact of Medicare Continuous Subcutaneous Insulin Infusion Policies in Patients With Type 1 Diabetes. *J Diabetes Sci Technol*. 2020 Mar;14(2):257-261. doi: 10.1177/1932296819838292. Epub 2019 Mar 31. PMID: 30931609; PMCID: PMC7196863.
18. **Sinclair AJ, Girling AJ, Bayer AJ**. Cognitive dysfunction in older subjects with diabetes mellitus: impact on diabetes self-management and use of care services. All Wales Research into Elderly (AWARE) Study. *Diabetes Res Clin Pract*. 2000 Dec;50(3):203-12. doi: 10.1016/s0168-8227(00)00195-9. PMID: 11106835.