Educating diabetic patients about insulin use: changes over time in certainty and correctness of knowledge

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S UMMARY

Aim: Diabetic patients should understand their disease correctly and be sure of what they know, but certainty is rarely considered by educators. Furthermore little is known about how certainty changes with time after an educational intervention.

To clarify this, in 38 patients with type 1 diabetes (0.3-36 years duration) we analysed the effect of a course on insulin use by administering a questionnaire before the course, after the course and 1 and 3 years later.

Methods: Answers, accompanied by a subjective estimate of the degree of certainty, were assigned to mastered knowledge (certainty ≥90%, correctness ≥90%), hazardous knowledge (certainty ≥90%, correctness ≤50%), uncertain knowledge (certainty ≤50%, correctness ≥90%) and residual knowledge (total-[mastered+hazardous+uncertain]). Answers were then counted and changes in distribution among areas were analysed by the χ² test. We also followed the fate of wrong answers.

Results: The course increased mastered knowledge, while other types of knowledge decreased. With time mastered knowledge decreased, patients losing both correctness and certainty. The loss affected declarative knowledge, based purely on theory, more than procedural knowledge, which concerns the way things are done. Wrong answers, mostly given with high degree of certainty, were heterogeneous since some became correct after the course, some remained wrong, some became wrong after the course, some became mistaken after having been corrected earlier.

Conclusions: The analysis of certainty helps in evaluating patient’s knowledge; programmes tending to improve procedural knowledge are more likely to have long lasting effects; wrong answers need to be considered on an individual basis.

Key-words: Patient education · Certainty and correctness of knowledge · Type 1 diabetes · Insulin use.

R ÉSUMÉ

Éducation des patients diabétiques à l’utilisation de l’insuline : évaluation de l’exactitude et de la certitude des connaissances avec le temps

Objectif: Les patients devraient posséder des connaissances exactes sur leur maladie et être certains de ce qu’ils savent. Cependant la certitude est rarement explorée par les soignants-éducateurs. Pour vérifier comment la certitude évolue au cours du temps, un questionnaire des connaissances associé à une estimation de la certitude a été proposé à 38 patients diabétiques de type 1 avant, immédiatement après une intervention éducative qui portait sur le traitement par insuline, puis un an et trois ans plus tard.

Méthodes: À chaque temps de l’étude, les connaissances ont été évaluées et classées correctes (certitude ≥90 %, exactitude ≥90 %), hasardeuses (certitude ≥90 %, exactitude ≤50 %), incertaines (certitude ≤50 %, exactitude ≥90 %), et résiduelles (toutes – [correctes + hasardeuses + incertaines]). Les variations de distribution des réponses ont été analysées grâce au test du χ². La correction des connaissances inexactes a été également évaluée.


Conclusion: Cette étude montre l’intérêt d’évaluer chez les patients le niveau d’exactitude et de certitude des connaissances et suggère le besoin de renforcer particulièrement l’acquisition de connaissances procédurales et de prendre en compte individuellement les connaissances inexactes.

Mots-clés: Éducation du patient · Certitude et exactitude des connaissances · Diabète de type 1 · Traitement par insuline.
The Diabetes Control and Complications Trial (DCCT) and the Epidemiology of Diabetes Interventions and Complications Study (EDIC) have shown that maintenance of strict glycaemic control delays the onset and slows the progression of complications in type 1 diabetes [1,2]. Accordingly, patients are educated to optimize glucose levels by adjusting insulin dose, correcting diet, and increasing physical activity.

The purpose of education is to improve global knowledge which includes declarative knowledge, based purely on theory, and procedural knowledge, which concerns the way things are done [3,4]. Having the correct knowledge, however, is not enough, since patients hesitate to use correct knowledge if they are uncertain, but readily use wrong knowledge, if they are sure about it [5-10].

Methods to analyse certainty are just starting to be used. Recently, in a group of patients with type 1 diabetes, we analysed the effect of a course on the use of insulin by considering both correctness and certainty. To that end, before and after the course, patients answered a questionnaire in which answers were accompanied by a subjective estimate of the degree of certainty. Answers were then categorized as mastered knowledge (certainty \( \geq 90\% \)), correct knowledge (certainty \( \geq 90\% \), correctness \( \geq 50\% \)), hazardous knowledge (certainty \( \geq 90\% \), correctness \( \leq 50\% \)), uncertain knowledge (certainty \( \leq 50\% \), correctness \( \geq 90\% \)) or residual knowledge (total-[mastered+hazardous+uncertain]). We found that mastered knowledge increased significantly after the course, while uncertain, hazardous and residual knowledge decreased [10]. In that study we did not investigate whether declarative and procedural knowledge were affected differently by the course.

Correct knowledge tends to wane, but this does not happen by chance. In fact the memory of procedural knowledge lasts longer than that of declarative knowledge, especially if knowledge is applied regularly and in a familiar context [10-12]. As, of now, it is unclear how certainty changes over time. To clarify this, the patients mentioned above received the same questionnaire on the use of insulin one and three years after attending the course.

To further evaluate the effects of education we studied wrong answers in detail. Wrong answers may have a different impact, depending from the degree of certainty associated with them [7] and may have different explanations depending on whether they are present at baseline, persist after a course, appear after a course or come back over time after having been corrected. To clarify some of these points we counted wrong answers given with high or low degree of certainty and followed the fate of individual wrong answers over time.

Patients and methods

Patients

Forty patients with type 1 diabetes, seen over two weeks as outpatients, volunteered to take part in a course on the use of insulin. Among the patients, one did not follow the course and another abandoned after one year. Thus the population studied included 38 patients (17 male, 21 female). Mean age was 28.8±0.1 years (SE) (range: 19-43), mean duration of diabetes was 13.3±1.3 years (range: 0.3-36), HbA1c was 8.1±0.2%. Six patients were treated with continuous subcutaneous insulin infusion, 32 with 4 daily insulin injections. Eleven had a primary school degree, 24 a secondary school degree, 3 a university degree. All of them had been formally introduced to the use of insulin on an individual basis at the time of diagnosis and then recalled on the correct use of insulin during subsequent ambulatory visits.

The course

The course consisted of three meetings held at weekly intervals, each lasting 2.5 hours.

During the first meeting patients were taught about: role of insulin, different types of insulin, preparation of insulin mixtures, insulin administration and insulin storage.

During the second meeting patients were taught about desirable blood glucose levels (glycaemic target), how to identify the insulin administration responsible of a given blood glucose value and how to change insulin dosage on the basis of blood glucose levels.

During the third meeting patients were taught to identify causes of hyper- and hypoglycaemia, to interpret glycosuria and ketonuria, and to modify insulin dosing in response to infectious diseases, increased physical activity or other stressing conditions.

Evaluation of knowledge

The effect of the course upon patient’s knowledge was analyzed with a questionnaire containing 49 questions that explored both declarative (38 questions) and procedural knowledge (11 questions).

Questions exploring declarative knowledge analyzed 6 fields: a. insulin action and insulin absorption (6 questions), b. hypo- and hyperglycaemia (7 questions), c. acetoneuria and glycosuria (6 questions), d. desirable blood glucose values (5 questions), e. length of action of different types of insulin, relationship between insulin administration and blood glucose levels (6 questions), f. how to adjust insulin doses (8 questions).

Questions regarding procedural knowledge analysed 3 fields: g. how to modify insulin administration according to blood glucose levels (5 questions), h. how to modify insulin administration according to physical activity...
(3 questions), i.e. how to modify insulin administration in case of fasting, infectious diseases, hyperglycaemic crisis (1 question each).

The questionnaire offered one solution for each question and the patients could answer: true, false, I don’t know. Along with the answer, patients indicated their degree of confidence using a 7 degree scale that went from total doubt to perfect certainty: totally unsure (2% certainty), not sure (10% certainty), a bit sure (25% certainty), fairly sure (50% certainty), sure enough (75% certainty), sure (90% certainty), perfectly sure (98% certainty) [10]. The questionnaire was reviewed by five independent diabetologists.

The questionnaire was administered at baseline, at the end of the course, after 1 year and after 3 years. During the study period the patients were not exposed to any formal educational intervention, besides the ordinary information exchanged with caregivers during ambulatory visits.

Ambulatory visits took place on average every two months and included a visit by a diabetologist and the measurement of capillary glucose, HbA1c, blood pressure and body weight by a nurse.

Analysis of data

We counted at baseline and at different times after the course: a) correct answers, wrong answers and answers to which patients answered “I don’t know”; b) the number of answers falling into the areas of mastered knowledge (certainty ≥90%, correctness ≥90%), hazardous knowledge (certainty ≥90%, correctness ≤50%), uncertain knowledge (certainty ≤50%, correctness ≥90%) or residual knowledge (total-[mastered+hazardous+uncertain]) [10]; c) the number of wrong answers given with low (<50%) or high (≥50%) degree of certainty; d) the number of wrong answers corrected by the course, persisting after the course, appearing de novo after the course or recurring after having been corrected.

Changes in the distribution of answers among different areas of knowledge were analysed with the $\chi^2$ test.

Results

Effects of course on correctness

After the course correct answers increased from 76 to 91%, wrong answers decreased from 19 to 9% and questions to which patients answered “I don’t know” decreased from 5 to less than 1% (figure 1). During the following three years correct answers decreased, wrong answers increased and questions to which patients answered “I don’t know” changed little (figure 1). The effects of the course could still be noticed at the end of the study. In fact, after three years, 87% of answers were correct, 12% were wrong and questions to which patients answered “I don’t know” were still less than 1% (figure 1).

From these data one could conclude that patients had a fairly good knowledge about insulin use from the start, that the course improved knowledge and that the effects of the course lessened with time, but were still present after three years.

Effects of course on certainty

The analysis of the degree of certainty gives a different picture. In fact before the course 50% of answers pertained to mastered knowledge, 40% to residual knowledge and 10% to hazardous and uncertain knowledge (figure 2).
After the course mastered knowledge almost doubled, residual and uncertain knowledge decreased, and hazardous knowledge did not change appreciably (figure 2). The change in the distribution of answers among the different areas of knowledge induced by the course was statistically significant (P<0.001 versus baseline by $\chi^2$ analysis).

Over the ensuing three years the effects of the course tended to fade, mastered knowledge decreasing and residual and uncertain knowledge increasing (figure 2). Nevertheless some of the effects persisted, since after three years mastered knowledge was greater and the other types of knowledge were smaller than at baseline (P<0.001 by $\chi^2$ analysis) (figure 2).

Effects of course on declarative and procedural knowledge

The course improved both declarative and procedural knowledge, but the effects on procedural knowledge lasted longer. In fact declarative knowledge deteriorated over time, mastered knowledge decreasing and other types of knowledge increasing, so that after three years the distribution of answers among different areas was different from end of course (P<0.001 by $\chi^2$ analysis) (figure 3). On the other hand procedural knowledge, which was also improved by the course, did not change appreciably with time, so that after three years the distribution of answers among different areas of knowledge was not significantly different from end of course (P ns by $\chi^2$ analysis) (figure 3).

Effects of course on wrong answers

Wrong answers, which were mostly given with a high degree of certainty, decreased after the course and then increased again (figures 1 and 4).

The course appeared to be most effective at correcting wrong answers given with a low degree of certainty. In fact answers wrong at baseline with a low degree of certainty almost disappeared after the course, while an important number of wrong answers with a high degree of certainty persisted after the course (figure 4).

Answers wrong at baseline had different fates: one half of them became correct after the course and then remained correct, one fourth remained wrong for the length of the study and one fourth became correct after the course but then became wrong again. It also appeared that some answers, which were correct at baseline, became wrong after the course (table I).

As shown in figure 5 questions eliciting the highest number of wrong answers concerned how to modify insulin dosing according to physical activity, while knowledge on hypo/hyperglycaemia and on the effect of insulin on blood glucose was satisfying both at baseline and after the course. figure 5 shows also that wrong knowledge decreased after course but tended to come back over time.

Discussion

Analysis of degree of certainty to evaluate knowledge

The effects of education are usually evaluated with the help of questionnaires which explore the correctness of knowledge. At present the degree of certainty is rarely
Table I
Properties of wrong answers.

<table>
<thead>
<tr>
<th>Type of answer</th>
<th>% of total*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wrong at baseline, correct after course and remained correct</td>
<td>36.0</td>
</tr>
<tr>
<td>Wrong at baseline, remained wrong</td>
<td>17.0</td>
</tr>
<tr>
<td>Wrong at baseline, correct after course, wrong one or three years after course</td>
<td>15.9</td>
</tr>
<tr>
<td>Correct at baseline, wrong after course</td>
<td>9.6</td>
</tr>
<tr>
<td>Correct at baseline and after course, wrong one or three years after course</td>
<td>21.5</td>
</tr>
</tbody>
</table>

*The total number of wrong answers was 511.

The course improved declarative and procedural knowledge to a similar extent, but the effects on declarative knowledge tended to deteriorate faster, which agrees with the view that procedural knowledge is more apt to long term remembrance, especially if it is applied regularly, quasi automatically and in a familiar context [3,14,15].

These findings indicate that in our patients the contact with caring personnel during outpatient visits was unable to prevent a progressive deterioration of knowledge. Thus it appears that, besides structured courses, patients need continuous support to maintain knowledge about the use of insulin. It is also clear that programmes tending to improve procedural knowledge have a better chance of inducing long lasting effects.

It should be remembered, however, that there is a difference between what patients know or claim to do and what they actually do and that there is a difference between the expressed and the real motivations of their actions [16]. Thus the final judgement concerning an educational intervention rests on its effect on behaviour.

Analysis of wrong answers

Wrong answers may have different meanings. Wrong answers at the start of a course may represent wrong knowledge. Wrong answers persisting after a course may be due to ineffectual education, may reflect previous experiences of high emotional content or may depend upon a combination of these conditions, as exemplified by the patient who finds it difficult to accept with low confidence knowledge affecting important aspects of life. Wrong notions that return after having been corrected may represent memories of emotionally significant events that surface, or may be the consequence of the loss of new knowledge through amnesia, extinction or repression [17]. Wrong answers that appear after a course may represent a failure from the side of educators.

In this study wrong answers pertained to all these categories, however patients gave the worst performance when asked how to modify insulin administration according to physical activity, indicating that this section of our programme needs to be revised. Wrong answers were very heterogeneous, suggesting that they may need to be considered on an individual basis.

Limitations of the study

We acknowledge that the small size of the population studied limits the analysis of patients’ characteristics which are likely to influence certainty, such as the duration and previous history of diabetes and number and efficacy of previous educational interventions.

Practical implications

This study indicates the following: 1) questionnaires considering both correctness and certainty help to better considered by educators, although it could offer the following advantages: a) it could help to identify areas of knowledge, like hazardous knowledge, that may need special educational efforts; b) it could help predicting the success of education, since uncertain and residual knowledge appear to respond to education better than hazardous knowledge [13].

Effect of time on knowledge about the use of insulin

The effect of the course waned over time and knowledge about the use of insulin became less correct and less certain.
define patient’s knowledge; 2) after formal teaching patients need periodic recalls of their notions, since time erodes both correctness and certainty in knowledge; 3) programmes tending to improve procedural knowledge are more likely to have long lasting effects; 4) wrong knowledge should be considered on an individual basis.

References


