Chapter 7 – Recall of neutral words and face recognition in patients undergoing cardiac catheterization

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Submitted
ABSTRACT

Objective
To investigate the influence of stressful circumstances on the recall of neutral information in a clinical setting, a prospective study was done on patients who were admitted to hospital to undergo cardiac catheterization.

Method
During their stay in hospital, cardiac patients were tested for verbal recall before cardiac catheterization and 24 hours afterwards. Cortisol levels in plasma were also determined. After catheterization, recognition of faces seen before catheterization was assessed.

Results
Patients’ scores on the verbal recall test were within normal limits for the age group on both assessments, but were significantly higher before undergoing the procedure than 24 hours afterwards. Face recognition was excellent. Blood levels of cortisol before and after the procedure did not differ significantly, and no significant relationship was found between change of cortisol levels and the change in scores on the verbal recall test.

Conclusions
The results suggest that the stress of hospital admission and cardiac catheterization does not impair recall of neutral information. Whenever necessary, information is best provided before the catheterization.
INTRODUCTION

The effects of stress on verbal recall in healthy subjects are contradictory. Psychosocial stress was associated with poor verbal recall in two studies (Kirschbaum et al., 1995; Kirschbaum, Wolf, May, Wippich, & Hellhammer, 1996), with no effect in two other studies (Wolf, Schommer, Hellhammer, McEwen, & Kirschbaum, 2001; Wolf, Schommer, Hellhammer, Reischies, & Kirschbaum, 2002) and with enhanced verbal recall in a fifth study (on exam stress) (Vedhara, Hyde, Gilchrist, Tytherleigh, & Plummer, 2000). The latter three studies also assessed cortisol levels, one showing an inverse relationship between cortisol level and verbal recall (Wolf et al., 2001), the second showing no relation between cortisol levels and verbal recall under stress although cortisol levels were increased (Wolf et al., 2002) and the third demonstrating a positive relationship between verbal recall and cortisol levels (Vedhara et al., 2000).

The effects of stress on verbal recall in patients undergoing major medical examinations or treatments has not been studied extensively. The only study we know of, investigated the ability to recall neutral words in patients admitted to hospital after attempting suicide with a benzodiazepine overdose (Verwey, Eling, Wientjes, & Zitman, 2000). Their patients’ ability to recall neutral words was impaired. As the degree of impairment correlated positively with benzodiazepine blood levels (Verwey et al., 2005), these drugs probably played a major role. However, as a control group of non-drug-using suicide attempters was absent (and could not be included because those patients are very rare) it remains unknown whether stress itself diminishes or enhances memory in clinical situations.

Nevertheless, better knowledge about what is remembered of neutral information, i.e. information not directly related to the stressful event, provided under stressful circumstances in the hospital, is important for two reasons. Firstly, it may help clinicians to decide when it is the best time to provide information to the patient. And secondly, it may help to better understand how the memory functions under stress. Therefore a prospective study was done on some aspects of memory, namely the immediate and delayed recall of neutral words and face recognition, in patients admitted to the hospital to undergo cardiac catheterization.
METHOD

Subjects
All patients admitted to the Rijnstate General Hospital (city of Arnhem, The Netherlands) for cardiac catheterization were eligible for the study. Exclusion criteria were: patients younger than 18 (because the tests used were not developed for younger people); a clinical diagnosis of delirium, dementia or amnesic disorder; alcohol dependence or abuse; and inability to read or to understand the verbal recall test. Patients were also excluded when benzodiazepines or alcohol were present in blood plasma.

Procedure
This prospective study was carried out between 2002 and 2004. The medical ethics committee of the hospital approved the study. Patients scheduled to undergo cardiac catheterization received a letter with information about the study before they were admitted to the hospital. After admittance and immediately prior to the catheterization, those who wanted to participate in the study were seen by a research physician who examined the patient with regard to the inclusion criteria, explained the procedure of the study, and asked informed consent. When written informed consent was obtained, a research assistant immediately started assessments (referred to as day 1). Twenty-four hours after the cardiac catheterization (day 2), the research assistant performed the same assessments.

ASSESSMENTS

1 The ‘15-woorden test’ (15-word test) is the Dutch equivalent to the Rey Auditory Verbal Learning Test (Lezak, 1983). The procedure was slightly adapted by administering the list of words only once on day 1 and once on day 2. To prevent learning, patients were presented parallel versions of the test on each day. On both days the research assistant instructed the patient to use a computerized version of the test. The patient was asked to remember words that were presented successively on the computer screen for a period of 2 seconds each. Immediately after the presentation of 15 unrelated words the patient was asked to recall as many words as possible (‘immediate recall’). After 15 minutes the patient was again asked to recall as many words as possible (‘delayed recall’).
2 Also a face recognition test, used in formal police investigations in the Netherlands, was done. On day 2 the patient was presented with a series of
6 photographs of faces with a variety of features such as hair, glasses, etcetera. One of the photographs showed the research physician who had examined the patient the day before. The patient had to answer three questions: [1] Do you recognize anyone? [2] Who do you recognize? and [3] How do you know this person? This test was done to find out whether the cardiac patients were able to remember the faces of clinical personnel. In the study with the patients who had attempted suicide, half of the patients did not recognize the face of the physician they had spoken to for at least 45 minutes on the previous day (Verwey et al., 2000). The cardiac patients spoke to the research physician for only 10 minutes or less.

3 There is extensive literature relating stress with cortisol levels in blood and with memory performance. Therefore, in this study, cortisol levels in blood were measured at the same time in each subject on both days using a competitive immunoassay (Roche Diagnostica BV, Almere, The Netherlands).

4 To exclude confounding factors that could have influenced the verbal recall and face recognition tests, the following measurements were obtained:

4.1 The degree of sedation was rated by the patient and by the research assistant on a 10 cm Visual Analogue Scale (VAS) on day 1 and day 2. A low score indicates a high level of sedation.

4.2 Blood alcohol concentration was measured with gas liquid chromatography. Presence of benzodiazepines in the blood was determined by the immunochemical method TDxFLx (Abbott Laboratories, USA).

STATISTICAL ANALYSIS

Differences in verbal recall, face recognition and cortisol levels between day 1 and 2 were tested using the paired t-test; the level of significance was $p < 0.05$. Linear regression analysis was used to investigate the relationship between changes in the scores of verbal recall and changes in cortisol levels in blood.

RESULTS

Fifty patients were eligible for the study. Two refused to cooperate and nine patients dropped out during the follow-up on day 2. Of the remaining 39 patients (29 male and 10 female; mean age 60.5 years; SD 10.2), no patients had to be excluded due to a measurable blood alcohol or benzodiazepine concentration. The patients were not sedated on either day 1 or day 2, as was shown by the ratings of the patients themselves (around 8.5 on the VAS) and the ratings by the
research assistant (around 0.7 on the VAS). Blood levels of cortisol on day 1 and
day 2 did not differ significantly ($p = 0.51$). The results are presented in Table 12.

**Verbal Recall with the 15-word Test**
Immediate recall on day 1 was significantly higher than on day 2 (the respective
means were $6.87 \pm 1.73$ and $5.79 \pm 1.79$, $p \leq 0.001$). Delayed recall was also
significantly higher on day 1 than on day 2 (the respective means were $5.46 \pm
2.01$ and $4.56 \pm 1.82$, $p = 0.004$). These findings were comparable to scores
of immediate and delayed recall on this test in healthy subjects of the same age
group (Savage & Gouvier, 1992). Regression analysis showed no statistically

| Table 12 | Recall ratings on the 15-word test, scores of sedation
on visual analogue scale, and blood levels of cortisol (N = 39) |
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<tr>
<td></td>
<td>Day 1</td>
<td>Day 2</td>
<td>$p$</td>
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<td></td>
<td>Mean (SD)</td>
<td>Mean (SD)</td>
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<tr>
<td>IMM</td>
<td>6.87 (1.73)</td>
<td>5.79 (1.73)</td>
<td>$\leq 0.001$</td>
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<tr>
<td>DEL</td>
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<td>4.56 (1.82)</td>
<td>0.004</td>
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<td>PVAS</td>
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<tr>
<td>Cortisol</td>
<td>0.38 (0.15)</td>
<td>0.39 (0.13)</td>
<td>0.51</td>
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IMM: immediate recall (range from 0 to 15)
DEL: delayed recall (range from 0 to 15)
IVAS: score of interviewer on visual analogue scale of sedation
(range from 1 to 10)
PVAS: score of patient on visual analogue scale of sedation
(range from 1 to 10)
Cortisol: blood levels (umol/l)
SD: standard deviation
$p$: significance (Paired T-test)
significant relationship between the change in verbal recall and cortisol levels (immediate recall = −1.08 + 0.03 x cortisol change; \( p = 0.98; R^2 = 0.00 \)) (delayed recall = −0.86 − 2.09 x cortisol change; \( p = 0.20; R^2 = 0.04 \)).

**Face Recognition Test**

All patients could recognize the research physician from the photograph and knew that he was the one with whom they had formally spoken the day before.

**DISCUSSION**

The scores of verbal recall before and after heart catheterization were within the normal range for the age group to which the subjects belonged. Face recognition on day 2 was excellent, although patients had spoken with the research physician for only a short time on day 1.

Remarkably, the verbal recall scores on day 1 were significantly higher than scores on day 2 and this needs an explanation. For clinical practice these findings imply that the stress of a heart catheterization does not necessarily influence remembrance of neutral information given to the patient and that, whenever possible, information should be given before the procedure.

Is the better performance on day 1 due to stress? It is noteworthy that one of the patients, who did not score as well on the second day, spontaneously commented, ‘The stress is over’. However, the perception of experienced stress by the patients was not measured, so it is hard to draw conclusions. The finding that blood levels of cortisol before and after the catheterization were within normal limits and did not differ significantly, as well as the finding that there was no relationship between change in verbal recall and change of cortisol levels in blood, do not support the hypothesis that stress had a major influence. Furthermore, the lower scores on day 2 could be attributed to a change in mood due to exertion after the procedure, some degree of sedation or a change in motivation. However, the degree of sedation determined either by the patients or the research assistant did not differ significantly between day 1 and day 2.

Some limitations of this study should be mentioned. Firstly, a control group is lacking in this study. Therefore it was not possible to establish the natural history of scores without the intervening procedure. An appropriate control group would have consisted of patients admitted to hospital without having been exposed to any form of stress and this is not likely to occur in clinical practice. Moreover, the verbal recall test has been tested for its validity by test-retest procedures (Benedict & Zgaljardic, 1998) and it can be argued that a control group is not necessary in this respect. Secondly, as almost three times more
men than women participated in the study, the results cannot be generalised to both sexes. However, stratifying the data on sex did not lead to different results (data not shown). Thirdly, although the cortisol samples were taken at the same time on both days, the method of taking single blood samples may have been too inaccurate to detect change in cortisol levels. A series of (preferably saliva) samples on both days might have shown a difference between the two measurements. However, for practical reasons saliva assessments were not available in this study. Finally, the subjective level of stress perceived by the patients before and after the cardiac catheterization was not determined, so this factor could not be correlated with the verbal recall and face recognition test.

In conclusion, in this study, elderly patients admitted to hospital to undergo cardiac catheterization performed within normal limits on a verbal recall test before the procedure and 24 hours afterwards. All patients could recognize from photographs the research physician they had spoken to before the, so no impairment of recall of neutral information was found. As patients scored significantly better before the catheterization, whenever necessary information is best provided at that time. Whether these results can be generalized to patients in other stressful situations requires further study.
REFERENCES


