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AGGRESSIVE BEHAVIOUR AFTER SEVERE ACQUIRED BRAIN INJURY: SUCCESSFUL TREATMENT WITH ELECTRICAL AVERSION THERAPY: A CASE STUDY

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AUTHORS' CONTRIBUTIONS

This work was carried out in collaboration between all authors. Author BJTM contributed to conception and design, contributed to interpretation of data, drafted the manuscript and revised the manuscript critically for important intellectual content. Author PJJS analyzed and interpreted data and revised the manuscript critically for important intellectual content. Author PNVH contributed to interpretation of data and revised the manuscript critically for important intellectual content. Author CMVH contributed to interpretation of data and revised the manuscript critically for important intellectual content. All authors read an approved the final manuscript.

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Case Study

ABSTRACT

Introduction: Aggression is a severe and frequent behavioral consequence of brain injury. Pharmacological interventions are used, though evidence of efficacy is lacking. Behavioral therapies have shown some effect. Electrical aversion therapy (EAT) is a behavioral therapeutic option that might be suitable for brain-injured individuals for whom other therapies are not effective.
The effect of EAT on aggression after brain injury has not been investigated previously.
Case Presentation: Here we report on a single case observational study on the effect of EAT on aggression in a 41-year old male with severe brain injury due to subarachnoid hemorrhage. Restraints, time out of bed, number of staff needed for care and aggressive behavior were measured.
The level of care and the number of restraints were markedly reduced with EAT, without incidents leading to injury to the patient or nursing staff. There was a trend towards decline in the frequency of aggressive behavior over time.
Discussion: The study design was observational but by comparing the first and the second part of the registration period we were able to demonstrate a decline in aggressive behavior after EAT. The large number of measurements was a strong aspect. The lack of control is however a major limitation.
Conclusion: We conclude that EAT was effective in this patient with aggressive behavior due to severe brain injury. EAT can therefore be considered in therapy resistant aggression in brain-injured patients.

Keywords: Brain injury; neurobehavioral; aggression; EAT.

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1. INTRODUCTION

Behavioral consequences of Acquired Brain Injury (ABI) can have a negative impact on the patient's life and social reintegration [1]. Aggression is a severe and frequent behavioral consequence of brain injury [2,3]. Currently, many pharmacological interventions are used in clinical practice, though evidence of effectiveness is lacking [4,5]. Non-pharmacological interventions, including antecedent control procedures and contingent reinforcement procedures, have been shown to be effective as a treatment for aggression in ABI [6-9].

Electric Aversion Therapy (EAT), a response contingent procedure, consists of the immediate application of an aversive electrical stimulus following inappropriate behavior, with the aim of reducing this behavior. EAT is potentially an effective treatment for aggressive behavior in ABI patients, because it pairs this undesired behavior with aversive consequences. This type of approach is especially important in people who are cognitively impaired or intellectually disabled [10].

To our knowledge, no studies have been published on the use of EAT to control aggression in brain-injured patients. The only other study on EAT in this population was done by our research group, and we found that EAT effectively managed inappropriate sexual behavior in a patient with traumatic brain injury [11].

In this case report we present case X, a patient with severe brain injury due to subarachnoid haemorrhage, and the effect of EAT on the management of his aggressive behavior.

2. CASE PRESENTATION

X is a 41-year-old male who sustained severe brain damage due to a subarachnoid haemorrhage from an aneurism of the posterior communicating artery in January 2003. After coiling of the aneurism, secondary infarction occurred and hydrocephalus developed, for which a Ventriculo-Peritonial drain was applied. During the acute phase the patient's score on the Glasgow Coma Scale was E1M1V1 indicating very severe brain injury. After initial hospital admission X was transferred to a nursing home. Eight months post-injury, the patient was in a persistent confusional state: Rancho Los Amigos scale IV (confused-agitated) [12]. As his confusional state progressed from Ranchos III to IV, he developed severe aggressive outbursts, during which he attempted to physically harm the nursing staff during daily care activities.

His behavior could not be controlled in the nursing home, and 10 months post-injury he was transferred to our brain injury rehabilitation unit specialized in the management of challenging behavior.

During adolescence he was known for seeking aggressive confrontation. He was referred to an outpatient psychiatric facility at the time. Afterwards there were no further aggressive incidents. Pre-injury, X was functioning normally and there was no substance abuse.

In the nursing home, non-pharmacological interventions such as reduction of stimuli were applied, but without effect. Sedative medication was prescribed, also without effect on overall behavior, although the aggressive incidents became less destructive. (Olanzapine 5 mgs bd, carbamazepine 200 mgs tds, valproate acid 300 mgs qds, and lorazepam up to 15 mgs daily were prescribed consecutively.)

However, secondary complications of sedation occurred. He developed a bladder infection and dehydration, and tube feeding became necessary.

After transfer to our facility, his behavior deteriorated and five-point restraints were needed during daily care activities, because of his constant aggression. At other times, a single restraint prevented him from leaving his bed without supervision, as this was deemed unsafe due to his aggression and the risk of falling. He was able to walk a short distance with the physical therapist on the ward. A reduction of sedative medication was tried, but his aggression then became more dangerous. For example, while taking a shower he administered a head butt to one of the nurses, resulting in a broken nose. Midazolam up to 60 mgs was added 30 minutes before care with no effect. At that time, sedation was the only option for providing effective and safe care. Transfer to a nursing home was impossible under these circumstances. His wife was very concerned and suffered severely seeing him like this. Consultation by specialists in the management of challenging behavior was procured and EAT was suggested.

3. TREATMENT

3.1 Electrical Aversion Therapy

EAT reduces or suppresses the target behavior by evoking avoidance conditioning, through parallel processes of operant and classical conditioning [13]. Because the electrical stimulus is an aversive consequence to the behavior, the response and the stimulus can be linked exactly together. EAT is

primarily used in intellectually disabled or autistic individuals who display severe self-injuring behavior [14], and in some cases in patients with aggressive behavior [15]. Although a number of side effects of EAT have been reported [16], a review by Matson and Taras (1986) [17] reported that most side effects were positive (e.g. increased social behavior).

In the current case study, the same EAT device was used as in our study on inappropriate sexual behavior [11]. The EAT device consisted of an electrode applied to X's right arm and a receiver attached to his belt and connected to the electrode. A transmitter (remote controlled shocker, type HSP, Schoutissen Electronics, the Netherlands) was carried by a nurse. (The pulse is about 40mA and is applied by an alternating current of 30 Hz during less than one second.)

The Dutch health authorities have approved the apparatus technically. The treatment is ethically approved under the condition that it is applied only under supervision of the CCE (Center for Consultation and Expertise). In this case the CCE provided the supervision of two experienced behavioral therapists.

3.2 Procedure and Measurement of Target Behaviour

First, we explained EAT to X's wife and introduced it as a treatment option. Subsequently, EAT was introduced to the team of nurses involved and the psychologist. EAT was explained and ethical issues were discussed in the team. During a basic care session, target behavior was operationally defined in an interactive process between the nursing staff, two experienced behavioral therapists, Duker & Seys [10], leaders in the research on EAT, and the psychiatrist involved. Subsequently the behavioral therapists instructed the nurses on the use of the EAT device while applying morning care.

In the treatment phase (see study timeline, Fig. 1), X was attached to the EAT device during morning care and physical therapy sessions. (We couldn't postpone the intervention to establish a proper baseline of the frequency of the target behavior due to ethical considerations.)

At any sign of physical aggression, such as beating, kicking, pinching, biting or spitting, the nurses gave the patient a pulse from the device. Furthermore, a pulse was given if X tried to remove the electrode or receiver. The nurses did not give a pulse in case of shouting, swearing, threatening, angry looks or touching the electrode or receiver. If threatening language or agitation increased and escalation was imminent, or if X touched the device in a way that anticipated removal of the electrode or receiver, the transmitter was shown to X as an adverse stimulus.

The nurse performing the actual care would say "shock". Another nurse holding the transmitter would push the button. The number of pulses was reported on weekdays only, due to staffing constraints in the weekend.

X was incapable of giving informed consent due to his confusional state, so X's wife gave informed proxy consent in writing for the treatment as well as for the collection and publication of data. Approval of a medical ethics committee was not required because the EAT intervention was an integral part of the treatment scheme. Registration of the data did not affect the treatment or the patient at all.

4. OUTCOME AND FOLLOW-UP

4.1 Study Design

We conducted a single case observational study. During four weeks before initiating EAT and at three months after discontinuing registration of EAT activities, we recorded the following data: the number of medical restraints necessary to ensure safety for daily care and physical therapy providers, the amount of time spend out of bed daily, and the number of nurses needed to provide care.

From 24 January 2005 to 1 December 2005, the frequency of target behaviour (=pulses delivered) during morning care was measured 5 days a week. Measurements continued after 1 December, but these measurements could not be used due to a large amount of missing data.

Frequency of target behaviour during physical therapy sessions was measured one to three times a week, from 24 February 2005 to 23 May 2006.

4.2 Analyses

The number of pulses per day per activity was represented graphically and descriptive analyses were performed to summarize the raw data. We divided the registration period into two equal parts to determine whether the number of EAT pulses would be lower in the second part compared with the first part. We determined both the mean (standard deviation) and median number of pulses (interquartile range). SPSS 19.0 for Windows was used for descriptive analyses.

Fig. 1. Registration time line

5. RESULTS

5.1 Restraints, Time Spend Out of Bed, Number of Nurses and Assistance during Meals

Before the EAT intervention, the patient was placed under five-point restraint during care sessions and three nurses were needed to provide care. When in bed he was secured by a Swedish bond for his own safety. X took his meals in bed under close supervision and usually he was fed. He was permitted to be out of bed only to go to the toilet or to take a shower, and during physical therapy. Transfer to a regular nursing home was not possible due to aggression.

At three months post-intervention, only one nurse was needed for the actual care. Another nurse was only present to hold the transmitter and to apply a pulse if necessary. Restraint during care sessions was no longer necessary. When in bed he was secured by a Swedish bond for his own safety. X was out of bed from 9 am to 1.30 pm sitting in a relaxation chair with one restraint, for his own safety due to risk of falling. He took his meals out of bed and ate by himself most of the time. He took his evening meal in bed in a sitting position, also by himself. He spent the rest of the day in bed because he was worn out. With this regime, we could transfer him to a regular nursing home, without relapse. From the nursing home we learned that this level of functioning was maintained for 7 years after transfer, with the help of continued application of EAT as before. Thanks to the EAT he lived in acceptable circumstances. He died in 2013 choking on a peanut butter sandwich. His death was neither related to EAT, nor to his aggressive behavior.

5.2 Target Behavior

5.2.1 Morning care

Of the 224 weekdays that were potentially available during the study (from 24 January to 1 December 1 2005), measurements during morning care were available for 150 weekdays. The number of pulses per day during morning care is depicted in Fig. 2, showing a trend towards decline in the frequency of target behavior over time.

For descriptive analyses, two periods of 112 days each were compared. Results showed that the mean number of pulses during morning care was lower in the second part of the registration period than in the first part. Although the median number of pulses did not differ between the two parts, the interquartile range (spread of data) was smaller in the second part of the registration period than in the first part.

Since the amount of missing data was larger in the second part of the registration period than in the first part, we also divided the number of days for which measurements were available (N=150) into two equal parts. Descriptive analyses showed similar results (data not shown).

5.2.2 Physical therapy

During the registration period for physical therapy (24 February 2005 to 23 May), measurements were available for 91 days. The number of pulses per physical therapy session is depicted in Fig. 2, showing a trend towards decline in the frequency of target behavior.

For descriptive analyses, two parts of 162 days each were compared, which showed that the mean number of pulses during physical therapy was lower in the second part of the registration period relative to the first. Although the median number of pulses did not differ between the two parts, the interquartile range (spread of data) was smaller in the second part of the registration period than in the first part.

Since the first part of the registration period included more measurements than the second part, we again divided the number of days for which measurements were available (N=91) into two parts (N=45 vs. N=46). Descriptive analyses showed similar results (data not shown).

No side effects were observed with X.

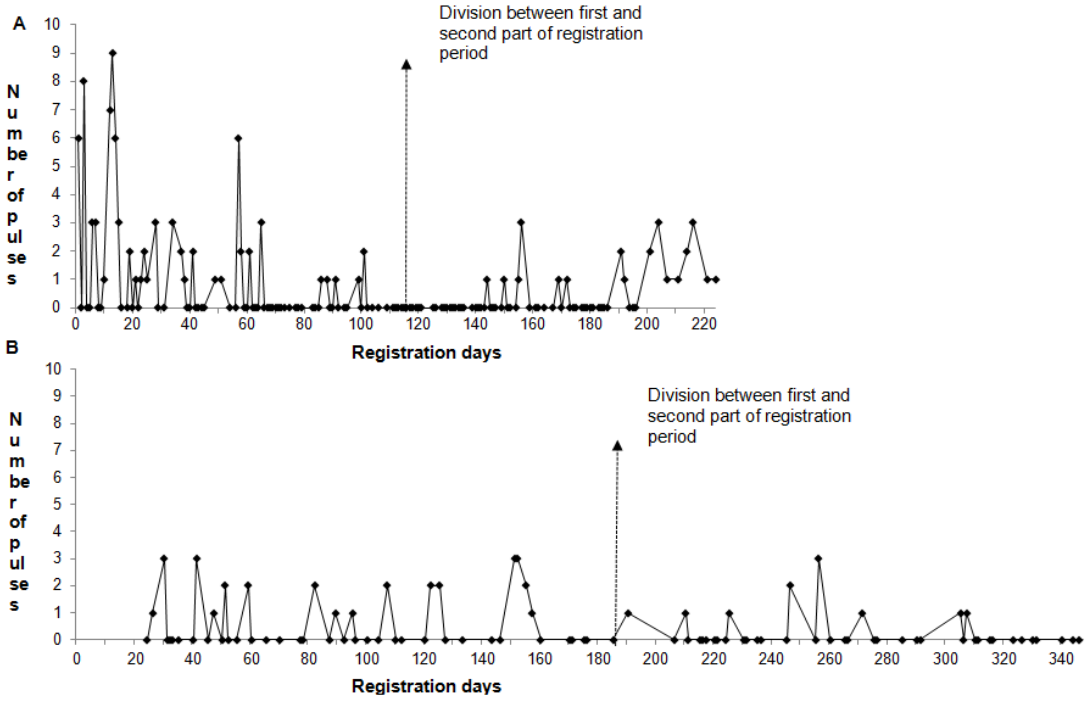

Fig. 2. Number of pulses per day during morning care (A) and per physical therapy session (B)
Registration days are marked
Registration period for A: From 24 January to 1 December 2005; Registration period for B: From 24 February 2005 to 23 May 2006

6. DISCUSSION

In this case study, the use of EAT to control aggressive behavior after brain injury was motivated by the severity, persistence and major impact of this problematic behavior. Moreover, after the EAT intervention, X could spend more time out of bed, and the level of care and the number of restraints could be reduced, without risk to the safety of the patient and the nursing staff. In addition, data showed a trend towards decline in the frequency of aggressive behavior over time after implementation of the EAT intervention. Due to these improvements, sedative medication could also be reduced relative to pre-intervention levels (retrospective data from patient's medical records). Eventually he could be transferred to a nursing home with a normal level of care, including continued application of EAT as before.

Ethical considerations were discussed throughout the process. We proposed this potentially controversial intervention only because all other available interventions had been exhausted and the measures needed to ensure staff safety were inhumane for the patient. In addition, his behavior and the required control measures had profound emotional impact on the nursing staff and especially on his wife. She was very concerned about the inhumane situation and suffered accordingly.

After proposing the EAT intervention, we painstakingly addressed the ethical issues during the informed consent process with his wife. During the treatment, we held frequent evaluations with the staff and his wife to evaluate the effect and discuss the necessity to continue with EAT.

Aggression is a high impact, difficult to treat consequence of brain injury, and treatment resistant aggression is not rare [3-9]. Evidence on efficacious interventions is scarce, although behavioral interventions are promising [6-9]. There is some evidence that EAT can be efficacious in the treatment of self-destructive behavior in intellectually disabled people [10]. However, studies on EAT as a treatment for aggression after ABI are lacking. There is one study of EAT being effective in a patient with traumatic brain injury and inappropriate sexual behavior [11].

This case report shows promising results from using EAT in a treatment-resistant case of severe aggression after severe brain injury. The design was observational but by comparing the first and the

second part of the registration we have demonstrated a beneficial effect on target behavior frequency during daily care activities, and physical therapy. In particular, the apparent effect of EAT on patient functioning and reduced necessity for restraints is clinically relevant.

The large number of measurements was a strong aspect of this case study. The lack of controls is, however, an inherent limitation.

7. CONCLUSION

We suggest that EAT be considered in brain-injured patients with severe aggressive behavior who are resistant to other behavioral and pharmacological treatments.

CONSENT

As per international standard or university standard, patient's written consent has been collected and preserved by the authors.

ETHICAL APPROVAL

It is not applicable.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Williams WH, Evans JJ. Brain injury and emotion: An overview to a special issue on biopsychosocial approaches in neurorehabilitation. Neuropsychol Rehabil. 2003;13:1-11.
2. Kant R, Smith-Seemiller L, Zeiler D. Treatment of aggression and irritability after head injury. Brain Inj. 1998;12:661-6.
3. Tateno A, Jorge RE, Robinson RG. Clinical correlates of aggressive behavior after traumatic brain injury. J. Neuropsychiatry Clin Neurosci. 2003;15:155-60.
4. Lombard LA, Zafonte RD: Agitation after traumatic brain injury: Considerations and treatment options. Am J Phys Med Rehabil. 2005;84:797–812.
5. Fleminger S, Greenwood RJ, Oliver DL. Pharmacological management for agitation and aggression in people with acquired brain injury. Cochrane database Syst Rev. 2003a; 1:CD003299.
6. Fluharty G, Glassman N. Use of antecedent control to the outcome of rehabilitation for a client with frontal lobe injury and intolerance for auditory and tactile stimuli. Brain Inj. 2001; 15:995-1002.
7. Hegel MT, Ferguson RJ. Differential reinforcement of other behavior (DRO) to reduce aggressive behavior following traumatic brain injury. Behav Modif. 2000;24:94-101.
8. Persel CS, Persel CH, Ashley MJ, Krych DK. The use of noncontingent reinforcement and contingent restraint to reduce physical aggression and self injurious behaviour in a traumatically brain injured adult. Brain Inj. 1997;11:751-60.
9. Watson C, Rutterford NA, Shortland D, Williamson N, Alderman N. Reduction of chronic aggressive behaviour 10 years after brain injury. Brain Inj. 2001;15:1003-15.
10. Duker PC, Seys DM. A quasi-experimental study on the effect of electrical aversion treatment on imposed mechanical restraint for severe self-injurious behavior. Res Dev Disabil. 2000;21:235-42.
11. Ter Mors BJ, Van Heugten CM, Van Harten PN. Evaluation of electrical aversion therapy for inappropriate sexual behaviour after traumatic brain injury: A single case experimental design study. BMJ Case Rep. 2012; 2012.
12. Hagen C, Malkmus D, Durham P. Levels of cognitive functioning. Professional Staff Association of Rancho Los Amigos Hospital eds. Rehabilitation of the head injured adult: comprehensive physical management. C. A. Downey, Rancho Los Amigos Hospital Inc.; 1987.
13. Hadley NH. Foundations of aversion therapy. Lancaster, England: MTP Press Ltd.; 1985.
14. Duker PC, Seys DM. A quasi-experimental study on the effect of electrical aversion treatment on imposed mechanical restraint for severe self-injurious behavior. Res Dev Disabil. 2000;21:235-42.
15. Duker PC, Seijs DM. Long-term use of electrical aversion treatment with self-injurious behavior. Res Develop Disabil 1996;17:293–301.
16. Van Oorsouw WMMJ, Israel ML, Von Heyn RE, et al. Side effects of contingent shock treatment. Res Dev Disabil. 2007;29:513-23.
17. Matson JL, Taras ME. A 20 year review of punishment and alternative methods to treat problem behaviors in developmentally delayed persons. Res Develop Disabil 1986;10:85–104.