# Insulin Levels After Injection by Jet Stream and Disposable Syringe

We read with interest the article by Malone et al. (1) and would like to report the results of our study of the influence of jet injection on the absorption of retarded (NPH) insulin.

We studied four insulin-dependent diabetic (IDDM) and two non-insulin-dependent diabetic (NIDDM) patients (5 men, 1 woman), aged between 13 and 65 yr (mean 34.33 yr), to compare insulin levels after needle injection with a disposable insulin syringe with levels after administration of the same dose and type of insulin (NPH) in the same anatomic side by jet-spray injection with a Medi-Jector II (Derata, Minneapolis, MN). Before breakfast, on both study days and after 24 h of regular insulin treatment, each patient was given the same insulin dose. All patients performed the same physical activity and received an identical diet during the 2 days of study. Blood was collected after a 12-h fast before insulin adminstration and at 90, 270, 450, 630, and 750 min after insulin injection to measure plasma glucose and total insulin. Total insulin was measured by radioimmunoassay (Diagnostic Product Corp.). Student's *t* test for paired data was used for statistical calculations. Each patient showed similar basal total insulin the 2 days of the study (means ± SD, 18.4 ± 21.17 vs. 15.8 ± 16.6 μU/ml). The rise of total insulin after Medi-Jector II administration was greater and more rapid than after administration with needle and syringe (162.7 ± 95.39 vs. 52.65 ± 30.29 μU/ml, $P < .025$; 120 ± 73.48 vs. 300 ± 73.48 min, $P < .001$). The area under the total insulin curve (during the next 12.5 h after injection) was greater when insulin was administered with the Medi-Jector II (913.8 ± 424.8 vs. 510.4 ± 319.8 $\mu U \cdot h^{-1} \cdot ml^{-1}$, $P < .005$). At the moment of greatest insulinemia or during the 2 h after, five of six patients showed clinical or analytical hypoglycemia (<60 mg/dl) only after insulin was injected with Medi-Jector II.

Previous studies report several different results regarding the influence of jet injection on the absorption of insulin. However, most of them suggest a more rapid absorption of jet-injected regular insulin (2–6). Our results confirm a greater and more rapid absorption of jet-injected retarded (NPH) insulin as measured by both plasma total insulin levels and biologic effects of insulin (changes in plasma glucose). Although we have not determined the plasma free-insulin levels, and our results of the absorption of total insulin are not exactly the same as Malone et al. (1), we agree that jet injection may reduce insulin requirements. We therefore think that these observations should be considered when changing a patient from needle to jet injection with Medi-Jector II to introduce the necessary modifications in both insulin dose and diet so as to achieve the best metabolic control.

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# A Reply

The letter of Lucas et al. is of interest to those of us who have patients using jet-injected insulin. The authors report total insulin levels after the injection of NPH insulin by needle and by jet spray (Medi-Jector II). The amount of endogenously produced insulin is not known; at least two of the subjects (those with non-insulin-dependent diabetes) had some capacity for making insulin. The possibility of endogenous insulin production confuses any relationship that might exist between the measured insulin levels and the method of injection. Lucas et al. report that the same insulin dose was injected in each patient with both the Medi-Jector II and the disposable insulin syringe. Of the 913.4 μU of insulin recovered after jet injection, only 510.4 μU (66%) was found in the patients during the 12.5 h after needle injection. It seems unlikely that the same amount of insulin was administered by needle as by Medi-Jector II. In our study, we found that the areas under the total insulin curves after both jet and needle injection were essentially the same (1). The difference that we noted

was in the amount of unbound, presumably biologically active insulin found after administration by jet spray. Lucas et al. did not measure the amount of free insulin available in their subjects. They also report that the rise of total insulin occurred more rapidly when the insulin was given with the Medi-Jector II. They indicate that the mean time to peak was 120 min after injection with the Medi-Jector II and 300 min after adminstration with the needle and syringe. This 3-h difference seems significant until it is realized that the blood was only sampled at 3-h intervals. We found that the peak levels of insulin after needle and jet-spray injection differed by 60 min when the blood levels were measured at 60-min intervals. The difference in time of peak levels may be even less than 60 min if sampling was more frequent. Thus, we are uncertain about the interpretation by Lucas et al. of the data, but we do agree with the cautions that they suggest when changing a patient from needle to jet injections of insulin.

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# Record Books and Patients With NIDDM

## Waste of Time?

Long-term good metabolic control improves the quality of life of diabetic patients and reduces the risk of diabetic complications (1,2). The use of a record book as an aid in controlling the disease is one of the major objectives of educational programs and is a great help to the physician and patient (3).

A recent study based on a diabetic population attending an outpatient clinic in England has shown good participation in the compilation of booklets by patients with insulin-dependent diabetes mellitus (IDDM) but not non-insulin-dependent diabetes mellitus (NIDDM) (4). Northern and southern Europeans differ much in lifestyle, educational programs, and doctor-patient relationships. Therefore, we undertook a similar study in Rome to determine the attitude of diabetic patients toward keeping a record book of their disease.

Patients attending the outpatient diabetic clinic of the University of Rome "La Sapienza" were asked to answer a questionnaire and to produce their record book or charts of self-monitoring glucose of blood glucose. On the basis of results obtained, patients were divided into three categories: *1*) those who produced excellent record books (i.e., the doctor could clearly understand data reported), *2*) those who produced fair record books (i.e., the doctor could interpret data with some difficulty), and *3*) those who produced poor record books (data were impossible to evaluate). Other specific questions were also asked (e.g., about difficulties in booklet compilation, urine- and/or blood-test monitoring, and waste of time in recording data).

As shown in Table 1, many (81%) IDDM patients produced record books compared with NIDDM patients (36%). The major reasons given for not keeping a record book were: *1*) patients felt there was no need for it because metabolic control was good and *2*) old age. No significant differences were observed between those patients who kept a record book and those who did not with respect to sex, age, and duration of disease. We found, however, that IDDM patients compiled their record books better than NIDDM patients (40% of IDDM received excellent assessment compared to 14% of NIDDM). Interestingly, none of the IDDM patients considered the compilation of a record book a waste of time, whereas 75% of NIDDM patients thought it was.

The results of the study in Rome are very similar to those reported in England, showing that despite the marked differences in life-style, a large proportion of IDDM patients produced a record book compared with NIDDM patients. As in the British study, we found that IDDM patients are more compliant. Insulin dependence is considered a much more serious disease by most patients; this is the main reason for the better metabolic control and in particular the correct use of a record book in these patients.

**TABLE 1**
**Compilation of record books by IDDM (*n* = 37) and NIDDM (*n* = 39) patients**

| | IDDM | NIDDM |
|---|---|---|
| Books produced | 30 (81.1) | 14 (35.8) |
| Book assessment | | |
| Excellent | 12 (40) | 2 (14.3) |
| Fair | 12 (40) | 8 (57.1) |
| Poor | 6 (20) | 4 (28.6) |
| Self-monitoring | | |
| Blood | 3 (10.4) | 5 (6.3) |
| Urine | 13 (43.3) | 24 (30.4) |
| Both | 14 (46.6) | 10 (12.7) |
| Self-monitoring complaints | 7 (18.9) | 5 (12.8) |
| Outpatient clinic attendance (yr)* | 3.4 ± 4.2 | 2.5 ± 2.4 |
| Duration of diabetes (yr)* | 10.7 ± 7 | 8.5 ± 7.5 |

Percentages given in parentheses.
*Values are means ± SD.