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Emergence delirium in adults in the post-anaesthesia care unit

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Background. Emergence delirium in the post-anaesthesia care unit (PACU) is poorly understood. The goal of this prospective study was to determine frequency and risk factors of emergence delirium in adults after general anaesthesia.

Methods. In this prospective study, 1359 consecutive patients were included. Contextual risk factors and occurrence of delirium according to the Riker sedation scale were documented. Groups were defined for the analysis according to the occurrence or not of agitation, then after exclusion of patients with preoperative anxiety and neuroleptics, or both, and antidepressants or benzodiazepines treatments.

Results. Sixty-four (4.7%) patients developed delirium in the PACU, which can go from thrashing to violent behaviour and removal of tubes and catheters. Preoperative anxiety was not found to be a risk factor. Preoperative medication by benzodiazepines (OR=1.910, 95% CI=1.101–3.315, *P*=0.021), breast surgery (OR=5.190, 95% CI=1.422–18.947, *P*=0.013), abdominal surgery (OR=3.206, 95% CI=1.262–8.143, *P*=0.014), and long duration of surgery increased the risk of delirium (OR=1.005, 95% CI=1.002–1.008, *P*=0.001), while a previous history of illness and long-term treatment by antidepressants decreased the risk (respectively, OR=0.544, 95% CI=0.315–0.939, *P*=0.029 and OR=0.245, 95% CI=0.084–0.710, *P*=0.010).

Conclusions. Preoperative benzodiazepines, breast and abdominal surgery and surgery of long duration are risk factors for emergence delirium.

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Emergence delirium in the postanaesthesia care unit (PACU) is poorly investigated. Such a delirium can suddenly become dangerous and have serious consequences for the patient such as injury, increased pain, haemorrhage, self-extubation and removal of catheters requiring physical or chemical restraint. The incidence of this type of delirium is around 3%,[1] but has rarely been studied with the exception of paediatric anaesthesia.[2 3] Furthermore, both the definition of emergence delirium and the phrasing (delirium, confusion, excitement, agitation) vary, as does its onset interval (upon awakening, within the first few hours, days or weeks). Another difficulty is the quantification of this agitation, as there is no specific scale.

We studied only acute, short-lived (that is, resolved at time of PACU discharge) postoperative delirium in the PACU after general anaesthesia. The goals of this prospective study are to define incidence and risk factors of emergence delirium in adults.

Methods

The study protocol was approved by our local ethics committee and informed consent was obtained from all patients. Every patient admitted to the PACU after general anaesthesia over a 3 month period, from November 2003 to February 2004, was included in our study. This 12-bed PACU is open day and night and is located next to the operating rooms (abdominal surgery, urology, ophthalmology, ENT, vascular surgery and abdominal endoscopies). Each PACU nurse is responsible for 2–3 patients and one nursing auxiliary is on-site for the entire unit. An anaesthetist is responsible for the discharge of patients. Every patient admitted to PACU

during the study period was included in the study, excluding those under 15 yr of age, those for whom dementia had been diagnosed and those under loco-regional anaesthesia.

After a preliminary feasibility study performed in the PACU with a small cohort of consecutive patients (*n*=150), we used the Riker sedation–agitation scale (Table 1), which was developed to assess the level of agitation and sedation in intensive-care patients, to evaluate delirium in the PACU.[4] We divided the patients into two categories using the Riker sedation–agitation scale: non-agitated patients (levels 1–4) and agitated patients (levels 5–7). We then subdivided those patients in the agitated group as agitated, very agitated and dangerously agitated. This scale is easy to use, even in emergency situations. Two nurses with a long PACU experience were responsible for evaluating the occurrence of agitation. These nurses had no responsibility concerning the care of the patients.

For each patient, the following variables were noted: age, gender, ASA score, pre-existing medical or surgical condition (cardiac, pulmonary, neurological, endocrinological, abdominal, psychiatric or kidney disorder, cancer, and drug or alcohol abuse), long-term (>1 month) treatment by benzodiazepines or antidepressants or neuroleptics, severe preoperative anxiety (as judged by a physician by a binary (yes/no) evaluation), recent surgery (either within the previous 2 weeks or the previous 3 months), length of stay before anaesthesia, emergency or non-emergency surgery, preoperative medication (benzodiazepines or hydroxyzine), type of surgery and its length, anaesthesia protocol (induction and maintenance of anaesthesia by propofol (Diprifusor TCI system), maintenance by inhaled anaesthetics after i.v. induction, or induction and maintenance by inhaled anaesthetics, type of inhaled anaesthetics, use of neuromuscular blockers, length of stay in the PACU and mortality at 3 months. For patients with emergence delirium, we also noted agitation score, its duration and consequences, the number of people needed to control

the situation, and, where possible, the most probable cause. An appropriate treatment was then performed with analgetics and anxiolytics. For all patients, pain was assessed and treated so as to obtain a pain level <3 on the visual analogical scale. Aetiologies were assessed on patient records by the anaesthetist responsible for the PACU. This anaesthetist was blinded to the study goals.

This study was conducted as a prospective study. Two groups were defined by the occurrence of agitation: one of agitated patients, and one of non-agitated patients. First, data of the two groups were pooled to analyse all patients as one group, to present an epidemiological knowledge, then each group was classically analysed. In the univariate analysis, tests used to compare groups were the Student *t*-test, the Kruskal–Wallis test and χ^2-test as required. A multivariate analysis was performed using a backward binary stepwise logistic regression (SYSTAT 8.0, SPSS) to examine and determine risk factors of delirium. All variables statistically linked to occurrence of delirium were included in the regression model with delirium as the dependent variable and the independent variables were age, previous history of illness, type of surgery, long-term treatment by antidepressants or neuroleptics, preoperative anxiety, preoperative medication by benzodiazepines or hydroxyzine, length of surgery, type of anaesthesia and ASA score. A second statistical analysis (both univariate and multivariate) was then conducted on a subgroup of patients. This subgroup of patients was defined by patients who had undergone general anaesthesia, and excluding those deemed anxious, or treated by neuroleptics, antidepressants and benzodiazepines, so as to avoid those patients with the probable highest risk of delirium. Data are shown as mean (SD). *P* <0.050 was considered significant.

Results

Description of the studied population

In the study, 1359 patients were included. Mean age was 51 (range 15–99) yr; 45% of patients were women (*n*=622). Emergence delirium in the PACU occurred in 64 (4.7%) patients.

The average length of delirium was 15 (20) min. All patients regained a normal cognitive status before their discharge from the PACU. In the agitated patients, the level of excitement according to the sedation–agitation scale was: 26% of dangerously agitated patients (*n*=17), 32% of very agitated patients (*n*=20) and 42% of agitated patients (*n*=27). The consequences were three attempts at self-extubation (4.7%), four catheter removals (both bladder and i.v. catheters) (6%), two injured patients (skin bruises) (3%) and three injuries to staff (4.5%). These cases of emergence delirium generally required 2–3 staff members to restrain and calm the patient (varying from 1–6). The suspected aetiologies were the existence of a tracheal tube (51.5%,

Table 1 Riker sedation-agitated scale[4]

	Agitated	Pulling at ET tube, trying to remove catheters, climbing over bed rail, striking at staff, thrashing side-to-side
7	Dangerous agitation	
6	Very agitated	Does not calm, despite frequent verbal reminding of limits; requires physical restraints, biting ET tube
5	Agitated	Anxious or mildly agitated, attempting to sit up, calms down to verbal instructions
	Non-agitated	
4	Calm and cooperative	Calm, awakens easily, follows commands
3	Sedated	Difficult to arouse, awakens to verbal stimuli or gentle shaking but drifts off again, follows simple commands
2	Very sedated	Arouses to physical stimuli but does not communicate or follow commands may move spontaneously
1	Unarousable	Minimal or no response to noxious stimuli, does not communicate or follow commands

n=34), pain (19.6%, *n*=13), anxiety (15%, *n*=10), overwhelming need to urinate despite the presence of an indwelling urinary catheter (4.5%, *n*=3), residual neuromuscular block (3%, *n*=2), acute urinary retention (3%, *n*=2) and intolerance to the oxygen catheter (3%, *n*=2).

Univariate analysis between agitated and non-agitated patients who had undergone general anaesthesia

Mean length of stay in the PACU was significantly longer for agitated patients [207 (171) min (range 50–960)] than in non-agitated patients [156 (146) min (range 10–1380)] (*P*=0.012). Average age was not significantly different in agitated patients compared with non-agitated patients [48 (range 15–78) yr *vs* 52 (range 15–99) yr]. The percentage of women in each group was similar (45% in agitated and 44% in non-agitated) but the ASA class distribution was different in agitated than in non-agitated patients (Table 2).

A pre-existing illness was significantly associated with a lower incidence of agitation (*P*=0.001). Thus, within agitated patients, 50% of patients had a known history of illness against 69% in non-agitated patients. Long-term medication with antidepressants and antipsychotic drugs was most often noted in non-agitated patients compared with agitated patients (24 and 9% against 6 and 0%, *P*=0.001 and *P*=0.010). No patient on neuroleptics developed an emergence delirium. No difference in the occurrence of emergent delirium was found in patients on long-term treatment with benzodiazepines (8% in non-agitated patients *vs* 3% in agitated patients, *P*=0.139).

Severe preoperative anxiety, noted as such in the patients' medical records, was positively correlated to the occurrence of agitation (12% in agitated patients *vs* 5% in non-agitated patients, *P*=0.032).

The interval between ward admission and surgery day was not significantly different in agitated than in non-agitated patients [2.2 (4.2) days *vs* 3.2 (6.8) days, *P*=0.257]. Neither, a previous surgical procedure within the past 15 days or 3 months, nor emergency surgery had an impact on the occurrence of postoperative agitation.

Table 2 Logistic regression: risk factors of emergence delirium in the PACU in general anaesthesia surgery patients. *Pearson chi-square; [†]two-sample *t*-test; [§]mean (range or SD)

	Total (*n*=1359)	Non-agitated (*n*=1295) (95.3%)	Agitated (*n*=64) (4.7%)	*P*-value
Female	622 (45%)	593 (45%)	29 (45%)	0.940*
Age	51 (15–99) yr[§]	52 (15–99) yr[§]	48 (15–78) yr[§]	0.077[†]
Pre-existing illness	929 (68%)	897 (69%)	32 (50%)	0.001*
Antidepressant drugs (>1 month)	315 (23%)	311 (24%)	4 (6%)	0.001*
Neuroleptics (>1 month)	122 (9%)	122 (9%)	0 (0%)	0.010*
Benzodiazepines (>1 month)	109 (8%)	107 (8%)	2 (3%)	0.139*
Preoperative anxiety	84 (6%)	76 (5%)	8 (12%)	0.032*
Recent surgery (<3 months)	90 (6%)	85 (5%)	5 (7%)	0.454*
Recent surgery (<2 weeks)	76 (4%)	75 (4%)	1 (1%)	0.235*
Length of stay before anaesthesia	3.2 (6.7) days[§]	3.2 (6.8) days[§]	2.2 (4.2) days[§]	0.257[†]
Emergency surgery	140 (10%)	131 (10%)	9 (14%)	0.314*
Preoperative benzodiazepine	333 (24%)	307 (23%)	26 (40%)	0.002*
Preoperative hydroxyzine	1050 (77%)	1008 (77%)	42 (65%)	0.076*
General anaesthesia procedure				0.006*
Propofol	490 (36%)	479 (37%)	11 (17%)	
I.V. + halogenated	855 (63%)	803 (62%)	52 (81%)	
Halogenated	14 (1%)	13 (1%)	1 (1%)	
Desflurane	6 (0.7%)	6 (0.7%)	0 (0%)	
Sevoflurane	521 (63%)	486 (63%)	35 (68%)	0.645*
Isoflurane	291 (35%)	275 (35%)	16 (31%)	
Neuromuscular blockers	560 (41%)	521 (40%)	39 (61%)	0.001*
ASA				
I	425 (31%)	396 (30%)	29 (46%)	
II	614 (45%)	589 (45%)	25 (40%)	
III	293 (21%)	285 (22%)	8 (13%)	0.034*
IV	23 (1%)	23 (1%)	0 (0%)	
Length of surgery	76 (67) min[§]	75 (67) min[§]	104 (68) min[§]	0.001[†]
Vascular surgery	159 (11%)	153 (11%)	6 (9%)	0.552*
ENT	226 (16%)	218 (16%)	8 (12%)	0.362*
Ophthalmology	142 (10%)	138 (10%)	4 (6%)	0.260*
Abdominal	280 (20%)	253 (19%)	27 (42%)	<0.001*
Endoscopies	159 (11%)	158 (12%)	1 (1%)	0.010*
Urology	169 (12%)	162 (12%)	7 (11%)	0.707*
Breast	29 (2%)	24 (1%)	5 (7%)	0.001*
External genitalia	23 (1%)	23 (1%)	0 (0%)	0.282*
Thyroidectomy	79 (5%)	75 (5%)	4 (6%)	0.881*
Length of stay in the PACU	158 (147) min[§]	156 (146) min[§]	207 (171) min[§]	0.012[†]
Death	21 (1.5%)	19 (1.4%)	2 (3.1%)	0.293*

In agitated patients, 40% of patients had received pre-medication by benzodiazepines, while only 23% did, in non-agitated patients (*P*=0.002). The proportion of patients who had been premedicated with hydroxyzine was comparable in the two groups.

Abdominal and breast surgery were significantly more frequent in agitated patients (42 and 7%) than in non-agitated patients (19 and 1%) (*P*<0.001 and *P*=0.001). Conversely, endoscopies were significantly less frequent in agitated than non-agitated patients (1% *vs* 12%, *P*=0.010). Surgery was longer in agitated patients [104 (68) min] than in non-agitated patients [75 (67) min] (*P*=0.001).

Patients in which anaesthesia was maintained by inhaled anaesthetics were more often agitated than those in which anaesthesia was maintained by propofol (*P*=0.006). There was no significant difference in agitation depending on the type of inhaled anaesthetics used. The use of neuromuscular blockers during surgery was significantly more frequent in agitated patients (61% *vs* 40%, *P*=0.001).

Postoperative mortality rate at 90 days, for all patients, was 1.4% (20 patients), with a mean age of 62 (range 42–79) yr. Mortality rate in agitated patients was 3%, 2 men of 52 and 69 yr of age, who died at Days 4 and 26 postop, respectively. The first died of a massive stroke after an emergency laparotomy for sigmoid perforation. The other, a 69-yr-old, died of multi-organ failure secondary to septic shock after postoperative peritonitis. Mortality rate in non-agitated patients was 1.3% (18 patients) with a mean age of 62 (range 42–79) yr. Death occurred on average around Day 13 (range 1–41 days). Univariate analysis of incidence of death did not show a significant difference of mortality rate at 90 days between the two groups (*P*=0.293). Moreover, length of stay in the PACU is significantly longer in agitated patients (*P*= 0.012).

Multivariate analysis of emergence agitation probability in general anaesthesia surgery patients

The univariate analysis between both groups showed that the incidence of emergence delirium was significantly related to 12 variables, of which 8 were more frequent in agitated patients (preoperative anxiety, preoperative medication by benzodiazepines, general anaesthesia procedure, use of neuromuscular blockers, ASA score, length of surgery, abdominal and breast surgery), and four were more often noted in non-agitated patients (a known history of illness, long-term use of antidepressants or neuroleptics, endoscopies) (Table 2).

Multivariate analysis by backward binary stepwise logistic regression found that of the 12 variables used in our model, six were significant in the onset of emergence delirium in the PACU (Table 3). Breast and abdominal surgery were the highest risk factors, with the risk of developing emergence agitation increased by 5 and 3 times (respectively, OR=5.190, 95% CI=1.422–18.947, *P*=0.013

Table 3 Logistic regression: risk factors of emergence delirium in the PACU in 1359 general anaesthesia surgery patients. *P**, backward binary stepwise logistic regression, significant to include or exclude equal to 0.15. 95% CI, confidence interval of 95%

Factor	Odds ratio	95% CI	*P**-value
Breast surgery	5.190	1.422–18.947	0.013
Abdominal surgery	3.206	1.262–8.143	0.014
Preoperative medication with benzodiazepine	1.910	1.101–3.315	0.021
Length of surgery	1.005	1.002–1.008	0.001
Previous history of illness	0.544	0.315–0.939	0.029
Long-term antidepressant treatment	0.245	0.084–0.710	0.010

and OR=3.206, 95% CI=1.262–8.143, *P*=0.014). Multivariate analysis confirmed that preoperative medication by benzodiazepines is a significant risk factor of emergence delirium in the PACU. Use of benzodiazepines before surgery nearly doubled the risk of emergence delirium in our study (OR=1.910, 95% CI=1.101–3.315, *P*=0.021). The length of surgery was a slight risk factor (OR=1.005, 95% CI=1.002–1.008, *P*=0.001) but the OR increased with the length of surgery. There was an exponential relationship between emergence delirium and duration surgery. A previous history of illness and long-term use of antidepressant drugs decrease the risk of emergence delirium by 0.5 and 0.2 times (respectively, OR=0.544, 95% CI=0.315–0.939, *P*=0.029 and OR=0.245, 95% CI=0.084–0.710, *P*=0.010) (Table 3).

Univariate analysis of emergence delirium probability in general anaesthesia surgery patients excluding those with preoperative anxiety and long-term use of antidepressants, neuroleptics and benzodiazepines (Table 4)

Emergence delirium was significantly related to seven variables, of which six were more frequent in agitated patients (preoperative medication by benzodiazepines, anaesthesia procedure, use of neuromuscular blockers, surgery duration, abdominal and breast surgery), and one was more often noted in non-agitated patients (endoscopies).

Multivariate analysis of emergence agitation probability in general anaesthesia surgery patients excluding those with preoperative anxiety and long-term use of antidepressants, neuroleptics and benzodiazepines (Table 5)

Multivariate analysis by backward binary stepwise logistic regression found that of the seven variables used in our model, four were significant in the onset of emergence delirium in the PACU (Table 5). Breast and abdominal surgery were the highest risk factors, with the risk of developing emergence agitation increasing respectively by 7 and 3.3 times (OR=7.024, 95% CI=1.692–29.156, *P*=0.007 and

Table 4 Logistic regression: risk factors of emergence delirium in the PACU in general anaesthesia surgery patients excluding preoperative anxiety and long-term treatment by benzodiazepines or antidepressants or neuroleptics. *Pearson chi-square; †two-sample *t*-test; §mean (range or SD)

	Total (*n*=850)	Non-agitated (*n*=799) (94%)	Agitated (*n*=51) (6%)	*P*-value
Female	348 (41%)	326 (41%)	22 (43%)	0.742*
Age	46 (00–00) yr§	46 (00–00) yr§	47 (00–00) yr§	0.773†
Pre-existing illness	460 (54%)	435 (54%)	25 (49%)	0.457*
Recent surgery (<3 months)	46 (5%)	42 (5%)	4 (7%)	0.430*
Recent surgery (<2 weeks)	31 (3%)	30 (3%)	1 (2%)	0.507*
Length of stay before anaesthesia	2.7 (6.3) days§	2.7 (6.3) days§	2.2 (4.3) days§	0.495†
Emergency surgery	100 (11%)	92 (11%)	8 (15%)	0.374*
Preoperative benzodiazepine	215 (25%)	195 (24%)	20 (39%)	0.018*
Preoperative hydroxyzine	641 (75%)	609 (76%)	32 (62%)	0.092*
GA				
Propofol	299 (35%)	289 (36%)	10 (19%)	0.047*
I.V. + halogenated	544 (64%)	504 (63%)	40 (78%)	
Halogenated	8 (1%)	7 (0.8%)	1 (2%)	
Desflurane	5 (1%)	5 (1%)	0 (0%)	
Sevoflurane	325 (63%)	298 (63%)	27 (67%)	0.718*
Isoflurane	183 (35%)	170 (36%)	13 (32%)	
Neuromuscular blockers	330 (38%)	298 (37%)	32 (62%)	<0.001*
ASA				0.881*
I	386 (45%)	362 (45%)	24 (47%)	
II	336 (39%)	316 (39%)	20 (39%)	
III	119 (14%)	113 (14%)	6 (11%)	
IV	7 (1%)	7 (1%)	0 (0%)	
Length of surgery	72 (67) min§	72 (67) min§	108 (68) min§	0.001†
Vascular surgery	77 (9%)	72 (9%)	5 (9%)	0.848*
ENT	175 (20%)	168 (21%)	7 (13%)	0.211*
Ophthalmology	69 (8%)	68 (8%)	1 (2%)	0.096*
Abdominal	185 (21%)	161 (20%)	24 (47%)	<0.0001*
Endoscopies	101 (11%)	100 (12%)	1 (2%)	0.024*
Urology	100 (11%)	96 (12%)	4 (8%)	0.369*
Breast	13 (1%)	10 (1%)	3 (5%)	0.009*
External genitalia	15 (1%)	15 (1%)	0 (0%)	0.323*
Thyroidectomy	57 (6%)	53 (6%)	4 (7%)	0.740*
Length of stay in the PACU	146 (128) min§	146 (128) min§	205 (142) min§	0.011†
Death	10 (1%)	8 (1%)	2 (4%)	0.060*

Table 5 Logistic regression: risk factors of emergence delirium in the PACU in general anaesthesia surgery patients excepting preoperative anxiety and long-term treatment by benzodiazepines or antidepressants or neuroleptics. *P**, backward binary stepwise logistic regression, significant to include or exclude equal to 0.15. 95% CI, confidence interval of 95%

Factor	Odds ratio	95% CI	*P**-value
Breast surgery	7.024	1.692–29.156	0.007
Abdominal surgery	3.376	1.775–6.418	<0.0001
Preoperative medication with benzodiazepine	1.838	1.002–3.519	0.050
Length of surgery	1.004	1.000–1.008	0.035

OR=3.376, 95% CI=1.775–6.418, *P*<0.0001). Multivariate analysis confirmed that preoperative medication by benzodiazepines is a significant risk factor of emergence delirium in the PACU. Use of benzodiazepines before surgery nearly doubled the risk of emergence delirium in our study (OR=1.838, 95% CI=1.002–3.519, *P*=0.050). The length of surgery was a slight risk factor (OR=1.004, 95% CI=1.000–1.008, *P*=0.035).

Discussion

Emergence delirium is an everyday problem in the PACU. In our population, the incidence of delirium was overall 4.7%. In a review of literature, we found an average of 3%.[1] Of all agitated patients in our study, more than 50% were graded very agitated or dangerously agitated.

Different scales of agitation exist, such as the Riker agitation–sedation scale, the Richmond sedation–agitation scale, the motor activity assessment scale and the New Sheffield sedation scale. Studies have demonstrated that both the Riker and the Richmond scales have an excellent inter-rater reliability.[5–8] The scales' advantages are their ease of use, especially in emergency situations, and their more precise evaluation of agitation compared with the Ramsay sedation scale, which rates essentially sedation. All of these scales were created for adults in intensive care. None has so far been established in the PACU. However, we feel that patients admitted to the PACU are comparable with patients admitted to the ICU.

The data were recorded in the PACU by nurses. Nurses were blinded to the study's objectives. Nonetheless, they were free to refer to preoperative evaluations, which may constitute a bias and a confounding factor. However, our study identified the same risk factors of emergence delirium (except for known history of illness), whether anxious patients were included or not in the analysis.

Probable aetiologies of emergence delirium found most often in our study include existence of a tracheal tube, pain, and anxiety. In awake patients, a tracheal tube can be stressing, and therefore should be removed as early as possible. In our study, where this was the cause of delirium, simple removal of the tube was sufficient to calm patients. Pain should be anticipated and treated preventively, as early as during surgery itself. However, in our study all patients had a pre-emptive analgesic protocol. More infrequent causes of delirium are the overwhelming need to urinate despite the presence of an indwelling urinary catheter, bladder distension and urinary retention. Better information should be given to patients before surgery concerning the use of various catheters (gastric tube, oxygen catheter, urinary catheter) to limit their surprise upon emergence. The use of ultrasound measurement at the patients' bedside gives a rapid diagnosis of urinary retention, thereby enabling rapid treatment.[9]

All PACU patients' oxygen saturation level was monitored according to recommendations. They received oxygen so as to maintain saturation ⩾95%. None therefore developed acute and durable desaturation.

Only one study in adults compared the incidence of emergence delirium between patients anaesthetized with inhalational anaesthetics and those anaesthetized with propofol.[10] In our study, the multivariate analysis did not suggest any difference between anaesthesia procedures, although the univariate analysis found more agitated patients anaesthetized with inhalational anaesthetics (62%) as compared with those anaesthetized with propofol (37%). No difference was observed between the different inhalational anaesthetics.

The residual neuromuscular block can be frightening. However, proper monitoring of neuromuscular block during surgery and in the PACU should reduce the risk of a residual neuromuscular block. Should a residual neuromuscular block be detected, patients can easily be antagonized.

It is important to define at-risk patients so as to best prevent emergence delirium. Our study has found that breast and abdominal surgery, and preoperative medication by benzodiazepines are risk factors of postoperative delirium. Length of surgery, while statistically significant, had no clinical impact except for long surgical procedure. On the other hand, a known history of illness and long-term treatment by antidepressants were found to be protective factors.

When anxious patients and those with long-term antidepressants, neuroleptics, or benzodiazepines are excluded the same risk factors are identified, with no protective factors.

Antidepressants were a protective factor of delirium, probably because they are anxiolytics and have a long half-life thereby covering the entire length of surgery. Previous history of illness was also a protective factor. This could be explained by the fact that these patients are more accustomed to a medical or hospital environment, and therefore less subject to anxiety.

Benzodiazepines surprisingly increased the odds of emergence delirium, as they were prescribed to alleviate anxiety and would have been expected to protect from delirium. However, they are known to have paradoxical effects such as irritability, aggressiveness or even confusion. Various reports find more frequent postoperative delirium in elderly patients on benzodiazepines, but did not study the incidence of delirium specially at emergence.[11–13] A prospective study by Schor and colleagues[14] found that benzodiazepines were protective of delirium in elderly hospitalized patients, whether for surgery or other reasons. In paediatrics, preoperative use of midazolam has variable effects on emergence delirium, certain studies having found an increased frequency of delirium,[15 16] while others found it to be a protective factor.[17] The exact role played by benzodiazepines cannot be inferred from our study, as their use was not randomized. They were more often chosen by anaesthetists as preoperative medication, when patients were considered to be particularly anxious.

Anxiety is a very subjective feeling, and may be perceived differently by various physicians. Preoperative anxiety was not assessed by structured interviews during the preoperative consultation. The evaluation in itself is known to modify the baseline anxiety level.[18] Our study found no relationship between preoperative anxiety and postoperative delirium. Conversely, a relationship between anxieties in children who underwent surgery was linked to emergence delirium.[19]

Breast surgery may be linked to agitation, as the modification of corporal representation may create important anxiety.[20] Abdominal surgery is known to be very painful. This may explain the higher incidence of agitation.[21] Unfortunately, it was very often difficult to monitor the level of pain accurately during the emergence delirium episode. Moreover, treatment of pain made it impossible to evaluate pain as a risk factor of emergence delirium.

Emergence delirium is costly in several senses: in terms of morbidity, in human resources and on a financial level. Self-extubation and removal of catheters can lead to aspiration pneumonia or emergency surgery. As far as human resources are concerned, it can require up to six staff members to restrain an agitated patient. The precise number of persons necessary has not yet been established, but will be important to determine, especially at night when less people are present. Staff must be present on-site at all times, and while nurses are attending an agitated patient, other patients might be less closely watched, thereby increasing their anxiety. Besides these risks, there is also a risk of injury to staff. Finally, emergence delirium is probably costly but not studied, in that it necessitates an increase in pharmaceuticals and staff, and lengthens the stay in the PACU. In our study, there is a significant increase in length of stay in agitated patients.

In conclusion, based on this descriptive study, we feel that anxiety is at the heart of the problem. Few studies have focused on preoperative risk factors of postoperative

delirium episodes in the PACU. Even though preoperative anxiety was not found to be a risk factor, it seems to be closely intricate with other factors. More stressful situations such as stressed patients, and breast or abdominal surgery patients, have a higher rate of delirium, while patients deemed calmer or less impressed by medical procedures are less subject to delirium. To reduce the occurrence and consequences of delirium episodes, one would need a structured preoperative evaluation of anxiety, and to take into account risk factors so as to treat them appropriately.

References

1 Rose DK. Recovery room problems or problems in the PACU. *Can J Anaesth* 1996; **43**: R116–28

2 O'Brien D. Acute postoperative delirium: definitions, incidence, recognition, and interventions. *J Perianesth Nurs* 2002; **17**: 384–92

3 Lipov EG. Emergence delirium in the PACU. *Crit Care Nurs Clin North Am* 1991; **3**: 145–9

4 Riker RR, Picard JT, Fraser GL. Prospective evaluation of the sedation-agitation scale for adult critically ill patients. *Crit Care Med* 1999; **27**: 1325–9

5 Sessler CN, Gosnell MS, Grap MJ, *et al.* The Richmond agitation-sedation scale: validity and reliability in adult intensive care unit patients. *Am J Respir Crit Care Med* 2002; **166**: 1338–44

6 Riker RR, Fraser GL, Simmons LE, Wilkins ML. Validating the sedation-agitation scale with the bispectral index and visual analog scale in adult ICU patients after cardiac surgery. *Intensive Care Med* 2001; **27**: 853–8

7 Simmons LE, Riker RR, Prato B, Fraser GL. Assessing sedation during intensive care unit mechanical ventilation with the bispectral index and the sedation agitation scale. *Crit Care Med* 1999; **27**: 1499–504

8 Brandl KM, Langley KA, Riker RR, Dork LA, Quails CR, Levy H. Confirming the reliability of the sedation-agitation scale administered by ICU nurses without experience in its use. *Pharmacotherapy* 2001; **21**: 431–6

9 Lamonerie L, Marret E, Deleuze A, Lembert N, Dupont M, Bonnet F. Prevalence of postoperative bladder distension and urinary retention detected by ultrasound measurement. *Br J Anaesth* 2004; **92**: 544–6

10 Patel SS, Goa KL. Desflurane. A review of its pharmacodynamic and pharmacokinetic properties and its efficacy in general anaesthesia. *Drugs* 1995; **50**: 742–67

11 Kudoh A, Takase H, Takahira Y, Takazawa T. Postoperative confusion increases in elderly long-term benzodiazepine users. *Anesth Analg* 2004; **99**: 1674–8

12 Marcantonio ER, Juarez G, Goldman L, *et al.* The relationship of postoperative delirium with psychoactive medications. *JAMA* 1994; **272**: 1518–22

13 Rogers MP, Liang MH, Daltroy LF, *et al.* Delirium after elective orthopaedic surgery: risk factors and natural history. *Int J Psychiatry Med* 1989; **19**: 102–21

14 Schor JD, Levkoff SE, Lipsitz LA, *et al.* Risk factors for delirium in hospitalized elderly. *JAMA* 1992; **267**: 827–31

15 Viitanen H, Annila P, Viitanen M, Yli-Hankala A. Midazolam premedication delays recovery from propofol-induced sevoflurane anesthesia in children 1-3 yr. *Can J Anesth* 1999; **46**: 766–71

16 Cohen IT, Drewsen S, Hannallah RS. Propofol or midazolam do not reduce the incidence of emergence agitation associated with desflurane anaesthesia in children undergoing adenotonsillectomy. *Paediatr Anaesth* 2002; **12**: 604–9

17 Lapin SL, Auden SM, Goldsmith LJ, Reynolds AM. Effects of sevoflurane anaesthesia on recovery in children: a comparison with halothane. *Paediatr Anaesth* 1999; **9**: 283–6

18 Maltby N, Mayers MF, Allen GJ, Tolin DF. Anxiety sensitivity: stability in prospective research. *J Anxiety Disord* 2005; **19**: 708–16

19 Kain ZN, Caldwell-Andrews AA, Maranets I, *et al.* Preoperative anxiety and emergence delirium and postoperative maladaptive behaviors. *Anesth Analg* 2004; **99**: 1648–54

20 Burgess C, Cornelius V, Love S, Graham J, Richards M, Ramirez A. Depression and anxiety in women with early breast cancer: five year observational cohort study. *Br Med J* 2005; **330**: 702

21 Manworren RC, Paulos CL, Pop R. Treating children for acute agitation in the PACU: differentiating pain and emergence delirium. *J Perianesth Nurs* 2004; **19**: 183–93