become hyperglycemic. The hyperglycemia is treated frequently by (1) giving insulin as a fixed ratio in the TPN bag, (2) using an insulin drip, or (3) administering subcutaneous (s.c.) insulin based on intermittent blood sugar recordings. Each of these techniques is fraught with certain hazards. The insulin/calorie ratio in the bag may be highly variable from patient to patient, which may result in wasting expensive preparations. The use of an intravenous (i.v.) insulin drip requires venous access, which is frequently a serious technical problem in these patients. The use of intermittent s.c. insulin may not provide optimal hepatic insulinization and lipolysis inhibition. Therefore, the use of continuous subcutaneous insulin infusion (CSII) represents a potential alternative.[1] This novel technique has certain qualities that make it the most satisfactory way of controlling hyperglycemia in patients receiving TPN, just as a recent report suggested CSII for parenteral alimentation.[2]

We reviewed retrospectively a 5-day period on a random basis of five patients who had received TPN in our ICU. Insulin had been added to the TPN on an empiric basis. Glucose determinations were done, using either Chemstrip bG (Boehringer-Mannheim, Indianapolis, Indiana) or glucose-oxidase determinations in the laboratory. During this interval, blood glucose levels were measured from two to four times per day. Total caloric intake varied from 1248 to 3484 cal/24 h. The mean blood glucose levels in the five cases were 155, 244, 254, 166, and 157 mg/dl, respectively. It is clear that in these individuals adding insulin to TPN on an empiric basis was reasonably satisfactory in four patients.

In other individuals, hyperglycemia occurred, requiring additional insulin treatment. One individual with multiple draining fistulae and sepsis will be discussed.

Before starting TPN, blood glucose was normal and glycosylated hemoglobin was 6.5%, reflecting relatively normal blood glucose levels in the previous 3 mo. Calories delivered by TPN ranged from 1048 to 2515. Eighty percent were carbohydrate calories. Because of strikingly elevated blood glucose levels over the next 24 h (mean 295 mg/dl), CSII was started, which resulted in a mean plasma glucose value of 112 mg/dl for the next 5 days. The program was supervised by an insulin pump team that works with our traditional type I diabetic patients on maintenance CSII, in conjunction with a resource registered nurse from the ICU.

Based on this experience, we are now using CSII to control glycemia in individuals on hyperalimentation therapy and feel it is an additional indication for this important insulin delivery system.

RALPH G. WIELAND, M.D.
MARIAN BARNETT, M.D.
PATRICIA WILLIAMS, R.N.
PATRICIA CUMMINS, R.N.

From the Department of Medicine (R.G.W., M.B.), the Intensive Care Unit (P.W.), and the High Observation Unit (P.C.), Huron Road Hospital, 13951 Terrace Road, Cleveland, Ohio 44112.

Address reprint requests to Ralph G. Wieland, M.D., at the above address.

REFERENCES

[1] Tamborlane, W. V., Sherwin, R. S., Genel, M., Felig, P.: Reduction to normal of plasma glucose in juvenile diabetes by subcutaneous administration of insulin with portable infusion pump. N. Engl. J. Med. 1979; 300:573–78.

[2] Bergman, M., Ravikumar, S., Auerhahn, C., Delsavio, N., Savino, S., and Felig, P.: Insulin pump therapy improves blood glucose control during hyperalimentation. Arch. Intern. Med. 1984; 144:2013–15.

Insulin-Related Hospital Incidents

A retrospective review (January 1980 through April 1985) of insulin-related "incident reports" in a 324-bed community hospital (Underwood Memorial Hospital, Woodbury, New Jersey) was undertaken; the final 16 mo reflected use of biosynthetic human insulin for all routine insulin orders. There were 22 insulin-related reports submitted by nursing personnel, which are categorized as follows: (1) administration of insulin to the incorrect patient (7 cases, 32%); (2) administration of written insulin concentration, i.e., 100 U injected when "U 100" concentration was written (4 cases, 18%); (3) administration of incorrect insulin type, i.e., regular for NPH or vice versa (3 cases, 14%); (4) insulin transcription error, i.e., 80 U administered when "8 U" ordered (1 case, 4.5%), (5) administration of insulin dose twice (1 case, 4.5%); (6) administration of incorrect insulin dose (2 cases, 9%); and (7) failure to administer insulin despite a written order (4 cases, 18%).

We suggest the following guidelines to optimize proper insulin adminstration to hospitalized patients:

(1) Before injection a "mental check" should be performed to determine whether insulin administration would be reasonable for the patient.

(2) Insulin concentration should be deleted from written orders.

(3) Before injection a "mental check" should be performed to determine whether short- or intermediate-acting insulin is appropriate for the patient.

(4) "Units" should be spelled out and the "U" abbreviation avoided.

(5) Administration of insulin should be recorded promptly on the medication administration record.

We estimate 73% of insulin-related hospital incidents will be reduced with implementation of these guidelines, and a further 27% reduction of incidents is possible with increased attentiveness by health care personnel.

Paradoxically, despite multiple inquiries to the pharmacy department from nursing personnel concerning insulin species, no species-related incidents were documented. There appears to be no deleterious effect on patient care by limiting

the hospital formulary to human insulin in hospitalized patients without insulin-species allergy.

JOSEPH J. FALLON, JR., M.D.
GEORGE STEFENELLI, B.S.N., N.P.
HAZEL GRANT, R.N.
ROBERT M. VOYTOVICH, Pharm.D.

Address reprint requests to Joseph J. Fallon, Jr., M.D., Medical Arts Building, Suite 24, West Red Bank Avenue, Woodbury, New Jersey 08096.

Insulin Allergy

Only 4 of the 5880 admissions to our ward from 1977 to 1983 (over 80% of which were due to diabetes) were for generalized insulin allergy.

Case 1 was a 58-yr-old woman suffering from type IIa diabetes since the age of 41, who required insulin for glucoregulation. Conventional insulin (regular and zinc-protamine) was administered at the time of diagnosis. Two months later, the patient exhibited a generalized allergic reaction (tingling paresthesias, a sensation of throat constriction, generalized pruritus, rash-like urticaria, and sweating). These symptons persisted after changing to monocomponent insulin; the patient was then treated with a sulfonylurea drug. In 1982, skin testing with various types of insulin, including converted human insulin, was performed, resulting in positive reactions at each insulin injection site (saline was used as a control solution). Desensitization using a modification of Galloway's method[1] was carried out with short-acting monocomponent porcine insulin, and the patient received a combination of short- and intermediate-acting insulins of the same type for 1 mo, but the reaction reappeared. Desensitization[2] was repeated with converted human insulin and glucocorticoids. The patient had received insulin for 3 mo when the reaction recurred. Thereafter, the patient refused any further desensitization attempts.

This patient had a history of penicillin anaphylaxis (4 yr after the onset of diabetes) and hay fever (for >30 yr) and a family history of diabetes (the patient's 31-yr-old son has suffered from diabetes since the age of 6, tolerating conventional insulin well). In this patient, as well as in case 2, IgE had been determined before desensitization. Total IgE was markedly elevated, whereas no significant increase in insulin-specific IgE[3] was observed.

Case 2 was a 29-yr-old woman who suffered from type I diabetes since the age of 16. She had been treated with regular and zinc-protamine insulin for 8 yr, and was then given semilente insulin for a better glucoregulation. Nine months later, swelling and a sensation of throat constriction appeared, accompanied by incipient lipodystrophy at the sites of injection. Monocomponent porcine insulin was then substituted for semilente insulin. Last year, the patient complained of rash, pruritus, and occasional attacks of choking and tingling paresthesias occurring 1 h after insulin injection. As in case 1, the skin tests were positive. Desensitization was performed using recombinant human insulin and the patient has been receiving a combination of short- and long-acting recombinant insulins for 7 mo, tolerating it well. Total IgE was slightly elevated, whereas insulin-specific IgE was not determined.

This patient has a history of penicillin anaphylaxis registered in the year of the onset of diabetes mellitus.

Case 3 was a 43-yr-old woman with onset of type I diabetes mellitus at the age of 36. After 1 wk on conventional insulin therapy, she developed generalized pruritus with a fine rash, tachycardia, and a sensation of throat constriction. The patient was switched first to purified and then to monocomponent insulin, but as the symptoms recurred, insulin was withdrawn. An attempt at desensitization was made, but the reactions reappeared after 3 days on insulin. The patient continued taking sulfonylureas. Four years later, skin testing was performed and there was no reaction at any injection site. Attempts at desensitization with monocomponent porcine insulin failed. One year later, desensitization was attempted again, this time with recombinant human insulin, for persistently poor control and ketonuria. The patient complained of the same problems when a twice-daily regimen was introduced, but was encouraged to continue taking insulin, and the symptoms gradually disappeared. She has continued this therapy for ~6 mo and is well controlled, without ketonuria and with normal body weight. (Since the onset of the disease, she has lost 20% of her body weight, which is now within the limits of ideal body weight.) Both total and insulin-specific IgE were within the normal range.

This patient had had ectopic dermatitis 4 yr before the onset of diabetes, but had no history of adverse drug reactions.

Case 4. A 26-yr-old woman suffering from diabetes mellitus since the age of 8 presented with late diabetes complications. She had received conventional insulins (regular, followed by lente and semilente) for 16 yr, and then switched to bovine purified insulin. Five months later, she developed generalized urticaria with pruritus and felt a choking sensation within a few hours after insulin injection. These symptoms persisted after change to monocomponent porcine insulin. She responded to skin tests by developing a small wheal and then an erythematous induration of 5 × 5 mm at the site of the zinc-ion suspension only. Though it did not seem to be a positive reaction, insulin with the lowest zinc-ion concentration (Protophane HM, Novo, Copenhagen, Denmark) was also tried, but without any improvement. At the same time, lung tuberculosis was diagnosed. After desensitization with converted human insulin, the treatment with this insulin was continued; however, as the symptoms persisted antihistamines were also added. The vehement reactions seen during the first few months of antituberculosis treatment diminished gradually with time. Presently, monocomponent insulin is well tolerated by the patient. Total and insulin-specific IgE were within the normal range.

The patient has no history of any allergy or adverse drug reactions.

Comments. Generalized allergic reactions to insulin are