“The ABCs of AD”: A prospective evaluation of the efficacy of an educational intervention to increase knowledge of autonomic dysreflexia management among emergency health care professionals

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Context/Objective: Despite the availability of consensus-based resources, first responders and emergency room (ER) health care professionals (HCPs) have limited knowledge regarding autonomic dysreflexia (AD) recognition and treatment. The purpose of this study was to assess the efficacy of “The ABCs of AD” educational seminar for improving HCPs’ short- and long-term knowledge of AD recognition, diagnosis, and management.

Design: Multi-center prospective pre, post, and follow-up questionnaire study.

Setting: Level I trauma centers with emergency departments in British Columbia, Manitoba, and Ontario.

Methods: ER professionals completed measures immediately before and after ($n = 108$), as well as 3-months following ($n = 23$), attendance at “The ABCs of AD” seminar.

Outcome Measures: AD knowledge test; seminar feedback.

Results: Following the seminar, participants had higher ratings of their AD knowledge and had significantly higher AD knowledge test scores ($M \pm SD$ pre = 11.85 ± 3.88 , $M \pm SD$ post = 18.95 ± 2.39 , out of 22; $P < 0.001$, $d = 2.21$). Most participants believed the seminar changed their AD knowledge, and rated the seminar information as having the potential to influence and change their practice. AD knowledge test scores significantly decreased between post-seminar and 3-month follow-up ($M \pm SD$ 3mo = 17.04 ± 3.28 ; $P = 0.004$, $d = -0.70$); however, 3-month scores remained significantly higher than baseline.

Conclusion: “The ABCs of AD” seminar improves HCPs’ perceived and actual AD knowledge in the short-term. To enhance knowledge retention in both the short- and long-term, the inclusion of additional active learning strategies and follow-up activities are recommended. The seminar is being translated into an online training module to enhance the dissemination of the AD clinical practice guidelines among first responders, ER staff, and SCI practitioners.

Keywords: Autonomic dysreflexia, Continuing medical education, Emergency care, Spinal cord injuries

Introduction

In addition to debilitating motor, sensory, and autonomic deficits, individuals with spinal cord injury (SCI) also suffer from significant cardiovascular

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dysfunction.¹⁻³ Among these cardiovascular impairments are episodes of uncontrolled hypertension known as autonomic dysreflexia (AD), an acute, life-threatening condition most commonly observed in individuals with a neurological level of injury above the sixth thoracic segment (T6 or higher).⁴⁻⁶ AD is characterized by a 20 to 30 mmHg increase in systolic blood pressure above an individual's baseline,³ and is often accompanied by pounding headache, flushing of the skin, profuse sweating, piloerection above the level of injury, and cold, pale skin below the level of injury (due to vasoconstriction).⁷ Furthermore, following the rise in blood pressure, reflex bradycardia commonly occurs, although tachycardia has been reported.⁸⁻¹⁰ Delayed diagnosis and inadequate management of AD may result in stroke,¹¹ myocardial infarction,¹² and even death.¹³ Thus, the early recognition and prompt management of this life-threatening, but easily treatable, condition among emergency room (ER) staff and SCI health care professionals (HCPs) is vital.

Thorough knowledge of AD, as well as good communication and coordination of efforts between HCPs and the person experiencing AD, are essential for prompt and appropriate management of AD. Despite the availability of consensus-based resources, including clinical practice guidelines¹⁴ and a published systematic review⁷ to assist HCPs with diagnosing and managing AD, a paucity of knowledge regarding AD recognition and treatment remains among ER nurses and physicians.¹⁵ As these individuals are among the first to treat persons with SCI in emergency situations, it is crucial that they are well-informed to manage life-threatening episodes of AD. A targeted intervention to enhance ER professionals' knowledge of AD would generate awareness of the importance of prompt and appropriate management of this condition, and may improve the medical treatment of people with SCI presenting with AD.

Educational interventions, such as courses and seminars, are a generally effective means for increasing knowledge about a specific medical condition,^{16,17} and are a preferred method for continuing medical education among HCPs.¹⁸ The impact of an educational intervention on professionals' knowledge and changes in practice behaviours may be enhanced by focusing on outcomes that are perceived as serious,¹⁶ such as the consequences of improper AD management, as well as by emphasizing relevant and practical information to the HCP group, and by evaluating knowledge using pre-, post-, and follow-up knowledge tests.¹⁸

Accordingly, a group of SCI clinicians and scientists developed "The ABCs of AD," a seminar-mediated intervention designed to improve ER professionals'

recognition and management of AD. The purpose of the current study was to assess the efficacy of "The ABCs of AD" educational seminar for improving HCPs' immediate and long-term knowledge of AD recognition, diagnosis, and management.

Methods

Study design

This multi-center, collaborative study took place between April 2010 and January 2011 and utilized a prospective pre-, post- and 3-month follow-up design. The protocol for this study was approved by the clinical research ethics boards of the hospitals affiliated with the University of British Columbia, the University of Manitoba, Toronto Rehabilitation Institute, and Sunnybrook Health Sciences Centre (Toronto).

Participants

ER and SCI personnel (physicians, nurses, medical residents) working in tertiary care Level 1 trauma hospitals in Vancouver, Winnipeg, and Toronto were recruited by email listserv, posters in staff areas, and word of mouth to attend the continuing education seminars. A total of 108 HCPs across the three study sites completed the pre- and post-seminar questionnaire, and 23 completed the 3-month follow-up questionnaire.

"The ABCs of AD" educational seminar

"The ABCs of AD" seminar was developed primarily by SCI clinicians and clinician-scientists in consultation with patients, specialists in rehabilitation medicine, and colleagues from ERs across Canada. The development team included physiatrists and registered nurses who have over 120 years of combined experience in SCI medicine, AD management, and AD research. The educational seminar was designed to provide a brief but comprehensive overview of the recognition and diagnosis of AD, as well as the latest evidence on non-pharmacologic and pharmacologic management of AD.^{7,14} Similar in design to the standard cardiopulmonary resuscitation course, the goal of the seminar was to disseminate lifesaving information regarding AD to HCPs. The 45-minute, 33-slide presentation consisted of a review of the consequences of not recognizing AD, relevant anatomy and physiology of AD, signs and symptoms associated with the condition, prevention and management techniques (non-pharmacological and pharmacological), and case studies to reinforce knowledge. Emphasis was placed on early recognition and initiation of non-pharmacologic treatment to prevent life threatening complications of AD. The last few slides provided review questions to reinforce key

constructs related to AD recognition. The research team reviewed and verified the course content on several occasions prior to implementation. The final, standardized version of “The ABCs of AD” seminar was presented a total of eight times by a SCI clinician-scientist who was also a member of the research team at each of the three study sites (AK delivered two seminars in Vancouver, KE delivered three seminars in Winnipeg, and BCC delivered three seminars in Toronto).

Protocol

At the beginning of the educational seminar, consenting participants were asked to complete a pre-seminar questionnaire that included a demographic and professional information survey and an AD knowledge test. Seminars were delivered during regularly scheduled continuing education sessions at each study site. Following the seminar, the post-seminar questionnaire included the AD knowledge test and a seminar feedback questionnaire. Both the pre- and post-seminar questionnaires were administered by a research assistant via hardcopies and anonymized using unique participant identification numbers. Participants were also asked whether they would be willing to be contacted in three months for a follow-up AD knowledge test. This 3-month follow-up questionnaire was distributed via post or email. Participant remuneration was site specific: participants in Toronto and Vancouver were given coffee shop gift cards; nurses in Winnipeg were provided with refreshments and one hour away from work, and physicians in Winnipeg received continuing medical education credits.

Measures

Demographic and professional information survey

Participants were asked to report their age, gender, job title (physician, registered nurse, other), number of years in practice (1–5, 6–10, 11–15, >15 years), and location of practice (urban >500 000, urban <500 000, rural). Participants were asked to report whether or not they have patients in their practice with SCI, the number of patients with SCI they saw in the past

month, and whether they had previously heard of the term “AD.”

AD knowledge test

The AD knowledge test was written by the course developers (SCI physiatrists and experts in the management of AD) for the purposes of the current study using evidence from the AD clinical practice guidelines¹⁴ and a published systematic review.⁷ The test items were then piloted among SCI rehabilitation practitioners and adults with SCI to ensure the questions adequately addressed the recognition, diagnosis, and management of patients presenting with AD. The course developers agreed on the items to be included in the final version of the questionnaire; items lacking unanimous support were deleted, while those with vague or unclear response options were revised or deleted. The introductory question asked participants to rate their current knowledge of AD as “Poor,” “Fair,” “Good,” or “Excellent.” The AD knowledge test consisted of 11 questions of varying question types (e.g. case studies, multiple choice, matching; see Appendix A for AD knowledge test and scoring key) that assessed participants’ current knowledge of AD etiology, signs and symptoms, and management protocols. The 11 items on the AD knowledge test had a maximum possible score of 22, with higher scores indicating more comprehensive AD knowledge.

Seminar feedback questionnaire

Following the seminar, participants were asked whether “The ABCs of AD” changed their knowledge of AD, and whether the information in the seminar would influence their practice or lead to practice change. See Table 1 for complete seminar feedback questionnaire items and scoring.

Statistical analysis

Descriptive statistics were calculated for each study measure. Preliminary analyses using two separate between-within ANOVAs were conducted to assess any differences in changes in AD knowledge test scores over time depending on participants’ (1) study site and (2) job title. No significant effects emerged for study

Table 1 Seminar feedback questionnaire

Item	Response scale	M ± SD or n(%) n = 108
Did participating in the “ABC of AD” course change your knowledge on AD?	Yes/No	87 (80.6) Yes 21 (19.4) No
Will this information influence your practice and lead to change?	5-point Likert-type scale (1 = <i>Strongly disagree</i> ; 5 = <i>Strongly agree</i>)	4.51 ± 0.78

AD, autonomic dysreflexia.

site or job title; thus, to simplify the analysis, we collapsed all participants into one group and examined changes in AD knowledge test scores using a single repeated-measures ANOVA. Significant time effects were followed by post-hoc paired samples *t*-tests to identify significant changes in AD knowledge test scores between pre-post-, post-3-month, and pre-3-month. Significance was set at $P < 0.017$ to account for multiple comparisons (i.e. Bonferroni correction). Cohen's *d* was calculated as an index of effect size and interpreted as small, medium, and large-sized effects according to Cohen's conventions of *ds* of 0.20, 0.50, and 0.80.¹⁹

Results

Participants

The majority of the 108 participants who completed pre- and post-seminar questionnaires were female (64.8%), had been practicing in their field for 1–5 years (53.7%), and were practicing in an urban setting with a population greater than 500 000 (91.7%). The participants' average age was 33.85 years ($SD = 9.48$). A greater number of registered nurses ($n = 44$) completed questionnaires than physicians ($n = 27$) or other types of HCPs ($n = 37$). See Table 2 for complete demographic characteristics of the participants.

AD knowledge test scores

Prior to the seminar, the majority of participants rated their AD knowledge as either "None" (45.4%) or "Poor" (39.8%) and the average AD knowledge test score was 11.85 ± 3.88 (out of 22). Following the seminar, the majority of participants rated their AD knowledge as either "Poor" (35.2%) or "Fair" (50.9%). There was a significant univariate effect in AD knowledge test scores over time ($F(2,44) = 42.911$, $P < 0.001$). Follow-up paired samples *t*-tests revealed significant, large effect size increases in AD knowledge test scores between pre- and post-seminar ($P < 0.001$; $d = 2.21$) and between pre-seminar and 3-month follow-up ($P < 0.001$; $d = 1.38$). However, between post-seminar and 3-month follow-up, there was a significant medium effect-size decrease in AD knowledge test scores ($P = 0.004$, $d = -0.70$). See Table 3 for all descriptive statistics, *t*-test results, and effect sizes for changes in AD knowledge test scores over the study period.

Seminar feedback

Following the seminar, 87 (80.6%) participants said "The ABCs of AD" seminar changed their knowledge of AD. Participants also felt that the information in

Table 2 Participant demographic and professional information

Variable	Completed questionnaires	
	Pre & Post $n = 108$	3-month $n = 23$
Age ($M \pm SD$)	33.85 $\pm$ 9.48	36.09 $\pm$ 8.94
Sex		
Male	36 (33.3)	10 (43.5)
Female	70 (64.8)	13 (56.5)
Study site		
Vancouver	20 (18.5)	5 (21.7)
Winnipeg	42 (38.9)	5 (21.7)
Toronto	46 (42.6)	13 (56.5)
Job title		
Physician	27 (25.0)	6 (26.1)
Registered Nurse	44 (40.7)	11 (47.0)
Other	37 (34.3)	6 (26.1)
Years in practice		
1–5 years	50 (53.7)	10 (43.5)
6–10 years	12 (11.1)	3 (13.0)
11–15 years	7 (6.5)	2 (8.7)
> 15 years	27 (25.0)	8 (34.8)
Location of practice		
Urban (>500 000)	99 (91.7)	22 (95.7)
Urban (<500 000)	5 (4.6)	1 (4.3)
Rural	1 (0.9)	0 (0)
Do you have patients in your practice with SCI?		
Yes	98 (90.7)	22 (95.7)
No	10 (9.3)	1 (4.3)
If yes, how many patients with SCI have you seen in the past month?		
N/A	6 (5.6)	0 (0)
1	25 (23.1)	7 (30.4)
< 10	53 (49.1)	11 (47.8)
> 10	14 (13.0)	4 (17.4)
Have you heard of the term "AD"?		
Yes	93 (86.1)	19 (82.6)
No	15 (13.9)	4 (17.4)

Note. AD, autonomic dysreflexia; ER, emergency room; SCI, spinal cord injury. All values are *n*(%) unless otherwise indicated. *ns* < 108 and 23 for some variables in the second and third columns, respectively, due to non-responding. "Other" job titles included medical residents, trauma practitioners, and rehabilitation specialists.

the seminar would influence their practice and lead to change (4.51 ± 0.78 , out of 5, where 5 is *strongly agree*).

Discussion

Following attendance at "The ABCs of AD" educational seminar, HCPs had more positive perceptions of their AD knowledge and achieved statistically significant improvements in their actual AD knowledge test scores. The majority of participants felt that the seminar changed their AD knowledge, and participants rated the seminar information as having the potential to influence and change their practice. However, increases in AD knowledge test scores were not maintained at 3-month follow-up.

Prior to seminar initiation, the majority of participants rated their AD knowledge as "None" or "Poor"

Table 3 Autonomic dysreflexia knowledge test scores

Variable	Descriptive statistics			Paired samples <i>t</i> -tests		
	Pre (<i>n</i> = 108)	Post (<i>n</i> = 108)	3-month (<i>n</i> = 23)	[Cohen's <i>d</i>]		
				Pre-Post	Post-3 month	Pre-3 month
Rating of AD knowledge, <i>n</i> (%)						
None	49 (45.4)	1 (0.9)	1 (0.9)			
Poor	43 (39.8)	38 (35.2)	15 (13.9)			
Fair	14 (13.0)	55 (50.9)	6 (5.6)			
Good	1 (0.9)	12 (11.1)	0 (0)			
Excellent	0 (0)	0 (0)	0 (0)			
AD knowledge test score, <i>M</i> ± <i>SD</i> (max. /22)	11.85 ± 3.88	18.95 ± 2.39	17.04 ± 3.28	−21.357** [2.21]	3.264* [−0.70]	−6.022** [1.38]

Note. AD, autonomic dysreflexia. *ns* < 108, 108, and 23 for some variables in the second, third and fourth columns, respectively, due to non-responding. **P* = 0.004, ***P* < 0.001.

and scored, on average, 11.85 out of 22 on the AD knowledge test. Similar to findings from Jackson and Acland¹⁵ examining AD knowledge among ER nurses and physicians in New Zealand, these findings confirm that there is a gap in AD knowledge among ER HCPs working in three large Canadian cities. Closer examination of the items on the AD knowledge test score revealed that prior to the seminar, 43% of participants were not able to identify the correct definition of AD. Further, only 64% of participants could correctly identify the typical systolic blood pressure for a person with chronic tetraplegia, only 38% of participants could correctly identify three or more signs and symptoms of AD, and only 51% could distinguish the three most common causes of AD. As ER professionals are among the first to treat patients with SCI who present with AD, these results are alarming and suggest that formal training of staff, local evaluation of adherence to guidelines, and maintenance of competence are needed.

Participants had higher ratings of their AD knowledge from pre to post seminar, with over half of participants rating their post-seminar knowledge as “Fair.” Further, 80.6% of participants felt the seminar improved their knowledge of AD. Taken together, these findings suggest that “The ABCs of AD” educational seminar improves ER practitioners’ perceptions of their AD knowledge. These perceptions of enhanced AD knowledge at post-seminar were confirmed by significant large effect-size increases in AD knowledge test scores from pre- to post-seminar, indicating an increase in knowledge and understanding of the causes, signs, and symptoms, and management protocols associated with AD following the completion of the educational seminar. However, these results are not particularly surprising given that educational interventions, such as the seminars used in the current study, have been shown to be effective at imparting knowledge to attendees.^{16,17}

Unfortunately, these post-seminar increases in AD knowledge test scores were not sustained at 3-month follow-up, suggesting that the current version of “The ABCs of AD” seminar is insufficient for long-term knowledge retention. These findings are consistent with previous reviews demonstrating that traditional seminar-based educational interventions are not particularly effective at maintaining change in physicians’¹⁷ and allied health care professionals’²⁰ knowledge over time. “The ABCs of AD” seminar may benefit from the inclusion of additional active learning strategies (e.g. audience engagement, hands-on activities, multiple formats) and follow-up activities to enhance knowledge retention both in the short- and long-term.¹⁸

A strength of this paper is that it reports on the efficacy of an educational intervention aimed to increase HCPs’ knowledge of AD recognition, diagnosis, and management—the first intervention of its kind. The promising results from this study may have important practical implications for the care of Canadians with SCI. A second strength of this study is that it assessed current AD knowledge across Canada. By using a multi-center design, the study demonstrates that gaps in AD knowledge persist in various regions in Canada, providing impetus for future initiatives to be developed and disseminated to educate HCPs about AD recognition, diagnosis, and management.

Despite these strengths, two limitations should be noted. First, there was a low response rate at 3-month follow-up, with only 23 of the 108 participants (21.3%) completing the follow-up measure. However, Eccles and colleagues have reported similar response rates on questionnaires over a series of five studies, suggesting that the response rate in the current study is typical of studies using questionnaire measures among HCPs.²¹ A second limitation is that, despite the promising increases in both perceptions of AD knowledge and

AD knowledge test scores following attendance at “The ABCs of AD” seminar, knowledge alone is insufficient for practice change. Traditional didactic approaches, similar to the educational seminar delivered in this study, have been shown to improve knowledge, and thus awareness. However, educational seminars without practice-enabling or reinforcing activities have relatively little impact on changes in HCPs’ behaviour.²² The use of mixed interactive and didactic formats has been shown to be more likely to increase the effectiveness of educational interventions on practice behaviour.¹⁶ Further, emphasizing relevant, practical, and current information that meets the needs of the end-user group can further bolster the impact of an educational intervention on practice behaviour,¹⁸ suggesting that stakeholders be involved in development of intervention (c.f.,²³). Changes in policy surrounding the requirements for continuing education of ER professionals may also be required; for example, annual competency demonstrations of acquired knowledge may bolster long-term retention of and application of knowledge in practice.²⁴ Nevertheless, the current study provides a foundation for future initiatives that examine the effect of educational strategies for enhancing AD knowledge and management among HCPs.

Conclusion

“The ABCs of AD” educational seminar appears to increase HCPs’ knowledge of AD in the short-term, but not in the long-term. Despite these encouraging findings, large gaps in AD knowledge exist among HCPs in Canada, and increased education and knowledge transfer of evidence-based resources for the management of AD is required. Further, it is imperative that this happens on a larger scale in Canada to enhance the reach of the intervention to all HCPs who work with patients with SCI, including paramedics who are first responders to emergency calls, family physicians, community service providers, and families. Work is currently underway to translate the content contained in the educational seminar into an easily accessible online training module to enhance the dissemination of the AD clinical practice guidelines to a broader segment of HCPs.²⁵

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KE, and DKE obtained ethics approval at their respective institutions. MP, MG, MF, DKE collected the data. JRT, MP, and KAMG analyzed and interpreted the data. AK, JRT, MP and KAMG wrote the article in parts. All authors revised the article and approved the final version before submission.

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