LONG-TERM EFFECTS OF A BEHAVIOURAL MANAGEMENT TECHNIQUE FOR NURSES ON AGGRESSIVE BEHAVIOUR IN BRAIN-INJURED PATIENTS

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Abstract

Objective: The ABC method (Antecedent events, target Behaviours, Consequent events) is a behavioural management technique developed for nurses. The objective of the present study was to examine the long-term effects of the ABC method on aggressive behaviour in 40 patients with acquired brain injury.

Method: Four aggression outcome measures and a questionnaire about the implementation of the ABC method were filled out by the nursing staff in this longitudinal intervention study.

Results: Contrary to expectations, a significant increase of aggression was found on two aggression measures. A possible explanation may be that the ABC method increased awareness of aggression in the nursing staff. Results of the implementation questionnaire indicated that the ABC method was not part of usual care at the long-term follow-up.

Conclusions: It seems that the quality of the implementation process was insufficient to find an effect of the ABC method on aggression. Suggestions for improving the implementation process are made in this paper.

Key words: ABC method, behavioural management technique, nursing staff, aggressive behaviour, brain injury

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Introduction

One of the most disruptive behaviours in patients with acquired brain injury (ABI) is aggressive behaviour (Tateno et al. 2003). The prevalence of aggressive behaviour after ABI varies widely, ranging from 2% to 84%, depending on the definition used (e.g. verbal or physical), the type of ABI (traumatic or non-traumatic) and instruments used to measure aggression (Feeney et al. 2001, Tateno et al. 2003, Baguley et al. 2006, Visscher et al. 2011, Buijck et al. 2012). Aggressive behaviour negatively influences patients' quality of life and puts a high burden on the patient's family and healthcare professionals (Azouvi et al. 1999, Alderman 2007).

Behavioural management is often used for reducing aggressive behaviour in a clinical setting and is based on the concept that behaviour operates on the environment and is maintained by its consequences (Wood and Alderman 2011). The focus of behavioural management can be put either on the causes or antecedents of aggression (pro-active antecedent procedures, e.g. tailor made environmental structuring) or on the consequences of aggression (contingency management procedures, e.g. positive reinforcement, negative reinforcement or extinction (Ylvisaker et al. 2007, Alderman and Wood 2013). There is some evidence for the effectiveness of behavioural management in people with brain injury, but more research is needed in order to achieve a practice standard (Ylvisaker et al. 2007, Slifer and Amari 2009, Heinicke and Carr 2014).

A limited number of studies have shown that in clinical settings the behaviour and communication style of the nursing staff may affect the problem behaviour of patients, i.e. be an antecedent of aggressive behaviour. Many aggression incidents are preceded by interaction with the nursing staff (Alderman 2007, Visscher et al. 2011). However, the nursing staff is not always sufficiently aware that their behaviour affects the onset and persistence of behavioural problems (Cohn et al. 1994). Training nursing staff in applying behavioural interventions in everyday practice may be a potentially powerful tool for reducing problem behaviour in a department, considering the effect that an interaction between patient and nursing staff may have on problem behaviour (Cohn et al. 1994, Alderman 2007, Visscher et al. 2011).

The ABC method, developed by Cohn et al. (1994), is a promising behavioural management method which can be used by the nursing staff. The ABC method is a basic and simplified form of behavioural modification therapy. The acronym ABC refers to the identification of *Antecedent* events, target *Behaviour*s and *Consequent* events. A key component of the ABC method is a detailed and structured (by questions to the nursing staff) observation of the problem behaviour every time the behaviour occurs. Based on these observations a functional assessment of the problem behaviour is made by the nursing staff, together with a psychologist. It includes a fine graded description of the problem behaviour and its antecedents and consequences. Based on this analysis, a patient– and situation-tailored intervention is made to reduce problem behaviour which will be evaluated and adjusted if necessary. A more extensive description of the ABC method can be found in Winkens et al. (2017). So, the ABC method offers nurses tools and skills to become more aware of the factors that can cause problem behaviour of patients which helps them to deal with these behavioural problems (Cohn et al. 1994).

The ABC method has been used widely in older institutionalised patients with dementia and challenging behaviour (Krishnamoorthy and Anderson 2011). To our knowledge, the ABC method has not yet been applied as an intervention for behavioural problems of institutionalised patients with ABI. As the rationale of the ABC method is independent of diagnosis, we were interested in the effects of introducing the ABC method in institutional care for patients with acquired brain damage change to ABI and behavioural problems. We were especially interested in the management of aggressive behaviour, as it is not only highly frequent but also highly disruptive in most clinical departments.

In our first study (Winkens et al. 2017) we investigated the immediate and three months effectiveness of the ABC method on behavioural problems in institutionalised ABI patients with neuropsychiatric symptoms. A trend was shown towards a decrease of the patients' behavioural problems, albeit not significant. Nurses rated the method as instructive, but also reported that it was not yet part of routine clinical practice at the time of the three months follow-up measurements, indicating that the implementation of the ABC method was not (yet) successful. It may also take time to find the right treatment approach (i.e. the antecedents that encourage the desired behaviour) and several reviews of antecedents and consequences may be required before a successful patient-tailored intervention plan is formulated. This suggests that the assessment at three months was too soon after training the nursing staff to determine the effects of the ABC method, and a longer follow-up period is recommended. Specifically, more practice may be needed for nurses to get acquainted with the newly learned skills.

Therefore, the objective of the present study was to examine the long-term effects of the ABC method on aggressive behaviour in patients with ABI. We hypothesised that the frequency and severity of aggressive behaviour would decrease from baseline to long-term follow-up (LT-FU; 18 or 36 months after use of the ABC method by the nursing staff). Since a successful implementation of the ABC method is important for its effectiveness, a secondary objective of this study was to evaluate the success of the implementation of the ABC method.

Method

Participants

Participants were patients with ABI and neuropsychiatric problems living in institutions specializing in ABI with neuropsychiatric problems, i.e. Ter Poorteweg of Stichting Voor Regionale Zorgverlening (SVRZ) and Multidisciplinary Specialist Center for Brain Injury and Neuropsychiatry Huize Padua (HP) of GGZ Oost Brabant in the Netherlands. In contrast to the first study of Winkens et al. (2017), this LT-FU took place at two permanent stay departments because the patients living there are in the chronic phase after their ABI.

All patients included in the first study who still lived at the permanent stay department were eligible for this LT-FU study. The inclusion criteria were the same as in the study of Winkens et al. (2017): non-progressive ABI (for example TBI or stroke) according to medical records, ≥ 18 years of age and having sufficient command of the Dutch language (by clinical judgment). The exclusion criteria were: post-traumatic amnesia, decreased consciousness during assessment or giving no approval for participation.

This study was carried out in accordance with The Code of Ethics of the World Medical Association (Declaration of Helsinki). The Medical Ethics Committee of the Maastricht University Medical Centre and all participating departments approved the study protocol. All patients (or their legal representative) gave informed consent.

Design

This study is a LT-FU of the longitudinal group intervention study of Winkens et al. (2017). In that study, a baseline assessment of aggressive behaviour took place six weeks before the ABC method was introduced on the departments (B0) and immediately before it was introduced (B1). Baseline assessments at HP started one and a half years earlier than the baseline assessments at SVRZ. Immediately after the baseline assessments, ABC training was provided and nurses started using the method and were urged to continue this beyond the follow-up measurements. Follow-up assessments took place immediately (FU1) and nine weeks (FU2) after the method was introduced. The LT-FU took place three years after FU2 at HP and one and a half years after FU2 at SVRZ. The same outcome measures and cognitive screening were used as in the study of Winkens et al. (2017). The questionnaires measuring aggressive behaviour were the primary outcome measures and were filled out by the nursing staff at all measurement moments. Subsequently, the cognitive screening was conducted by the psychologist or a trainee (under the supervision of the psychologist) at B0 and the LT-FU. The assessment setting was the patients' personal room or a testing office. The nursing staff, working in the department at the time of the LT-FU assessment, also completed a questionnaire at the

LT-FU. This secondary outcome measure evaluates the implementation based on the theory of Grol and Wensing (2010). See supplemental **table 1** for a summary of all measurements.

The ABC method

All qualified members of the nursing staff working with the patients at baseline had a three-day training with a total duration of 15 hours in working with the ABC method. This method was developed by Cohn et al. (1994) and translated into Dutch by Hamer and Voesten (2001). The original method focused on dealing with behavioural problems in geriatric populations. For the purpose of the present study, the training was shortened from six to three days and from six to five modules for practical reasons. In the module left out participants apply the ABC method on themselves and their own situation/ environment. No new information was given in this module. The method was also slightly adjusted for use in an ABI population, with practice tasks that were more focused on the specific problems nurses encountered when taking care for ABI patients.

To promote and strengthen the implementation of the ABC method, nurses working at SVRZ and HP were instructed to take several actions after the training. Every time a patient showed problem behaviour, a registration form had to be filled out by the attending nurse to make an analysis of the antecedents, the problem behaviour and the consequences. In this way, several nurses filled out registration forms about the same problem behaviour of a patient, which were discussed in the weekly meeting. A psychologist was present during this meeting to analyse all forms together with the nurses, and after this meeting a patient-tailored intervention was determined. This intervention was evaluated weekly and adjusted when necessary. In this way the team practiced frequently in order to ensure that the ABC method became regular practice. During the weekly meeting, the theory of the ABC training was repeated by the psychologist, and the nurses could ask specific questions concerning the method. In addition, there was one facilitator in each department who encouraged colleagues in using the ABC method.

Measurements

Demographic characteristics

Information on gender, age, education, type of injury, time since injury and psychiatric comorbidity (such as schizophrenia, bipolar disorder) was obtained through examination of the patients' medical files at B0. The nursing staff was asked whether their patients acquired new brain injury in the period between baseline and this LT-FU.

Cognitive measures

Patients' overall cognitive functioning was evaluated at baseline with the Mini Mental State Examination (MMSE; Folstein et al. 1975), the Frontal Assessment Battery (FAB; Mungas 1991) and the Key Search Test of the Behavioural Assessment of the Dysexecutive Syndrome (BADS; Wilson et al. 1996). At LT-FU the cognitive screening was repeated to determine whether there had been a decline in cognitive function, because cognitive decline may be associated with an increase in problem behaviour.

Aggression measures

Several outcome measures were used to measure different aspects of aggressive behaviour. The Social Dysfunction and Aggression Scale (SDAS-11) by Wistedt et al. (1990) is a questionnaire regarding mainly verbal and physical aggression. Nine items are related to interpersonal aggression (directed toward others) and two items are related to self-harm. This scale was completed retrospectively over one week and scored on a 5-point scale ranging from 0 (not present) to 4 (very severe). The minimum score is 0 and the maximum score is 44. Higher scores indicate a higher level of aggression. The total score of the SDAS-11 was used in this study.

The Neuropsychiatric Inventory (NPI) by Cummings et al. (1994), translated into Dutch by de Jonghe et al. (1997), is a rating scale of how often problem behaviour of patients has occurred in the past two weeks; the inventory is completed by a caregiver. The NPI consists of twelve behavioural subscales, but in the current study only the total score at baseline and the subscale score for agitation/aggression (NPIaggression) at baseline and follow-up were used. The first step in a subscale is a screening question to examine whether the behaviour is present. If the answer is yes, questions about the frequency (4-point scale) and the severity (3-point scale) of the problem behaviour are asked (Tate 2010). Each domain can be scored a maximum of twelve points (frequency x severity). The higher the score, the more frequent or severe the behaviour is. The NPI also investigates nurses' emotional burden due to patients' neuropsychiatric problem behaviour, but this was not included in the current study.

The Staff Observation Aggression Scale – Revised (SOAS-R) by Nijman et al. (1999) gives an indication of the nature and severity of aggressive incidents. The nursing staff completed the SOAS-R for each aggressive incident during seven days. The five domains of aggressive incidents are: triggers which lead to the aggressive behaviour, kind of aggression used by the patients, target of aggression, consequences for victims and measures to stop aggression. The overall score of the SOAS-R for each aggression incident, across all domains, ranges from 0 to 22. A score of 22 indicates the most severe aggressive incident. The total score of the severity of all incidents during one week was used in this study.

The Agitated Behaviour Scale (ABS) by Corrigan (1989) is an observational scale. After an observational period of one day, the caregiver has to answer 14 questions regarding the patient's behaviour on a 4-point scale: 1 meaning absent, 2 meaning slightly present, 3 meaning moderately present and 4 meaning present to an extreme degree. This results in a score range of 14-56, where higher scores indicate higher levels of agitation (Tate 2010). In this study the ABS was filled out once a day during a period of a week. The mean score of the ABS of the week was used.

Evaluation of the implementation of the ABC method

Twenty-eight nurses received a questionnaire, including open (more than one answer was allowed), closed (yes or no) and multiple choice (1 totally disagree to 5 totally agree) questions about the implementation of the ABC method. The questionnaires were filled out by the nursing staff to evaluate the quality of the implementation and to provide recommendations for improving the implementation process. This

questionnaire was developed by our research team based on the theory of change management (Grol and Wensing 2010). For more details on the questionnaire see supplemental **table 2**.

Analyses

Demographic and injury-related characteristics

Descriptive statistics were used to describe demographic and injury-related parameters (gender, age, educational level, psychiatric comorbidity, type of injury and time since injury, new brain injury acquired after B0) for patients who were still participating at LT-FU and for patients who had dropped out during the follow-up period (drop-out). In addition, independent-samples T-tests (for quantitative variables with a normal distribution), Chi-Square Tests (for categorical variables) and the non-parametric Mann Whitney U tests (for quantitative variables with a non-normal distribution) were executed to examine whether included and drop-out patients differed significantly in demographics, aggression and cognitive functioning at B0.

Cognitive functioning

Descriptive statistics were used to describe overall cognitive functioning at baseline. Clinical cut-offs (MMSE < 24 and FAB <13) were used to subdivide the group into patients with an abnormal score and patients who did not have an abnormal score on the MMSE and the FAB. The related sample Wilcoxon signed rank test was used to examine change in cognitive functioning over time from B0 to LT-FU.

Effects on aggressive behaviour

Friedman's ANOVA analysis was performed, because of the skewed data, to examine whether there was any overall change in measures over time from B0 to LT-FU. Subsequently, when change over time was significant, pairwise comparisons between separate time points were executed. The short-term effects of the ABC method have already been described in the study of Winkens et al. (2017). As our focus is on the long-term effectiveness of the ABC method, only post-hoc pairwise comparisons between B1 *vs.* LT-FU and FU2 *vs.* LT-FU were performed. Data at B0 were not used for post-hoc comparisons, because there was a significant decrease in problem behaviour from B0 to B1 which could not be explained by the ABC method (Winkens et al. 2017). The overall effects over time of the Friedman ANOVA analyses were considered significant if p<.05. For the post-hoc comparisons a Bonferroni correction was applied; therefore post-hoc effects are reported at a 0.025 (0.05/2) level of significance. All statistical analyses were conducted using IBM SPSS 21.0.

Evaluations of the implementation of the ABC method

The quantitative data of the questionnaire for measuring the implementation of the ABC method were analysed with descriptive statistics. Qualitative data resulting from the open questions were clustered based on the contents of the answers by two authors (C.P and P.S).

Results

Demographic and injury-related characteristics

Table 1 shows the demographic and injury-related

characteristics at B0 of the patients who were included in the current study and the patients who dropped out. A total of 40 patients participated in the current LT-FU study, 30 at SVRZ and 10 at HP. Patients were predominantly male (80%); the mean age was 61.6 years (SD 9.7) and the mean time post-injury was 17.8 years (SD 14.3). None of the patients acquired new brain injury after B0. There was no significant decrease in cognitive functioning between B0 and the LT-FU on the MMSE (p = .085), the FAB (p = .662*)* and the KST (p = .557).

Relative to B0, 12 patients dropped out due to death or moving to other residences. In terms of demographic characteristics, patients who maintained participation did not differ significantly from patients who dropped out. Patients who dropped out did have more psychiatric comorbidity and/or behavioural problems at B0, according to all outcome measures, although the difference was significant only for the SOAS-R (p = .044) (see **table 2**). Patients who dropped out scored lower on all three cognitive measures, although only the score on the KST differed significantly between both groups (p = .004).

Aggressive behaviour

The results of analyses of overall change in aggressive behaviour from B0 to LT-FU are shown in Table 3. Friedman's ANOVA analyses showed significant changes over time for all outcome measures ($\chi 2$ ABS (4) = 9.918, p = .042; $\chi 2$ SOAS-R (4) = 14.917, p = .005; $\chi 2$ NPIaggression (4) = 24.588, p = .000), while scores on the SDAS increased over time ($\chi 2$ SDAS-11 (4) = 28.611, p = .000) (**Table 2**).

Post-hoc analyses showed no significant changes in aggression between B1 and LT-FU and between FU2 and LT-FU, measured with the SOAS-R (Z B1-LTFU = -.859, p = .390 and Z FU2-LTFU = -.537, p = .591) and the ABS (Z B1-LTFU = .251, p = .802 and Z FU2-LTFU = .358, p = .720). No significant change was found for the NPIaggression between B1 and LT-FU (Z B1-LTFU = -.363, p = .717), but a significant increase was found between FU2 and LT-FU (Z FU2-LT-FU = -2.285, p = .022). A significant increase was found for the SDAS-11 between B1 and LT-FU and between FU2-LT-FU (Z B1-LFU = -3.019, p = .003 and Z FU2-LT-FU = -3.988, p = .000) (Supplemental **table 3**).

Evaluation of the implementation of the ABC method

Table 3 shows the nurses' evaluation of the implementation. The number of nurses who filled out the questions ranged from 20 to 28, depending on the question. Nearly all nurses, 96.2%, felt that the nursing staff was sufficiently involved in the preparation of the introduction of the ABC method at the department. The purpose of the methodology became clear to 53.6% of the nurses during the training. Most nurses reported having sufficient skills after the training to work in accordance with the methodology (85.7%) and to think immediately of the ABC method when behavioural problems occurred (80.8%), and all nurses wanted to continue working with the method (100.0%). Most nurses reported that everything was arranged at the department to start working with the ABC method (75.0%). Surprisingly, only 44.4% of the nurses reported that the ABC method was usual care at the moment of the LT-FU (**table 3**).

Table 4 presents the frequencies of answers to the questions about the pros and cons of the ABC

Table 1. *Demographic and injury-related characteristics, psychiatric comorbidity and behavioural problems at baseline (B0)*

	Inclusion LT-FU					Drop-out					*p*
	N	*%*	Mean (SD)	Median (IQR[a])	Range	*N*	*%*	Mean (SD)	Median (IQR[a])	Range	
Age	40		61.6 (9.7)	62.5 (11.8)	42-84	12		67.25 (9.66)	66.0 (14.0)	52-83	.085
Gender	40					12					.701
Male	32	80.0				9	75				
Female	8	20.0				3	25				
Education	34					3					
Low	25	73.5				2	66.7				
High	9	26.5				1	33.3				
Type of brain injury											
Korsakoff	17	42.5				2	16.7				
ABI and Korsakoff	7	17.5				2	16.7				
Contusio Cerebri	6	15.0				1	8.3				
CVA	4	10.0				1	8.3				
Encephalitis	2	5.0				0	0.0				
Hydrocephalus	1	2.5				0	0.0				
Tumour	0	0.0				1	8.3				
Other	0	0.0				2	16.7				
Unknown	3	7.5				3	25.0				
Time since injury (months)	24		214.0 (171.0)	210 (201)	12-679	7		193.0 (146.7)	185 (228)	24-451	.661
Co-morbid Psychiatric disorder	19	47.5				7	63.6				.499
Total NPI score	40		19.7 (19.1)	16 (16.3)	0-90	12		28.8 (21.6)	22.5 (30.8)	0-67	.090
Aggression scales											
SDAS-11[a]	40		6.9 (6.6)	5.00 (10.3)	0-21	12		8.8 (6.1)	8.5 (10.0)	0-21	.218
NPIaggression[a]	40		3.1 (3.5)	2.0 (4.0)	0-12	12		3.6 (4.8)	1.0 (7.8)	0-12	.991
SOAS-R[a]	40		3.4 (6.5)	0.00 (4.0)	0-30	12		12.1 (18.7)	3.5 (15.3)	0-51	**.044**
ABS[a]	40		19.8 (3.5)	19.2 (5.7)	14-27	12		21.6 (3.9)	21.5 (4.1)	14-29	.141
Cognitive measures											
MMSE[b]	36		21.6 (4.1)	23 (5.8)	11-28	7		17.4 (6.2)	16 (8)	9-28	.057
<24	24	66.7				6	85.7				
24 >	12	33.3				1	14.3				
FAB[b]	36		9.9 (3.5)	10.0 (5)	3-18	7		9.4 (4.8)	8.0 (9.0)	4-16	.782
<13	28	77.8				4	57.1				
13 >	8	22.2				3	42.9				
KST[b]	35		1.7 (1.4)	1.0 (3.0)	0-4	7		0.1 (0.4)	0.0 (0.0)	0-1	.004

Note.
[a] SDAS-11 = Social Dysfunction and Aggression Scale; NPIaggression = Neuropsychiatric Inventory agitation/aggression subscale; SOAS-R = Staff Observation Aggression Scale-Revised; ABS = Agitated Behaviour Scale;
[b] MMSE=Mini Mental State Examination; FAB=Frontal Assessment Battery; KST =Key search test of the Behavioural Assessment of the Dysexecutive Syndrome.

method, the facilitating factors and impediments to the implementation process and factors that can help the nursing staff in continuing work with the ABC method. The most frequently mentioned limitation during the implementation of the ABC method was that the nurses did not have enough time to practice with the new methodology (30.4%), while the most frequently reported disadvantage of the method was that it takes a lot of time (26.1%) to work according to the method. Despite the training, some nurses reported that there were still uncertainties about how to work according the ABC method (18.2%). Even though the ABC method was developed specifically for the nursing staff, cooperation with the psychologist was considered the most important facilitating factor in implementing the ABC method on a department (41.2%). However, 18.2% of the nurses felt that this was something that was not immediately arranged at the start of working with the ABC method. The two most frequently mentioned benefits of the ABC method were a better understanding of behavioural problems (42.3%) and becoming more aware of antecedents (26.9%). Booster sessions (35.7%) and working together with the psychologist (28.6%) were the two most frequently

Table 2. *Overall change in aggression outcome measures over time, from the first baseline (B0) to long-term follow-up (LT-FU)*

	Friedman's statistic					Median (IQR^a)				
	χ^2	df	N	SE		B0	B1	FU1	FU2	LT-FU
SDAS-11	28.611**	4	36	.373		5.00 (10.25)	3.00 (11.00)	3.00 (5.75)	2.00 (8.00)	6.50 (8.00)
NPIaggression	24.588**	4	38	.363		2.00 (4.00)	0.00 (6.00)	0.00 (2.00)	0.00 (2.00)	1.00 (5.50)
SOAS-R	14.917*	4	39	.358		0.00 (4.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (2.00)
ABS	9.918 *	4	39	.358		19.15 (5.73)	17.50 (5.08)	17.90 (4.40)	17.30 (5.30)	16.79 (5.04)

Note. B0 = first baseline; B1 = second baseline; FU1 = first follow-up; FU2 = second follow-up; LT-FU = long-term follow-up; SDAS-11 = Social Dysfunction and Aggression Scale; NPIaggression= Neuropsychiatric Inventory agitation/aggression subscale; SOAS-R = Staff Observation Aggression Scale-Revised; ABS = Agitated Behaviour Scale.
^{a}IQR = Interquartile range
$^*p < .05$
$^{**}p < .001$

Table 3. *Frequency of answers given by the nurses on the closed questions of the questionnaire about the implementation*

Questions	Yes (%)	multiple choice (%)
Was the nursing staff sufficiently involved in preparing the introduction of the ABC method?	25/26 (96.2)	

When was the goal of the method clear to you?
  a. At the introduction of the new method
  b. Before the training
  c. During the training
  d. Shortly after the training
  e. After working with the method for a long time
		a: 2/28 (7.1)
		b: 4/28 (14.3)
		c: 15/28 (53.6)
		d: 2/28 (7.1)
		e: 5/28 (17.9)

Do you think the goal is achieved?	27/28 (96.4)	
Did you know what you had to do after the training?	25/28 (89.3)	
Did you have enough skills after the training to work according the ABC method?	24/28 (85.7)	
Was everything arranged at the department to start working according the ABC method?	15/20 (75.0)	
I use the method during my work (1 not at all – 5 totally agree)		1: /28 (0.0) 2: 0/28 (0.0) 3: 4/28 (14.3) 4: 17/28 (60.7) 5: 7/28 (25.0)
Do you immediately think of the ABC method when a patient is showing behavioural problems?	21/26 (80.8)	
Is working with the ABC method routine?	12/27 (44.4)	
Do you know exactly how the ABC method works?	22/26 (84.6)	
Do you want to continue working with the ABC method?	28/28 (100.0)	

cited factors needed to help the nursing staff to continue working with the ABC method (**table 4**).

Discussion

In our first, short-term follow-up study, a trend was shown towards a decrease of the patients' aggressive behaviour, albeit not a significant decrease. The possible reason for the non-significant effect was that the time since training was too short to properly implement the ABC method. Therefore, the current study examined the long-term effects of the ABC method on aggressive behaviour in patients with ABI, assuming that the nursing staff had had more time to practice their new skills and that the method had been sufficiently implemented in the departments at the time of the LT-FU. However, no significant decrease in aggressive behaviour over time was found. Surprisingly, a significant increase

of aggressive behaviour over time was found for two aggression measures. To our knowledge, this is the first study examining the long-term effects of the ABC method. Therefore, it was not possible to compare our results with results of other studies.

The unexpected finding that aggressive behaviour, measured with the retrospective SDAS-11 and NPI, increased may be explained by the nursing staff's increased awareness of aggression, following the training. Increased awareness is more likely to affect the outcome of the retrospective measures because of the indirect and more subjective rating of aggressive behaviour over a certain period of time (Rahman et al. 2013).

One possible explanation for the finding that aggressive behaviour did not decrease on any outcome measure after implementation of the ABC method could be that there was not much room for improvement in behaviour as patients showed little aggressive behaviour

Table 4. *Frequency of answers given by the nurses on the open questions of the questionnaire about the implementation*

Question	Answers	Frequency (%)
What was not arranged at the moment the nursing staff started to work with the ABC method? N = 15	There was insufficient time to practice with the methodology From the start there wasn't a weekly meeting in which the way of working was discussed with support of a psychologist. There were still uncertainties about how to work according the ABC method. Other The methodology was not directly incorporated into the computer system. There was no quiet workplace.	6 (27.3) 4 (18.2) 4 (18.2) 4 (18.2) 3 (13.6) 1 (4.5)
Impediments to the implementation of the ABC method N = 18	There was insufficient time to practice and getting used to the new method None Other There were still uncertainties about how to work according the ABC method Lack of cooperation Not everyone was trained	7 (30.4) 4 (17.4) 4 (17.4) 3 (13.0) 3 (13.0) 2 (8.7)
Factors facilitating the implementation of the ABC method N = 15	Support by a psychologist Other Collaboration with colleagues The training itself Colleagues who are fanatically in working with the ABC method	7 (41.2) 4 (23.5) 3 (17.7) 2 (11.8) 1 (5.9)
Benefits of the ABC method N = 24	A better understanding of behavioural problems Becoming more aware of antecedents including your own behaviour Work more like a team Work more systematically Other	11 (42.3) 7 (26.9) 3 (11.5) 3 (11.5) 2 (7.7)
Cons of the ABC method N = 18	It's time-consuming to work according to the ABC method. A lot of paperwork must be completed. None There was too little time to work with the ABC method. The ABC method is difficult. Other	6 (26.1) 4 (17.4) 4 (17.4) 3 (13.0) 3 (13.0) 3 (13.0)
What can support you and/or your team to continue working with the method? N = 24	A booster session More support of the psychologist Continuing to motivate each other Integrating the ABC method into the evaluations of the patients treatment Other More time to work with the ABC method There is nothing more required.	10 (35.7) 8 (28.6) 4 (14.3) 2 (7.1) 2 (7.1) 1 (3.6) 1 (3.6)

Note: Other = answers that are not directly related to the ABC method and answers that don't answer the question. Frequency = number of times that the answer is given

at baseline. The patients who dropped out showed more aggressive behaviour and more neuropsychiatric problems than the patients who were included, although the difference was significant for only one outcome measure, which may explain why patients included in this study showed little aggressive behaviour at baseline. The small number of patients participating in this study may explain why the differences between patients who dropped out and patients who were included, were significant for only one outcome measure.

At the start of this LT-FU study our hypothesis was that more time was needed for implementing the ABC method and that nine weeks, which was the follow-up duration in the study of Winkens et al. (2017), was not enough time for a successful implementation. The questionnaire in which the nursing staff evaluated the implementation shows that the ABC method was still not usual practice for the majority of nurses at this long-term follow up, indicating that the implementation of the ABC method may not have been successful, even though all nurses wanted to continue working with the ABC method, the majority of the nurses indicated that they had enough skills after the training to work according the ABC method and they immediately think of the ABC method at the moment behavioural problems occur. The impediments to successful implementation of the ABC method (e.g. not enough time to practice in the workplace immediately after the training) mentioned by the nursing staff could be a possible explanation of why the method was still not usual practice. The literature states that before implementing a new methodology, such as the ABC method, several conditions (e.g. the availability of resources and the support of management) must be fulfilled and that potential barriers to and promoters of changing behaviour of a team have to be identified. After this, an implementation plan has to be created, including determinants of change, before actually starting with the introduction of a new methodology. Based on this implementation plan, tailored interventions can be chosen in order to bring about behavioural changes in a team and to ensure that the methodology becomes usual care (Grol and Wensing 2004, Grol and Wensing 2010). Looking back, we see that we did not have an implementation plan. Important factors, like time to practice the method, discussions with colleagues about the method, cooperation with the psychologist immediately after the training, and integration of the ABC method into digital reporting systems, were likely not sufficiently arranged before the start of the training. Moreover, the rationale of the goal of working with the ABC method was not sufficiently clear for the majority of the nurses; this may have decreased their awareness of the need to start working with a new methodology. Putting the results together, it seems that the quality of the implementation process was insufficient, which may explain why aggressive behaviour did not decrease after implementation of the ABC method. Accordingly, we can say that more time to implement a new methodology, as has been hypothesized in the study of Winkens et al. (2017), is not enough by itself to decrease aggressive behaviour, when the quality of the implementation process is insufficient.

Strengths and limitations of the study

This study is innovative because it is the first long-term follow up study examining the effects of the ABC method in patients with behavioural problems after ABI. In addition, multiple measurements were used to identify changes between multiple measurement points. However, this study also has several limitations. First, no control group was used because this study was performed in a clinical setting. Assigning half of the patients of one department to an experimental ABC group and the other half of the patients of the department to care as usual was not possible because the nursing staff takes care of the entire department. Instead, we chose to conduct a double baseline measurement, including a 'control' baseline measurement, to check for instability of problem behaviour in the baseline data (Winkens et al. 2017). Second, problem behaviour was assessed by different nurses. This may have biased the results, as one nurse may experience the disturbing behaviour as more severe than another nurse. Third, not every member of the nursing staff was fully trained in the ABC method (e.g. interns). Although the staff members who did receive the training were urged to educate their colleagues, this lack of or incomplete training may have influenced the results. Fourth, in this study, standardised behaviour scales were used which may be less sensitive in picking up subtle changes in specific and individual problem behaviour. Finally, we were unable to control for other factors, such as group dynamics, and/or the physical condition of patients, which could influence the behaviour of patients in a department.

Recommendations for further studies

Although the current study did not show that the ABC method decreases aggressive behaviour in the long term, it is considered to be premature to conclude that the ABC method does not affect problem behaviour in neuropsychiatric patients with ABI. In subsequent studies, more attention should be paid to tailoring implementation plans, supported by the knowledge of change management, before introducing the ABC method into a new department. More effort is required for successful implementation, meaning more time to practice the ABC method and to discuss it with each other, cooperation with a psychologist, integrating the method into (digital) reporting systems, repetition of the information from the training and further explanation while working with the ABC method. Further, it would be interesting to measure the effect of the ABC method not only in terms of a decrease in behavioural problems, but also in terms of nurses' awareness of behavioural problems or their attitude towards aggression, because they mentioned an advantage of working with the ABC method despite the fact that there was no decrease in aggression. Finally, it would be interesting to examine the effect of this awareness on retrospective measures of behaviour, because implementation of a behavioural intervention may increase nurses' awareness of behavioural problems, which in turn may influence scores on outcome measures, in particular on retrospective outcome measures.

The supplemental tables are available upon request. Please contact the corresponding author.

Acknowledgements

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