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Treating Diabetic Ketoacidosis in the Emergency Department

Clinical Bottom Line: Yes, the use of a subcutaneous insulin protocol for the management of mild to moderate diabetic ketoacidosis is both safe and efficacious when compared to the standard IV insulin treatment, as patients not only did not require ICU level care, but also had no evidence of increased adverse events when compared with standard IV insulin treatment.

PICO question:
In adult patients with mild to moderate DKA, is the use of subcutaneous insulin protocol safe and efficacious?

P: Adult patients with mild to moderate DKA
I: Subcutaneous insulin protocol
C: Traditional IV insulin drip protocol
O: DKA resolution, need for ICU, adverse events

Background:
The standard treatment of patients with diabetic ketoacidosis involves a labor-intensive treatment protocol with an insulin drip, which requires significant nursing attention and incurs high costs to both patients and hospitals. Additionally, even in patients who are not severely ill, management of an insulin drip requires use of an ICU bed in many hospitals. The treatment for these patients typically begins in the emergency department, where it can detract from the level of attention that can then be directed toward care of other patients in the emergency department. We were hoping to see if the literature supported use of a different, less labor-intensive protocol in some patients, and if there were any detriments to patients in using an alternative treatment plan in the management of this condition.

Article 1: Evaluation of Outcomes Following Hospital-Wide Implementation of a Subcutaneous Insulin Protocol for Diabetic Ketoacidosis

Citation: Rao P, Jiang SF, Kipnis P, Patel DM, Katsnelson S, Madani S, Liu VX. Evaluation of Outcomes Following Hospital-Wide Implementation of a Subcutaneous Insulin Protocol for Diabetic Ketoacidosis. JAMA Netw Open. 2022 Apr 1;5(4):e226417. doi: 10.1001/jamanetworkopen.2022.6417. PMID: 35389497; PMCID: PMC8990349.

Pubmed link: https://pubmed.ncbi.nlm.nih.gov/35389497/

Summary: In this study, the outcomes of patients with DKA treated with an SQ insulin protocol in place of IV insulin infusion followed by rapid acting insulin injections given over longer

periods were analyzed. This SQ DKA protocol intervention was implemented at a single hospital for around 3 years and compared to 20 other standard of care hospitals during that same time after a “pre implementation” phase where initial SQ insulin for DKA management was rarely used at all 21 sites. It was found that money was saved at the implementation site due to decreased ICU admissions for DKA management without increased risk of complications or increased length of stay due to these new practices.

Inclusion Criteria: DKA diagnosis as determined by ICD code, Ketosis on UA or Serum studies, adult patients.

Exclusion Criteria: Pregnant, age <18, GCS <8, Non DKA co presentation.

Results: At the intervention site during the post implementation phase, 80% of patients received the SQ insulin protocol for DKA management as compared to just 12.8% at the control sites in the same respective period. The Initial SQ insulin protocol provided a 57% reduction in ICU admissions and a 50% reduction in re admission up to 30 days as compared to control sites implementing IV insulin drips in this study without significant difference in measured lengths of hospital stay or death rate. Rates of rescue glucose administration were favored the intervention site (7.4%) as compared to the control sites (11.0%) in the post implementation phase. Additionally, the time difference to serum glucose <250 among each of the two groups was statistically insignificant.

Limitations: DKA diagnosis was determined based upon billing codes instead of raw lab values therefore there could be some discrepancy in disease type or severity. I would like to see more rigid inclusion/exclusion criteria to select cases. Additionally, the intervention site had a much smaller sample size as compared to the control sites. It is possible that the intervention site selected had favorable results because it is unique in its efficiency and care and that the findings discussed have not been proven to be generalizable. Also, this was a retrospective study of a prospective protocol. For more accurate measures, a prospective study should be implemented. Next, confounding factors such as e- and fluid management differences from intervention site to control sites were not controlled and could influence overall outcomes attributed to insulin administration alone.

Article 2: The SQuID protocol (subcutaneous insulin in diabetic ketoacidosis): Impacts on ED operational metrics

Citation: Griffey RT, Schneider RM, Girardi M, Yeary J, McCammon C, Frawley L, Ancona R, Cruz-Bravo P. The SQuID protocol (subcutaneous insulin in diabetic ketoacidosis): Impacts on ED operational metrics. Acad Emerg Med. 2023 Aug;30(8):800-808. doi: 10.1111/acem.14685. Epub 2023 Feb 27. PMID: 36775281.

Pubmed link: https://pubmed.ncbi.nlm.nih.gov/36775281/

Summary: In a single academic medical center study, subcutaneous administration of insulin via protocol in the management of mild to moderate severity diabetic ketoacidosis in the emergency department was studied over a 6-month period. The objective of this retrospective evaluation of the prospective cohort placed on a subcutaneous insulin protocol was to evaluate the safety and efficacy of using a subcutaneous insulin protocol vs. standard care with insulin drip. The outcome of the intervention showed significant decrease in intensive care use and in readmissions, without increase in adverse effects seen.

Inclusion Criteria: Adult patients with hyperglycemia with glucose of >300, who were then found to be in mild to moderate severity diabetic ketoacidosis. Definition of mild DKA included pH 7.25 to 7.30 and bicarbonate of 15-18, moderate DKA required pH 7.00 to 7.24, or bicarbonate level of 10-14.

Exclusion Criteria: Patients <18 years old, pregnancy, severe concomitant infection, presence of active comorbid conditions such as ESRD, CHF, or immunosuppression, altered mentation, concern for ACS, need for surgical procedure, or severe DKA defined as pH <7.00, or bicarbonate level <10.

Results: 177 mild to moderate severity patients with DKA were studied (78 SQuID and 99 traditional treatment). Adherence to the chosen treatment pathways were examined and found to be reliable. There was no difference in the proportion of rescue dextrose administration compared to the traditional treatment, but the ED length of stay was significantly reduced in the SQuID group, even when compared with the pre-intervention period and the pre-COVID control period.

Limitations: We would have liked to have seen additional patient criteria discussed such as average vital signs (HR, BP) between groups. Patients who had comorbid conditions were screened out but comprise a sizeable population, so the generalizability of the results to the overall treatment population is difficult. We also thought there could be more discussion about how many patients required PO glucose rescue vs. IV dextrose rescue from hypoglycemic events. Additionally, although emergency department length of stay was discussed, it would have been nice to see if this protocol implementation had effects on total hospital length of stay for the treated patients.