SURGERY

Delusional memories following cardiac surgery and prolonged intensive care: a retrospective survey and case note review

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Abstract

The objective of this study was to examine the association of delusional and real memories for events with both the pre-operative and early post-operative clinical condition and to examine interventional, supportive and therapeutic factors. Its design was retrospective, using a questionnaire and review of clinical records. The study was carried out in a university teaching hospital cardiothoracic intensive care unit (ICU) on 161 patients without professional experience of intensive care, who had received four days or more in intensive care after cardiac surgery.

Its main outcome measures were the prevalence of delusional memory persisting after recovery and the recall of real events whilst in intensive care. Seventy-eight (48%) patients recalled events apparently occurring whilst in intensive care, which were delusional or hallucination-like ('dreamers'). This group recalled a mean of 2.6 of a possible 10 normal intensive care events compared with 1.0 of 10 for those who were not able to recall delusions or hallucinations ('non-dreamers'). Dreamers were younger at the time of surgery (mean age 63.6 vs. 68.9 years, p=0.003). Dreaming was more common in patients who received intravenous glucose (to treat hypoglycaemia), midazolam, steroids and in those with episode(s) of sepsis.

We concluded vivid memory of unreal events is common after discharge from intensive care. The aetiology is probably multifactorial. The retrospective nature and the inexact methods preclude confirming that midazolam is a direct, much less a causal, risk factor. However, the association is strong enough to warrant prospective studies.

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Introduction

At our institution, 7% of patients stay for five days or longer following cardiac surgery. Some of these stay for upward of two months (intensive care unit database). Follow-up studies of patients discharged from general intensive care units (ICU)[1-3] suggest that 30% have vivid recollection of events perceived as real, for which there is no factual basis. A fascinating personal account of such hallucinations appeared in the *Daily Telegraph*.[4] The term delusional memory is applied to these perceptions. It covers:

● a dream, nightmare or hallucination experienced by the patient during his ICU stay
● a belief or memory of the ICU that has been rejected as false by the patient
● a belief or memory of events in ICU that is not shared by medical staff or family members present during the patient's stay.[5]

Although psychological mechanisms have been suggested,[6] the aetiology of delusional memories remains uncertain. No work has specifically examined potential causal factors of delusional memories, partly because of the lack of homogeneity among ICU patient populations. Accordingly, we undertook to study patients following cardiac surgery after discharge from a dedicated cardiothoracic ICU. We examined the association of the recall of real and unreal events with the pre-operative, operative and early post-operative clinical condition, with interventional, supportive and therapeutic factors. For the purposes of the study, we refer to the recall of imaginary events, be they illusions, hallucinations, delusions or delusional memories, as dreams.

Participants and methods

Following ethical committee and, subsequently, each patient's general practitioner's approval, written informed patient consent, a single questionnaire was sent in January 2000 to all adult patients who had received four or more bed-days in intensive care following cardiac surgery between March 1995 and November 1999. Using a modification of the interview schedule used by Jones *et al.*,[7] inquiry was made of memories

Table 1. Memories for normal occurrences in the intensive care unit

- Members of their family
- The sounds of ventilator and monitoring alarms
- Voices
- Lights
- Faces
- Pain
- Feeling 'down'
- The feeling of anxiety or fright
- The presence of the endotracheal tube
- Endotracheal suction
- Darkness
- The visit of ward rounds
- The feelings of confusion and panic

Table 2. Memories for events considered to be unreal. A positive response to one or more defined the patient as a dreamer

- The thought that others were trying to inflict harm
- The thought that others were plotting against you
- The thought that you travelled after surgery
- Dreams
- Nightmares

for specific events considered to have occurred during their ICU admission.

Although randomly listed, the events were categorised into those considered to be normal (table 1) and unreal (table 2) in ICU. The inclusion of at least one positive response from table 2, classified the patient as a 'dreamer'. A narrative section allowed for detailed description of some of the patient's experiences. Attempts were not made to categorise the nature of dreams.

Upon return, the replies were matched with the medical records for the admission to ICU and clinical data were extracted (table 3). Responses from the dreamers (group D) were compared with those from the non-dreamers (group ND) using t-test for age and EuroSCORE,[8] a Mann-Whitney U-test for bed-days and odds ratios from logistic regression for dichotomous variables. A p value of less than 0.05 was taken as significant.

From 1995–1996, there was no change in either sedation concepts nor antibiotic prophylaxis or treatment regimens.

The retrospective nature of the study precluded the assessment of the pre-operative neurological and psychiatric condition of the patients.

Results
From 423 possible patients, 89 had died, 24 were uncontactable and the general practitioner refused assent for 59. Two hundred

Table 3. Clinical details recorded from the medical records

- Demographic data, including age, gender, duration of stay in ICU, surgical diagnosis and calculation of the EuroSCORE
- Therapy with glucose, propofol, morphine, midazolam, steroids or insulin
- Mechanical ventilation
- Mechanical and inotropic cardiovascular support
- Nutritional support, either enterally or parenterally
- The development of new neurological signs
- Cardiac arrest requiring resuscitation
- Episodes of systemic sepsis as defined by pyrexia and leucocytosis or positive bacteriological culture
- Renal failure (creatinine > 200 μmol/L or the use of haemofiltration)

and fifty-one questionnaires were sent and responses received from 161 (64%) patients (113 of them male). Responses were matched with medical records in 154 patients (96%). Replies from 78 of 161 (48%) fulfilled the definition of dreaming (dreamers) and were received after a median time of 28.2 months from ICU discharge (27.2 months for non-dreamers). The median stay in ICU was seven days for dreamers (range 4–44) and five days for non-dreamers (range 4–64). Demographic pre-operative and operative data from 161 replies are presented in table 4. Dreamers were younger than non-dreamers but no other variable was identified as being associated with an increased chance of dreaming. Significantly, urgency of surgery did not affect the chance of dreaming.

Post-operative therapy and events obtained from medical record review in 154 of the 161 responses is presented in table 5. Factors found to be positively associated with the recall of dreams were: intravenous 50% glucose to treat documented hypoglycaemia (odds ratio [OR] 14.5, 95% confidence intervals [CI] 3.19–66.4), midazolam infusion for sedation (OR 3.51, 95% CI 1.59–7.75), steroid therapy (OR 10.2, 95% CI 1.1-93.0) and episodes of sepsis (odds ratio 3.0, 95% CI 1.44–6.29). The development of new neurological signs exerted a protective effect (or 0.36, 95% CI 0.14–0.97). Group D recalled a mean of 2.6 of 10 common events in ICU (table 1), whereas those in group ND recalled a mean of 1.0 (p<0.0005). Twenty-seven percent of patients had no recollection of ICU at all.

Discussion
Whilst we have described 'dream-like' experiences as dreams, they are unlikely to be so. Given the frequency of drug-induced sedation, it is unlikely that patients enter REM sleep.[9] Further, the responses to their recollection are not typical. Patients fail to understand why their families collude with what to them are plots and intrigue; one patient, convinced that he was witness to torture, began legal action. Almost invariably persecutory, very vivid and recalled in great detail years later, they are a recollection of events perceived as being real. Originating either as mis-

Table 4.   Pre-operative characteristics of patients in the study

	Dreamers (n=78)		Non-dreamers (n=83)		p-value	Mean difference	95% CI
Age (Mean [SD])	63.6	(13.2)	68.9	(8.0)	0.003	5.2	(1.8–8.7)
EuroSCORE (Mean [SD])*	8.0	(4.4)	7.2	(4.0)	0.234	-0.8	(-2.2—-0.5)
						Odds ratio	
Gender							
Male	56	(72%)	57	(69%)	0.665	1.16	(0.59–2.29)
Female	22	(28%)	26	(31%)		1.00	
Presentation type**							
Emergency	25	(32%)	20	(25%)	0.304	1.44	(0.72–2.88)
Elective	53	(68%)	61	(75%)		1.00	
Diagnosis includes							
Ischaemic heart disease	42	(54%)	47	(57%)	0.723	0.89	(0.48–1.66)
Aortic valve disease	10	(13%)	14	(17%)	0.471	0.73	(0.30–1.74)
Mitral valve disease	6	(8%)	18	(22%)	0.013	0.30	(0.11–0.80)
Other diagnosis	25	(32%)	20	(24%)	0.261	1.49	(0.74–2.97)
Surgery includes							
CABG	43	(55%)	48	(58%)	0.730	0.90	(0.48–1.67)
Mitral valve replacement	11	(14%)	21	(25%)	0.075	0.49	(0.22–1.09)
Aortic valve replacement	13	(17%)	13	(16%)	0.863	1.08	(0.47–2.49)
Other operations	19	(24%)	17	(21%)	0.555	1.25	(0.60–2.63)

Key: CI = confidence intervals; SD = standard deviation; CABG = coronary artery bypass graft: * Four missing from the dreamers group and three missing from the non-dreamers group; ** Two missing from the non-dreamers group

interpretation of illusory stimuli (the squeak of the door interpreted as the cry of an animal, for example), or hallucinations (the misappropriation of body parts, for example), they become distorted beliefs and, as such, have recently become described as delusional memories.[10] Examples of such delusional memories are given in table 6.

Within ICUs, the terms 'ICU psychosis' and 'ICU syndrome' have been used to describe hallucinations, delusions and fluctuating level of consciousness, poor orientation, passivity or aggression,[11,12] features consistent with the diagnosis of a delirium. Despite the lack of supportive empirical evidence, there is a widely held view that sleep deprivation[13] is a cause of the ICU syndrome. McGuire[14] argues that the ICU syndrome does not differ from, and may have features clinically and temporally identical with, post-operative delirium. This work supports that view. Reports from 1964 to 1982 describe delirium after cardiac surgery (post-pump psychosis) in 17% to 73% of patients.[14] However, changes in surgical, perfusion and anaesthetic techniques make comparison with today's practice difficult. Since delusional memories are as common among general intensive care patients as cardiac surgical intensive care patients, then it is likely that it is the post-operative condition and management, rather than the specific surgical procedure, that is responsible.

Within the present study, it is impossible to be certain at what point delusional memories originated. However, the narrative never described events that could be interpreted as having occurred in the operating theatre. Further, as memory processing is required in order to recall, it is probable that the perceptions that subsequently were recalled as delusional memories were experienced whilst in the ICU.

The retrospective design, reliant upon self-reporting in response to a single letter, has substantial limitations when compared to a prospective randomised approach and favours responses from dreamers. This may, in part, explain our higher figure of 48% compared with previously quoted incidences of 30–40%.[1,2,14,15] As Dyer points out,[15] this may in fact be an underestimate. The current study, by enquiring into symptoms rather than relying on signs from patients intubated with endotracheal or tracheostomy tubes, is likely to yield greater symptomatology. Indeed, in the present study, in only one instance did the medical record describe the patient's symptoms (that he later recalled) as a delusion. Further selection bias is inevitably introduced given the study design and responses from 161 (38%) of 423 patients.

Whatever the mechanism responsible for the vivid memory of unreal events, its association with recognised causes of delirium would support the contention that illusions and hallucinations are symptomatic of a delirium. Sepsis is well recognised to be a cause of delirium. Steroid therapy is known to be associated with neuropsychiatric effects. One can only speculate how episodes of hypoglycaemia requiring 50% glucose result in delusional memories that are often complex and embroiled.

Sedation is used in ICU in order to reduce the stress response, to provide anxiolysis, to improve the tolerance to ventilatory support and to allow nursing care. Many different sedative regimes are used,[16] but most studies have compared propofol with the

Table 5.   Post-operative therapies, events and memories of patients in the study

Response	Dreamers (n=78)		Non-dreamers (n=83)		Unadjusted odds ratios			Adjusted odds ratios *		
	n	(%)	n	(%)	p-value	OR	95% CI	P-value	OR	95% CI
Therapies										
Glucose bolus	23	(30%)	4	(5%)	<0.001	8.26	(2.71–25.2)	0.001	14.5	(3.19–66.4)
Propofol infusion	72	(92%)	79	(95%)	0.450	0.61	(0.17–2.24)	0.934	0.89	(0.05–14.8)
Morphine infusion	69	(89%)	74	(89%)	0.889	0.93	(0.35–2.49)	0.784	1.25	(0.26–5.97)
Midazolam infusion	35	(45%)	17	(21%)	0.001	3.16	(1.58–6.33)	0.002	3.51	(1.59–7.75)
Steroids	6	(8%)	2	(2%)	0.123	3.38	(0.66–17.3)	0.040	10.2	(1.11–93.0)
Insulin	43	(55%)	36	(43%)	0.136	1.60	(0.86–2.99)	0.090	1.92	(0.90–4.06)
Ventilation	68	(87%)	79	(95%)	0.072	0.34	(0.10–1.15)	0.029	0.03	(0.002-–7.02)
Positive inotropes	60	(77%)	67	(81%)	0.555	0.80	(0.37–1.70)	0.528	1.37	(0.51–3.66)
IABP	18	(23%)	18	(22%)	0.832	1.08	(0.52–2.27)	0.716	0.85	(0.36–2.04)
Nutritional support	45	(58%)	32	(39%)	0.015	2.17	(1.16–4.08)	0.003	3.03	(1.46–6.28)
Events										
New neurological signs	8	(10%)	20	(24%)	0.021	0.36	(0.15–0.88)	0.044	0.36	(0.14–0.97)
Cardiac arrest	10	(13%)	5	(6%)	0.138	2.29	(0.75–7.04)	0.036	4.58	(1.11–19.0)
Sepsis	47	(60%)	25	(30%)	<0.001	3.52	(1.83–6.75)	0.004	3.00	(1.44–6.29)
Renal failure	18	(23%)	19	(23%)	0.978	1.01	(0.49–2.11)	0.662	1.22	(0.50–2.97)
	Median (minimum-maximum)				p-value	Median difference and 95% CI				
Bed days	7	(4–44)	5	(4–64)	<0.001	1	(1–3)			

Key: CI = confidence intervals; IABP = intra-aortic balloon pump; *Estimates the relative risk of an event (e.g. sepsis) for a 'dreamer' compared to a 'non-dreamer', adjusting for age, sex, presentation type, EuroSCORE, diagnosis and surgery. The adjusted odds ratios (OR) use n=74 (dreamers) and n=80 (non-dreamers) because of missing data in presentation type and EuroSCORE

Table 6.   Examples of delusional memories

- I was convinced that the night nurse was plotting to kill me
- Babies were being killed at the bottom of the intensive care unit. I had to remember everything so that I could put it right
- I thought I could see a vulture over my bed
- I had no footrests for my wheelchair, which cost £29.49. I therefore could not go out
- The nightmares went on and on. In the space ship I had to hide from the robots
- My eldest daughter was trying to choke me

water-soluble benzodiazepine, midazolam.[17] A personal account[3] specifically linked midazolam injections to recurrent 'nightmares'. Midazolam premedication in children has been followed by hallucinations, agitation and violent behaviour.[18] Concurrent drug therapy and renal failure may alter the pharmacokinetics of midazolam infusions in ICU and its cessation may be followed by a withdrawal reaction. Recently,[19] work has suggested that it is the duration of sedation that predisposes to nightmares and hallucinations. However, the proportion of patients in this study receiving midazolam was only 20%.

The differentiation between central and peripheral neurological signs is difficult in ICU. The development of new neurologi-cal signs protected against delusional memories. Presumably, neurological injury impairs cognitive and memory processes. Further research is required.

Post-traumatic stress disorder (PTSD) has been described among survivors of respiratory failure, most of whom were sedated with midazolam.[20] Studying the impact of delusional memories on the development of PTSD, Jones et al.[21] found that the persistence of memory for real events up to two months after discharge from ICU exerted a protective effect against the development of PTSD-related symptoms. In contrast, those with delusional memory but no factual memory scored significantly higher on anxiety, fear and impact scores. The authors conclud-ed that even relatively unpleasant factual memories during criti-cal illness protected patients from anxiety and the later develop-ment of PTSD symptoms when delusional memories are promi-nent. It would appear then that delusional memories, especially in the absence of factual memory, predispose to PTSD-related symptoms.

Conclusions
The experience of persisting delusional memory is common after a prolonged stay in ICU after cardiac surgery. Hypoglycaemia, steroid therapy and sepsis are risk factors. Midazolam infusion for sedation is known to cause hallucination and nightmares and should be studied prospectively to examine the link with the development of delusional memories.

Key messages

- Those patients recovering from cardiac surgery and prolonged intensive care may experience delusional memories

- This retrospective study suggests that factors commonly associated with delirium (hypoglycaemia, steroid therapy and sepsis) are associated with delusional memories, as is midazolam used for sedation in intensive care

Acknowledgements

Conflict of interest

None declared.

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