

Case Study 4

43 year old male, roll-over collision, depression and ETOH premorbidly, RLA-5, argumentative.

4.1 Glasgow Coma Scale

Q1. Is the Glasgow Coma Scale as determined in the field predictive of outcome?

4.2 Multiple Focal Brain Lesions

Q2. Describe the most likely reason for the multiple brain lesions.

Q3. What would be the likely focal contusions suffered after TBI? How would they effect rehabilitation?

4.3 Admission to Rehabilitation

4.3.1 Admission to an ABI Rehabilitation Unit

Q4. What is the evidence for admitting the patient immediately to an inpatient rehabilitation unit?

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Q5. List some of the benefits of early admission of an ABI patient to rehabilitation.

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Q32. What is the evidence for the use of cholinesterase inhibitor in treatment of attention disorders following TBI?

4.9 Rehabilitation of Learning and Memory Deficits Post ABI

Q33. Design a program for this patient's learning and memory deficits.

Case Study 4

Case Study

A 43 year old divorced male, involved in a roll-over car crash, was not wearing a seat belt. Upon arrival at the local emergency room, he was diagnosed with a traumatic brain injury. Glasgow Coma Scale (GCS) was 6, but it was found to be 9 shortly afterward. RLA-V.

4.1 Glasgow Coma Scale

Q1. Is the Glasgow Coma Scale as determined in the field predictive of outcome?

Answer

1. Higher initial GCS scores tend to predict better recovery.
2. However, prediction of prognosis and severity may be improved by considering the CT scan results and other factors.
3. Hypoxia and hypotension can decrease the GCS; therefore, GCS values after resuscitation from cardiopulmonary insults are more specific.
4. Sedative medications can decrease GCS values and should be used only after full neurological evaluation (Koch et al. 2007).

Discussion

Over the years, the GCS has remained the most popular tool used to assess the level of consciousness for those who sustain a head injury (McNett, 2007). Emergency service responders, the first on scene, are generally the first to assess an individual using the GCS. The GCS is used to decide what treatment protocols should be followed, prior to the patient arriving at hospital. Even though the GCS has been shown to predict mortality and morbidity in the acute phase post injury, it remains unclear as to the GCS ability to predict functional outcomes during rehabilitation (Zafonte et al., 1996).

Case Study 4 (continued)

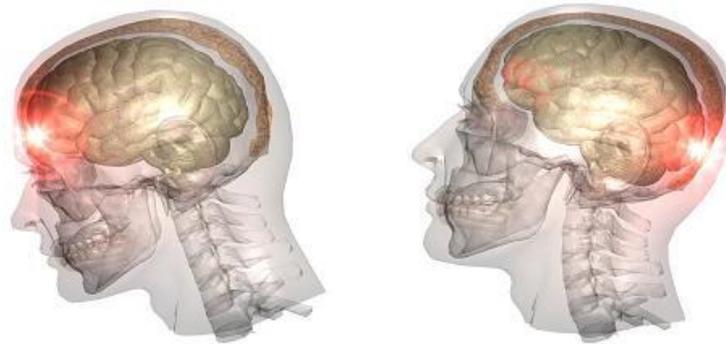
Medical reports received at the rehab hospital revealed the patient had multiple focal brain injuries and memory problems.

4.2 Multiple Focal Brain Injuries

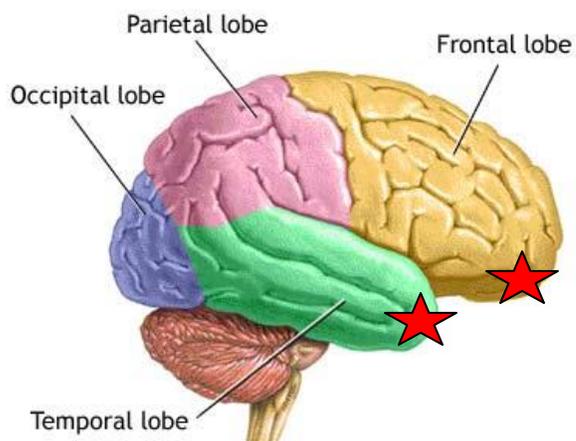
Q2. Describe the most likely reason for the multiple focal brain injuries.

Answers

1. The patient likely sustained a contra-coup injury.
2. Most commonly, bruising of cerebral (cortical) tissue on under surface of frontal lobe (inferior frontal or orbitofrontal area), and anterior temporal lobe, regardless of the site of impact.
3. Also damage to the occipital lobes on the contra-coup impact.
4. May produce focal deficits.
5. Not directly responsible for LOC following trauma.
6. May occur from relatively low velocity impact, such as blows and falls.



Coup (left) and contra-coup (right) brain injury



Q3. What would be the likely focal contusions suffered after TBI? How would they effect rehabilitation?

Answer

Frontal Lobe Dysfunction

- Difficulties with working memory, problem solving, behavioural, and executive function.
- Need for rehabilitation plan that provides external structure, organization, and multiple opportunities for learning because of the compromised learning abilities.

Temporal Lobe Dysfunction

- Impaired memory and difficulties with word finding.
- Rehabilitation planning must inherently address the need for multiple trials, to learn new pieces of information and teach strategies to deal with memory difficulties.

4.3 Admission to Rehabilitation

Case Study 4 (continued)

A request was put in place for admission to rehabilitation. The patient was still agitated and aggressive. The question arises as to whether he should wait until he is admitted to an inpatient rehabilitation unit.

4.3.1 Admission to an ABI Rehabilitation Unit

Q4. What is the evidence for admitting the patient immediately to an inpatient rehabilitation unit?

Answer

1. There is no level 1 evidence (from at least one RCT) as to the efficacy or lack thereof of ABI rehabilitation units.
2. There is some level 4 evidence that inpatient rehabilitation improves self-care and mobility.
3. There is level 2 evidence that inpatient rehabilitation significantly improves functional outcome, as measured by the FIM.

Discussion

Sahgal and Heinemann (1989) conducted a pre-post study on 189 patients with TBI admitted to a National Institute on Disability and Rehabilitation Research-Designated Center in the USA. Using a locally developed functional rating scale as the main outcome measure, the authors noted improvements in the patients for self-care and mobility after discharge from the comprehensive multidisciplinary program. Two case series evaluated patients' functional outcome after discharge from inpatient rehabilitation. Both used the Functional Independence Measure (FIM) as one of their main outcome measures, and both

noted significant improvements for patients on FIM measurement (Gray & Burnham, 2000; Whitlock, Jr. & Hamilton, 1995).

4.3.2 The Benefits of Early Admission to Rehabilitation

Q5. List some of the benefits of early admission of an ABI patient to rehabilitation?

Answer

1. Better outcomes overall
2. Improved functional outcomes
3. Shorter overall length of stay
4. Decreased overall costs
5. Higher cognitive levels at home
6. Greater likelihood of discharge to home

Discussion

Early onset of therapeutic interventions for those who have sustained a traumatic head injury is beneficial. Several studies have shown that introducing a rehabilitation program during the acute phase assists in the overall recovery of individuals with a TBI (Heinemann et al., 1990; Cope & Hall, 1982a; Blackerby, 1990). Cope's (1995) review concluded that those who receive early intervention have better outcomes than those who do not. Wagner et al. (2003) examined the proper timing for physical medicine and rehabilitation consultation. Using multivariate analysis, the authors found that when PM&R consultations occurred earlier (< 48 hours after hospital admission), patients experienced significantly better FIM scores with transfers, locomotion, and significantly shorter lengths of stay ($p = 0.001$). Edwards et al. (2003) compared 26 patients admitted to inpatient rehabilitation more than 200 days after injury to 264 patients admitted to inpatient rehabilitation less than 200 days after injury. Discharge BI and FIM scores were lower in the former group than in the latter (11 vs. 14 and 77 vs. 92 respectively). However, the differences were not significant. Rehabilitation length of stay was also similar for the two groups.

Mackay et al. (1992b) assessed the timing of inpatient rehabilitation during the earlier phase of recovery in their cohort study. They compared a formalized program (average of 2 days to initiation of therapy) with a non-formalized program (average of 23 days to initiation of therapy) using co-relational analysis. The number of days in coma, length of stay, cognitive levels, and discharge disposition were used as the main outcome measures. Overall, starting rehabilitation early was associated with shorter comas and lengths of stay, higher cognitive levels at discharge, and a greater likelihood of being discharged to home. High et al. (2006), in a study of TBI patients, examined the amount of time that lapsed from diagnosis of injury to the start of rehabilitation and its effect on outcomes of rehabilitation. They found that those who began treatment within six months of their TBI scored higher on the disability rating scale indicating a decrease in their disability. These results were not noted for the other two groups. The supervision rating scale scores decreased for all groups, which indicated that they required less supervision after admission to rehabilitation. When tested again at follow up post discharge, a decrease in supervision was noted once again. When analyzing the results of the community integration questionnaire, an increase in scores could be seen from admission to discharge from the program for all groups.

Semlyen et al. (1998) divided 53 subjects into two groups; the first was those that received treatment (experimental group), and the second was those who did not (control group). The authors found that those who received early rehabilitation not only showed gains throughout the intervention phase, but were able to maintain these gains after the intervention phases had come to an end. Overall, the intervention group demonstrated an improvement on FIM, Barthel, and the Newcastle Independence Assessment Form (NIAF), as opposed to those in the control group who did not receive the early intervention. Mackay et al. (1992a) and Cope and Hall, (1982b) found that those who were involved in rehabilitation earlier in the recovery stage were discharged from hospital earlier than those who were not involved in the early rehabilitation program. Aronow (1987) found that although there was no statistically significant differences on the individual outcomes, there was a cost savings favoring those who were subjected to early interventions.

4.4 Alcoholism

Case Study (continued)

Upon questioning the family, it was revealed that the patient had a history of depression. Although Celexa (20 mg daily) had been prescribed to treat the depression, the patient had not been compliant with the doctor's recommendation. Prior to the accident, the patient drank at least 6 beers each day, and a case of 24 beers on the weekends. He lives alone, and his eating habits are poor.

4.4.1 Complications of Alcoholism

Q6. Provide a potential list of problems arising out of the patient's history of alcoholism and depression.

Answer

Given the patients history of alcohol abuse and depression, issues that might be seen include the following:

- Withdrawal from alcohol
- Malnutrition, or nutritional deficiencies
- Vitamin B1 and B6 deficiencies
- Noted increase in depressive symptoms, as they are no longer masked by an alcohol dependency

4.4.2 Thiamin Supplementation

Case Study (continued)

Once in rehabilitation, Vitamin B 1 was administered to boost thiamin.

Q7. Why would thiamin be important in this case?

Answer

1. Vitamin B1 is an essential vitamin obtained through diet.
2. Alcoholics frequently suffer from thiamine deficiency
3. Prolonged lack of thiamine can affect the brainstem, cerebellum, thalamus, hypothalamus, and mamillary bodies.

Q8. How does alcoholism induce thiamin deficiency?

Answer

1. Alcoholism may contribute to thiamine deficiency by causing an inadequate nutritional intake, by decreasing the absorption of thiamine from the gastrointestinal tract, and reducing its uptake into cells.
2. Alcoholism may also lead to an impaired utilization of thiamine in the cells (Martin et al., 2003).

Discussion

Thiamin (vitamin B1) is an essential vitamin which is not produced in the body, and must be ingested with our diets. Currently, it is recommended adults consume a minimum of 1mg of thiamin per day (Butterworth, 2003); however, it has been found that alcoholics have a tendency to consume less than 0.29 mg/1000 Kcal of thiamin (Neville et al., 1968). Alcoholism may further contribute to thiamine deficiency by decreasing the absorption of thiamine from the gastrointestinal tract, and reducing its uptake into cells. Alcoholism may also lead to an impaired utilization of thiamine in the cells (Martin et al., 2003). Areas of the brain that may be affected by a thiamin deficiency include the brain stem, cerebellum, thalamus, hypothalamus, and mamillary bodies (Martin et al., 2003). Therefore, when an alcoholic with a brain injury is admitted to rehabilitation, there should be a high suspicion for malnutrition in general, and thiamine deficiency in particular. Therefore, the patient should be assessed clinically for the presence of anemia, a serum vitamin B12 level, and a thiamine (vitamin B1) supplementation (50 – 100 mg per day) should be initiated. A daily multivitamin/mineral supplement should also be considered.

4.5 Assessment of Agitation and Aggressive Behaviours

Case Study (continued)

The patient was admitted. He was noted to be restless, aggressive, argumentative, and experienced sleep disturbance. He often wandered about in the middle of the night. A 24-hour sleep record was ordered, and maintained for the next 7 days, to allow for staff to assess the patient's sleep patterns. Behaviour logs were ordered to assess what behaviours were being seen and what might have been triggering them. He constantly wanted to go home. When told he could not go home he would become very

anxious and would then suffer sudden unpredictable outbursts of anger characterized by loud verbal arguing and making threatening gestures. Other times he would just lie curled up in his bed and would refuse to participate in his therapies.

Q9. What is agitation, and why is it important?

Answers

1. Agitation is often displayed as physical or verbal aggressiveness, explosive anger, increased psychomotor activity, impulsivity, restlessness, etc.
2. High levels of agitation associated with poorer recovery and a delay in return to work.

Discussion

Agitation is one of several behaviours observed in those who have sustained a brain injury. Agitation can be difficult to define, as it is variable, subjective, and often dependent on context and the observer. Agitation itself has been described as a single construct, but is often displayed as physical or verbal aggressiveness, explosive anger, increased psychomotor activity, impulsivity, restlessness etc. (Bogner & Corrigan, 1995; Fugate et al., 1997). Therefore, agitation may be associated with behavioural observations of dysphoria (mood disorder), anxiety, restlessness, frustration, mood lability/irritability, physical violence, and threats/acts of self-harm. Poor recovery and a delay in the return to work have been associated with higher levels of agitation in the early recovery periods post ABI/TBI, and are typically seen in those who have sustained an ABI.

Q10. What would be involved in assessing the patient who appears agitated?

Answer

1. Behavioural assessment: Longitudinal assessment with behavioural mapping, and specific descriptions of behaviours (situation, precipitant, behavior, response, effectiveness).
2. Psychiatric assessment to rule in/out psychiatric or cognitive sequelae of the TBI.
3. Rule out other physical causes through physical assessment and diagnostic testing.

Discussion

Agitation is not indicative of a specific neuropsychiatric diagnosis, or particular pathophysiological process. Therefore, the patient must be assessed to rule in/out various contributors. Approximately one-third of TBI patients have agitation or aggression in the first year post-injury (Kim & Bijlani, 2006). Features associated with agitation or aggression includes the following: 1) frontal lobe injury; 2) premorbid substance use and aggressive behavior; 3) possibly associated with cognitive impairment.

4.5.1 Causes of Agitation

Q11. In chronic TBI, agitation could be due to a number of “psychiatric” causes. List them.

Answer

- Depression
- Mania
- Anxiety “free-floating” or specific symptoms (obsessions/compulsions, panic disorders, PTSD)
- Psychosis
- Cognitive impairment
- Frontal lobe syndromes
- Substance/Medication-induced (antipsychotics, benzodiazepines, ongoing substance abuse)

Q12. In chronic TBI, agitation could be due to a number of “non-psychiatric” causes. List them.

Answer

- Uncontrolled seizures
- Endocrine (anterior pituitary) dysfunction
- Pain
- Dental problems
- Uncontrolled/disinhibited appetite/sexual behavior
- Incontinence, constipation, retention, UTI
- Skin breakdown
- Can be complicated by difficulty communicating, vision, or hearing impairment

It is not unusual for multiple factors (psychiatric and non-psychiatric) to co-exist.

Q13. What assessment tool could be used to assess his agitated behavior?

Answer

The Agitated Behavior Scale (ABS).

4.5.2 The Agitated Behavior Scale (ABS)

Q14. Describe the Agitated Behavior Scale, including advantages and disadvantages.

Answers

1. The ABS is a 14 item scale, with each item scored from 1 (absent) to 4 (present to an extreme degree).
2. Designed to be done by those working with agitated patients.
3. Advantages include the short length of the scale (14 questions), short amount of time to complete it (<30 minutes), and its availability. These advantages make the scale very practical.
4. Limitations include the risk of overdiagnosis of agitation (Corrigan & Mysiw, 1988)

Discussion

To measure agitation post-injury, the Agitated Behavior Scale was developed (Bogner & Corrigan, 1995). The ABS was designed to assess agitation in patients by those working with them. The scale, which began as a 39 item scale, was reduced to 14 items, with each item scoring 1 to 4, (from absent to present to an extreme degree). The scale was originally tested by nurses, occupational therapists (OT), physiotherapists (PT) and other hospital staff, and was designed to be used by allied health professionals (Corrigan, 1989a). According to Levi et al. (2005), despite the availability of the scale, agitation remains unmeasured by most who work with the TBI population.

Table 1: ABS Evaluation Summary

Reliability		Validity		Responsiveness		
Rigor	Results	Rigor	Results	Rigor	Results	Floor/ceiling
++	++(IO) ++(IC)	++	++			N/A

NOTE: +++=Excellent; ++=Adequate; +=Poor; n/a = insufficient information; TR=Test re-test; IC= internal consistency; IO = Interobserver;

Q15. What are some key threshold scores for the Agitated Behavioural Scale?

Answer

1. ABS >21 = agitation, <23 unlikely to be violent, >28 = treatment with pharmacological agents.

4.6 Management of Agitation and Aggression

Q16. Describe the principles of non-pharmacological measures for agitated and aggressive behaviour?

Answer

1. Reduce the level of stimulation in the environment
2. Protect the patient from harming himself or others
3. Reduce the patient's cognitive confusion
4. Tolerate restlessness when possible (i.e. limit physical restraints)

Discussion

Agitation or aggressive behaviours have been reported in approximately 33% to 50% of the ABI population, and last approximately 1 to 4 weeks. For those experiencing agitated behaviours, a quiet, safe and structured environment is been suggested (Elovic et al., 2004). If the patient becomes a danger to staff, family, or him/herself, then physical restraints may be necessary, but should only be used as a last resort and exercised with extreme caution. Restraints are not to be used as a substitute for one to one interventions, other environmental interventions, or modifications. Staff and family may also find it necessary to modify their behaviours (Elovic et al., 2004).

Environmental Management of Agitation (Bontke & Boake, 1996)

Reduce Level of Stimulation in the Environment

- Place patient in quiet private room
- Remove noxious stimuli if possible, tubes, catheters, restraints, traction
- Limit unnecessary sounds, television, radio, background conversations
- Limit number of visitors
- Staff to behave in a calm and reassuring manner
- Limit number of length of therapy sessions
- Provide therapies in patient room

Protect Patient from Harming Self and Others

- Place patient in a floor bed with padded side panels (Craig bed)
- Assign 1:1 or 1:2 sitter to observe patient and ensure safety
- Avoid taking patient off the unit
- Place patient in a locked ward

Reduce Patient's Cognitive Confusion

- One person speaking to patient at a time
- Maintain staff to work with patient
- Minimize contact with unfamiliar staff
- Communicate to patient briefly and simple, one idea at a time

Tolerate restlessness when possible

- Allow patient to thrash about in floor bed
- Allow patient to pace around the unit with 1:1 supervision
- Allow confused patient to be verbally inappropriate

4.6.2 Pharmacological Treatment of Agitated and Aggressive Behaviour

Q17. When non-pharmacological measures are unsuccessful which medications are recommended to decrease aggressive and agitated behaviours?

Answers

Initially

Atypical antipsychotics prn – Risperidone up to 3 gm daily; alternative Seroquel or Olanzapine

Later (if ABS \geq 28, then provide scheduled dose medications)

1. Beta-blockers
2. Anticonvulsants (i.e Valproic Acid)
3. SSRI (Sertraline)
4. Tricyclic antidepressants (Amtriptyline titrated up to 75 mg/day)
5. Methylphenidate
6. Avoid the use of antipsychotic drugs such as Haldol

Discussion:

Neuropharmacologic agents given early in the treatment of posttraumatic brain injury agitation may be an effective therapeutic intervention for both behavioral and cognitive problems. *Anticonvulsants and beta-blockers are the two classes of drugs most often recommended to treat agitation or aggression post injury. The best evidence of effectiveness in the management of agitation and/or aggression following ABI was for beta-blockers* (Fleminger et al. 2006). Although several other medications may be used such as Amantidine, Ritalin, Trazadone and Dexedrine more research is needed to determine their effectiveness and efficacy (Rosati, 2002). Despite the lack of research evidence, clinically, atypical anti-psychotic medications are frequently used early on because they act so quickly.

4.6.3 Evidence for Pharmacological Measures Used to Treat Aggressive Behaviors Post TBI

Q18. What medications are used to treat aggressive behaviours post ABI?

Answer

Medications to treat aggressive behavior post ABI		
Medication	Recommended Doses	Level of Evidence
Divalproex		Level 4
Carbazepine	400 mg -800 mg per day for 8 weeks	Level 4
Lamotrigine	25 mg daily	Level 5
Pindolol	60 mg -100mg/day	Level 1
Propranolol	520 mg/day 60 mg -420 mg/day	Level 1
Methotrimeprazine	2-50 mg, 2-4 times per day	Level 4
Droperidol	2.5-5 mg IM	Level 4
Haloperidol	1-6 mg	Level 4
Quetiapine	25 to 300mg	Level 4
Sertraline HCH	50 mg- 200 mg per day	Level 4
Amantadine	100-300 mg per day	Level 4
Trazadone	150 to 400 mg per day, for seniors start at 75 mg day	Level 4
Lithium carbonate	150 to 300 mg TID, (monitor serum levels, should be drawn every 2 months)	Level 5

The ABIKUS (Bayley et al. 2007) was a consensus driven document; the ERABI dealt with the published research. A comparison of the two is shown in the table below:

Medication to treat Aggression Post ABI: A comparison of the findings from ABIKUS and ERABI		
Medication	ABIKUS	ERABI
Valproic Acid and Divalproex	Recommended	Level 4 evidence for Divalproex
Methylphenidate	Recommended	No evidence
SSRIs	Recommended	No evidence
Beta-Blockers	Recommended	No evidence
Tricyclic antidepressants	Recommended	Level 4 evidence for Trazadone
Amantadine	No comment	Evidence is uncertain
Methotrimeprazine	No comment	Level 4 evidence
Other Anticonvulsants	No comment	Level 4 evidence for Carbamazepine
Lithium carbonate	No comment	Level 4 evidence

4.7 Management of Sleep Disturbance

Q19. What medications would you recommend to help him sleep?

Answer

1. Medications of choice would be benzodiazepines (Lorazepam and Zopiclone have had the most research conducted on them).

Discussion

The following medications may be prescribed for sleep:

Diazepam (Valium Oral) is benzodiazepine which provides sedation, is used to treat muscle spasms, enhancing the effects of gamma-amino-butyric acid (GABA). Diazepam is not useful to treat cognitive and attention disorders for patients with TBI (Mayer et al., 2007). Diazepam can be used as treatment for patients who have sleep walking and night terrors (Thaxton & Patel, 2007).

Li Pi Shan & Ashworth (2004) conducted a randomized, crossover, double-blind trial of **lorazepam and zopiclone** for a group of stroke and TBI patients. The patients were divided into one of two groups. One group received lorazepam orally in the evening (0 to 1mg/daily PRN), and the second group received zopiclone orally (3.75 to 7.5 mg/daily PRN). There were no differences reported in the length of sleep, on quality of sleep, depth of sleep, feelings of being refreshed, or alertness in each group. There was no significant difference in the MMSE cognitive scores over the course of the study. The ERABI reported there was Level 1 evidence that there is no difference between the effectiveness of lorazepam and zopiclone for insomnia symptoms post ABI (Aubut et al., 2008).

4.8 Cognitive Rehabilitation

Case Study 4 (continued)

In rehabilitation, the patient had difficulty making decisions, solving problems, and processing information presented to him visually. He has significant memory problems, in particular short-term memory. He was an RLA-V. The question arises as to whether he would benefit from cognitive rehabilitation.

4.8.1 Cognitive Rehabilitation Therapy

Q20. What is the evidence for cognitive rehabilitation therapy post ABI?

Answers

1. There is conflicting evidence that a cognitive rehabilitation program focusing on memory strategies and selective attention will have a significant benefit relative to controls.
2. There is Level 4 evidence that general cognitive rehabilitation therapy post acquired brain injury is effective for improving cognition. Although there are variable strategies and protocols for cognitive rehabilitation, all comprehensive interventions appear to provide benefit.
3. There is Level 4 evidence that working memory training is effective in recovering the central executive system of working memory.
4. There is Level 4 evidence that an outpatient day program is effective for assisting brain injury survivors in returning to competitive employment.

Discussion

Gordon et al. (2006c) conducted an extensive review of the traumatic brain injury rehabilitation literature and identified 13 studies dealing with rehabilitative treatments of cognitive deficits (Table 6.18). A comprehensive literature search of MEDLINE, CINAHL, and PsychINFO databases was performed. Gordon et al. (2006a) included studies based on several inclusion criteria: more than 20 participants with TBI and 20 controls, the sample was comprised of more than 75% adults, and more than 75% of the participants were individuals with TBI.

Fourteen studies examined the effects of cognitive rehabilitation strategies. Cicerone et al. (2000d) had concluded that comprehensive-holistic cognitive rehabilitation should be recommended as a practice guideline for patients with either a stroke or acquired brain injury. Since completion of this review, further quality studies have been published supporting a general cognitive therapy approach following acquired brain injury. In the studies by Drette et al. (1999), Rath et al. (2003) and Cicerone et al. (2004a) comparisons of specific strategies using experimental techniques (randomized and non-randomized) are attempted. All groups demonstrated benefit from the interventions, and in the studies by Rath et al. (2003) and Cicerone et al. (2004b), there were overall trends in improvement for the experimental groups. The study by Salazar et al. (2000) provides contradictory results to these other studies in that no benefit was demonstrated for an intensive in-patient rehabilitation program, versus a limited home based rehabilitation program. This study was

a RCT, and challenges the trend of studies demonstrating the benefit of intensive cognitive rehabilitation programs. Comparison of cognitive rehabilitation strategies against a non-intervention group has been generally considered unethical supporting the general held belief that cognitive rehabilitation is effective. Therefore, trials such as these which compare different cognitive therapy strategies remain necessary to optimize rehabilitation outcomes.

Although there are differences in the delivery techniques of cognitive rehabilitation therapy, most studies considering within-group comparisons demonstrated an overall improvement in cognitive abilities across multiple cognitive domains. The majority of the studies included patients greater than one-year post injury, which would assist in controlling for the effects of spontaneous recovery. There are limitations in most studies because typically a time series design is used with pre- and post-intervention testing, where the subject acts as their own control. The primary limitation with regards to brain injury rehabilitation is time-dependent confounding. Two factors contribute to this, including anticipated spontaneous recovery, as well as the consideration of the practice/ learning effect of repeat neuropsychology testing which may lead to higher scores.

Analysis of findings from the current review as well as those from Cicerone et al. (2005d) and Gordon (2006b) all suggest that future studies need to control for patient characteristics (e.g., level of impairment needs to be clearly defined, not just severity of injury), spontaneous recovery and practice effects on outcome measures used. Studies should not just rely on psychometric tests, but should consider functional outcome measures and long-term effects of treatment interventions should be monitored through follow-up.

Q21. Describe the recommendations for Cognitive Rehabilitation Post ABI

Answer

1. Moderate to severe ABI patient should have a cognitive function assessment.
2. Therapeutic interventions should include activities that are meaningful to the patient and can be applied to the patient's home environment.
3. Strategy training across all cognitive domains is recommended during postacute rehabilitation for persons with TBI

According to ABIKUS Recommendations (2007):

Cognitive Rehabilitation

All patients after moderate to severe ABI should be referred for neuropsychology, occupational therapy, and speech language assessment to evaluate cognitive functioning. (ABIKUS C) (G32-p.21)

The treatment team should be multidisciplinary and based on the individual's developing needs as determined by initial and ongoing assessment and goals. (ABIKUS C) (G33-p.21)

In order to facilitate/achieve generalization of skill/strategies to daily activities, rehabilitation should:

- *Focus on engaging in activities that are perceived as meaningful*

- *Include therapy interventions in the affected person's own environment and/or application to the person's own life (ABIKUS B) (G34-p.21)*

Strategy training across all cognitive domains is recommended during postacute rehabilitation for persons with TBI (ABIKUS A, adapted from Cicerone et al. 2005) (G35-p.21)

Cognitive rehabilitation should include the use of periodic, random auditory alerting tones to improve sustained attention in subacute ABI/TBI. (ABIKUS A, adapted from Cicerone et al. 2005) (G36-p.22)

4.8.2 Remediation of Attention Deficits

Case Study 4 (continued)

In rehabilitation, the patient has difficulty focusing his attention. This is having a negative impact on his rehabilitation because he is easily distracted and has trouble focusing on various tasks.

Q22. What is the evidence for remediation of attention deficits following a brain injury?

Answer

1. Strategy training is recommended for improvement of attention deficits following TBI.

Discussion

Evaluating the efficacy of remediation or rehabilitation of attention deficits following a brain injury is complicated by a number of factors. First, there is no consensus regarding a definition of attention. Is it a general construct, or does it reflect more specific sub-components or systems of functioning (e.g., sustained, divided, focused, selective, vigilance, speed of information processing, etc)? Second, different researchers and clinicians will report using the same or similar tests to measure different aspects of attention. Third, a study may use the same outcome measures repeatedly, thereby confounding practice and treatment effects (e.g., PASAT performance improves significantly with repeated exposure to the test). Finally, studies may not consider and account for the rate of spontaneous recovery following brain injury (i.e. Would participants naturally show recovery of function in the absence of treatment?)

Comparing the efficacy of various remediation efforts is also complicated by cross-study variability in treatment duration (e.g. from 30 minutes once a day for 5 days to 5 hours, every day for 6 weeks). Severity of injury, and time since injury, may fluctuate from study to study.

Cicerone et al. (2000c) reviewed 13 studies investigating the effectiveness of attentional retraining interventions during rehabilitation following traumatic brain injury and stroke. In

2005, five studies were added specific to the TBI population. Cicerone et al. (2005c) recommended strategy training for persons with TBI for improving deficits of attention. However, it should be noted that there was insufficient evidence to distinguish the effectiveness of specific attention training during acute stage rehabilitation from improvements made from spontaneous recovery, or from more general cognitive interventions (Cicerone et al., 2005a).

Case Study 4 (continued)

The patient did not respond to cognitive rehabilitation, and still had severe attention deficits. It was suggested that pharmacological measures may help.

4.8.3 Donepezil

Q23. What is the evidence for the use of a cholinesterase inhibitor in treatment of cognitive disorders following TBI?

Answer

1. There is level 1 evidence, based on a single RCT, that Donepezil improves attention and short-term memory.

Discussion

The effectiveness of the cholinesterase inhibitor, Donepezil, for improving cognitive functioning following brain injury was assessed in one study. Zhang et al. (2004a) conducted a randomized placebo controlled double-blind cross-over trial of 18 post acute TBI patients which demonstrated that donepezil significantly increased scores on tasks of sustained attention, and short-term memory when compared to placebo. These improved results were sustained after the wash-out period.

4.8.4 Methylphenidate

Q24. What is the evidence for the use of methylphenidate in the treatment of cognitive disorders post TBI?

Answer

1. There is conflicting evidence regarding the effectiveness of the administration of methylphenidate following brain injury for the improvement of cognitive functioning.

Discussion

Methylphenidate is a stimulant whose exact mechanism is unknown (Napolitano et al., 2005b), although it is thought to act on the presynaptic nerve and acts to restrain the reabsorption of serotonin and norepinephrine (Kim et al., 2006b). Methylphenidate has been extensively used as a treatment for attention deficit disorder, as well as narcolepsy (Glenn, 1998).

Four randomized controlled trials examined the efficacy of methylphenidate as a treatment for the recovery of cognitive deficits post- brain injury. In a RCT examining the effects of methylphenidate, a psychostimulant on attention, Whyte et al. (2004b) indicated that speed of processing, attentiveness during individual work tasks, and caregiver ratings of attention were all significantly improved with methylphenidate treatment. No treatment related improvement was seen in divided or sustained attention or in susceptibility to distraction. Another RCT by Plenger et al. (1996) also found that methylphenidate significantly improved attention. Speech et al. (1993) conducted a double blind placebo controlled trial evaluating the effects of the stimulant medication methylphenidate following closed head injury. In contrast to the results noted by Whyte et al. (2004a) and Plenger et al. (1996) , methylphenidate did not demonstrate significant differences compared to placebo on measures of attention, information processing speed, or learning. Kim et al. (2006a) examined the effects of a single-dose treatment of methylphenidate and, although a trend was found in favour of improved working and visuospatial memory for the treatment group, these results did not reach significance.

Q25. What dose of methylphenidate is recommended in the treatment of cognitive disorders post TBI?

Answer

1. The recommended dose of methylphenidate is 0.25-0.30 mg/kg bid.

According to ABIKUS Recommendations (2007):

Medication for Attention and Arousal

Methylphenidate (0.25-0.30 mg/kg bid) is recommended in adults to enhance attentional function in the adult population. Methylphenidate (0.25-0.30 mg/kg bid) is also recommended to enhance the speed of cognitive processing, although only one study provides evidence to support a change in speed in a naturalistic task. (ABIKUS A, adapted from GPT, I, p.1482) (G44-p.23)

4.8.5 Treatment of Learning and Memory Deficits

Case Study 4 (continued)

The patient continues to have memory deficits. In particular, he experiences difficulties with short-term memory, which is interfering with progression of his rehabilitation.

Memory impairment is one of the most common symptoms following brain injury. It is estimated that time and cost of care would be reduced if effective medical treatments were found to improve memory (McLean, Jr. et al., 1987)

Q26. Describe the two major approaches to learning and memory deficits post ABI.

Answers

1. Restoration: remediation of memory deficits.
2. Compensation: circumventing the difficulty which arises because of the memory deficit.

Q27. What are different examples of these two approaches?

Answers

Restoration: remediation of memory deficits.

- External compensatory aids including computers, pagers and notebooks
- Individualized remediation programs
- Family/social support
- Environmental adaptations
- Didactic lessons and homework

Compensation: circumventing the difficulty which arises because of the memory deficit.

- Rehearsal
- Organizational strategies
- Visual imagery
- Verbal labeling
- Use of mnemonics
- Implicit memory tasks

Discussion

When evaluating intervention strategies to improve memory performance following brain injury, the literature indicates that there are two main approaches to rehabilitation: restoration or compensation. **Compensation** includes “training strategies or techniques that aim to circumvent any difficulty that arises as a result of the memory impairment.”

Compensatory techniques include internal aids, which are “mnemonic strategies that restructure information that is to be learned.” Various interventions have focused on: **1) remediation** of memory deficits in individuals with TBI, including external compensatory aids (computers, pagers, and notebooks), individualized remediation programs, family/social support and environmental adaptations, didactic lessons and homework; **2) compensatory strategies** including rehearsal, organizational strategies, visual imagery, verbal labeling, and use of mnemonics, as well as implicit memory tasks.

Cicerone et al. (2000b) reviewed 42 studies examining the effectiveness of various interventions to improve memory impairment following stroke and TBI (Table 6.6). It should be noted that studies were not included in our review if the population did not comprise of more than 50% brain-injured patients, or if the sample size (n) was less than 3. For this reason, only those studies dealing with moderate-to-severe brain-injured individuals are included in our review. Thirteen additional studies were added to the review in 2005 (Cicerone et al., 2005b).

In an updated review by Cappa et al. (2005) strategies used to improve memory deficits without the use of electronic, external aids were judged to be “possibly effective.” Specific learning strategies (e.g. errorless learning) were found to be “probably effective” depending upon the task used, the type of memory involved and the severity of impairment.

Several studies were identified examining interventions to improve learning and memory following acquired brain injury. Studies were categorized into the three groups: external aids used to enhance memory, internal strategies used during learning to enhance recall, and memory intervention programs consisting of a number of sessions.

4.8.6 External Aids for Remediation of Memory Deficits

Case Study 4 (continued)

The most commonly studied remediation approach is the use of external memory aids. The therapist recommended the use of a number of external memory aids.

Q28. What evidence is there for external memory aids?

Answers

1. There is conflicting evidence as to whether external memory aides are an effective strategy for memory-impaired individuals.

Discussion

External aids assist memory by use of external methods of recording and accessing information. In an updated review by Cappa et al. (2005), the use of external, electronic assistive devices were assessed as “probably effective.” Fourteen studies examined how external aids could be used to enhance memory following brain injury.

Wade and Troy (2001) used a case study to examine the use of cell phones as an effective memory aid for 5 moderately-to-severely memory impaired ABI individuals (as shown on testing and in everyday functioning as rated by a caregiver). Each phone was set up with a computerized system to send reminder messages that were specific to the individuals (e.g., upcoming appointments, to take medications, etc). The message was voice-activated by the recipient, it was preceded by the explanation that it was a recorded message and if the phone was engaged, the computer would continue to send the message until it was received (repeat at regular intervals until answered). The outcome measure was the percentage of success achieved on 4-5 items to be remembered independently over a 12-week period. Results showed improvement compared to baseline data (success ranged from 92-100% for the individuals).

Wright et al. (2001a) examined the effect of two pocket computer systems containing three memory aides: appointment diary, notebook, and a to-do-list with a group of 12 ABI participants (9 TBI, 2 ABI). The type of pocket computer was counterbalanced and

participants used each one for 8 weeks. No significant difference in use was found between type of pocket computer (they differed in terms of text entry – physical keyboard or touch-screen keyboard), and the majority (83%) used the three aids. Those participants who had previously used a memory aid made significantly more diary entries compared to those who had not previously used a memory aid. Severity of injury, as well as level of cognitive function, was not reported in this study. In another study by Wright et al. (2001b), findings were similar (i.e. no differences between computer systems in terms of use of memory aids).

Wilson et al. (1997) evaluated the efficacy of NeuroPage, a portable paging system, in reducing everyday memory problems in 15 ABI participants (10 TBI, 5 ABI). Using an A-B-A design, results indicated that all subjects significantly benefited from using the NeuroPage system and that following 12 weeks of use, performance remained at improved levels compared to baseline for another 3 weeks. Wilson et al. (2001) conducted a randomized controlled cross-over trial with 143 memory impaired patients, many having sustained a TBI. The objective for this study was to evaluate a paging system designed to improve independence in people with memory problems, as well as to reduce deficits in executive function. Results demonstrated that the pager system significantly increased patients' ability to carry out daily tasks, and successful task achievement was more efficient after the pager intervention was introduced.

Hart et al. (2002) used hand-held recorders to remind moderate-to-severely impaired patients of their therapy goals (within subject design). Six individual goals were determined and half were recorded onto a hand-held organizer with an alarm preprogrammed to review the goals 3 times a day throughout the week. The other half of the goals were not recorded but were summarized at the weekly clinical management meetings. Goals were correctly recalled when using the hand held recorder compared to when goals were reviewed. It should be noted that the study examined only if the goals could be elicited during recall (either free recall or cued) and did not examine whether the subjects actually followed through with their goals.

Burke et al. (2001) used a complex computerized tracking system (patient locator and reminder system – PLAM) to remind and direct 5 patients on an acute rehabilitation unit to their next therapy appointment. The electronic tracking system prompted patients 10 minutes in advance of their appointments and continued to do so until the patient started moving toward the therapy room. If patients were going in the wrong direction, the system would prompt them on how to get to the appointment, and would offer positive reinforcement as the patient made their way to the therapy room. Using a case series design, baseline data was gathered for a week and included the number of staff prompts needed to get the person to scheduled therapy and the time the person arrived at the therapy. Once the patients were introduced to the PLAM system, data was collected for a 3-day period. Results indicated that the subjects arrived earlier to their appointments and required fewer prompts (i.e. the number of sessions that did not require prompting increased from 7% to 44%).

Using a memory notebook as the external memory aid, Schmitter-Edgecombe et al. (1995) assigned 8 individuals with severe closed-head-injury and memory deficits into either a notebook-training group, or an interpersonal support group (control). Groups were matched on a number of demographic variables. Outcome measures included both performance on memory tests, as well as observation and responses to a questionnaire on everyday memory failures. Both groups received two 1-hour sessions per week for 8 weeks (16 sessions). Results indicated that on cognitive measures of memory functioning, there was

no difference between groups. However, on observed everyday memory failures (questionnaire), performance improved (i.e., less failures) following treatment although performance was not maintained at 6-month follow-up.

Zencius et al. (1991) used a case study to demonstrate that notebook training enhanced recall of components of homework assignments, as compared to baseline performance. However, no neuropsychological evidence of memory impairment or severity of injury was specified in the study. In an earlier study, Zencius et al. (1990b) also compared notebook strategy to other strategies and found it to be superior to other strategies.

In a randomized controlled trial, Watanabe et al. (1998) examined whether use of a calendar would enhance orientation following an acquired brain injury. Results indicated that the presence of a calendar did not enhance performance on a temporal orientation test (date and time). It is difficult to judge the outcome of this study as no scores were reported for either the control or treatment group, and it is not clear whether post-traumatic amnesia, and/or severity of injury had an impact on performance.

Owensworth and McFarland (1999) evaluated two different training approaches in the use a diary to compensate for memory problems. They randomly assigned 20 ABI volunteers (15 TBI; 5 ABI) to either a Self-Instructional Training (SIT) approach or to a task-specific learning approach. The Diary-SIT approach trains compensation using higher cognitive skills of self-regulation and self-awareness. Participants were taught to question themselves with the following script (WSCT): What are you going to do?; Select strategies; Check how it's working; and Try it out. By using this training approach, the researchers speculated that it provides direct, internal feedback, which can generalize to other situations involving memory. In contrast, the Diary-Only approach taught subjects how to use the diary. Results indicated that those in the Diary-SIT group made consistently more diary entries, reported a reduction in everyday memory problems, and made more positive ratings on treatment efficacy compared to the Diary-Only group.

Van den Broek et al. (2000) evaluated the effectiveness of the compensatory external aid called the Voice Organizer for five individuals following brain injury. All five participants benefited from the use of the Voice Organizer as measured by the Message-Passing Test. For four of five patients, there was no significant improvement or deterioration in positive or negative affect during the course of the study.

In a case series conducted by Manasse et al. (2005), subjects were exposed to 2 treatment measures to aid them in memory recall. The traditional treatment was designed to assist subjects with memory recall, by pairing pictures of staff with an imagery statement, while the real-world treatment consisted of name restating, phonemic cueing and visual imagery to assist subjects in remembering names. Results from the traditional treatment indicated that 2 of the 5 subjects mastered 6 names during treatment, 1 of the 5 mastered 3 names and 4 of the 5 mastered one of the names. During the cueing condition of the real world treatment sessions, only 2 names were consistently used by each subject. The visual memory program was the only program where subjects consistently used both target names. When questioned directly, 4 of the 5 subjects could consistently identify one or both of the target names. Because subjects did not use the names, it was not indicative of whether or not they knew them.

Cicerone et al. (2000a) recommended that the use of memory notebooks or other external aids "*may be considered for persons with moderate to severe memory impairments after TBI*

[and] should directly apply to functional activities, rather than as an attempt to improve memory function per se."

4.8.7 Internal Aids as a Compensatory Strategy for Memory Deficits

Case Study 4 (continued)

The therapist has been teaching the patient a number of internal memory aid strategies to assist with short-term memory recall.

Q29. What is the evidence for internal memory aids?

Answers

1. There is Level 2 evidence from several studies that internal strategies appear to be an effective aid in improving recall performance.
2. There is Level 3 evidence from several case-control studies that internal strategies appear to assist in improving recall performance.

Discussion

Four randomized controlled trials, seven prospective controlled trials (plus one follow up study), and three single group interventions examined the effect of strategy use on memory following brain injury.

Twum and Parente (1994b) randomly assigned 60 TBI patients into one of 4 groups (one control and three mnemonic strategy groups) counterbalanced. The researches demonstrated improved performance for subjects who were taught a strategy (either verbal labeling or visual imagery) while learning paired-associations. Treatment groups showed greater efficiency in learning and greater delayed recall information.

Ryan and Ruff (1988) used mnemonic strategies, including visual imagery in a memory group and found that these strategies enhanced performance for mildly impaired subjects only (severely impaired group showed non-significant findings between control and treatment groups). Thoene and Glisky (1995), using a case series design also showed enhanced performance following the use of a mnemonic strategy (verbal elaboration and visual imagery) as compared to vanishing cues and/or video presentation during paired associations.

Goldstein et al. (1996) and Malec et al. (1991) evaluated a visual-imagery technique ("Ridiculously Imaged Story" technique (RIS)) in training severely brain injured individuals to learn and recall lengthy word lists. Participants were asked to read a story where 20 words are presented in bold-face, and subjects were instructed to remember the bold-face words for later recall. If subjects could not recall all the words they were provided with (1) the part of the story in which the word appeared, and if that didn't aid recall, they were then provided with (2) a category cue for the word. It should be noted that in both studies reviewed, a number of their subject pool (N=10) came from a previous study (Goldstein et al., 1988).

Goldstein et al. (1996) evaluated whether there were differences between a computerized and non-computerized version of RIS and another visual imagery technique (Pictorial Imagery). Results indicated that although the computerized versions resulted in a slightly better performance on learning trials, the difference was non-significant. Malec et al. (1991) used the RIS technique to examine the predictors of memory training success and found that the *“better subjects did at tasks similar to those which they were trained, the better their learning and capacity to generalize.”*

By using the various visual imagery techniques to aid learning and recall, researchers have demonstrated that increasing the saliency of features encoded, results in an increase in the amount recalled. Milders et al. (1998) examined performance on a name learning task by increasing the meaningfulness of people’s names with various strategies (e.g. when learning a new name-face association try to think of an occupation or object with the same name or a famous person with a similar name etc). When subjects (13 severely TBI vs. 13 matched controls) were tested on 3 different memory tasks, results indicated a significant difference following training, more so for the control group than the TBI group. Also, learning procedures were more effective on one task (where subjects were required to learn the name-occupation-and town) compared to the other two tasks (famous-faces or name learning), which supports Malec et al. (1991) findings of generalization when tasks are similar. Goldstein et al. (1990) found that semantic processing aids recognition of to-be-recalled words compared to processing words at a more perceptual level in both closed head injury patients and control subjects (of course the degree of facilitation is reduced in the TBI group compared to controls).

Zencius et al. (1990a) examined the differential effects of various strategies on recall of information. Six TBI patients were asked to find two jobs from the help wanted column of a newspaper extracting 3 pieces of information for each job. They were asked either to learn the information for later recall using one of the following strategies: verbal rehearsal, written rehearsal, acronym formation, or notebook logging. All strategies resulted in improved performance (number of information correctly recalled) with the exception of written rehearsal (performance similar to baseline). Notebook logging resulted in the best performance.

Berg et al. (1991) demonstrated that severely brain injured patients demonstrated improved effects on objective measures of memory at 4 months following training in a strategy-use group as compared to a pseudo-treatment, and a no treatment control group. In the strategy group, individuals were taught general cognitive principles of memory functioning and aids (i.e., internal and external strategies were taught and practiced). In contrast, the pseudo-treatment group practiced memory games and tasks with no explanation. In a 4-year follow-up study Milders et al. (1995) demonstrated that the effects at 4 months were no longer evident at 4 years (all groups were equivalent).

How individuals learn (i.e., encode) information determines to a large extent what is later recalled. Twum and Parente (1994a) demonstrated that if an active strategy (either verbal labeling for visual information or visual imagery for verbal information) is taught to individuals while learning the paired associations, learning and recall is enhanced (i.e., fewer trials needed to reach criterion during learning and improved recall following a delay). Tailby and Haslam (2003) also examined how learning can improve or limit later recall of information. They had 24 ABI subjects matched on basis of age, gender, premorbid and current intellectual status divided into 3 groups based on performance of verbal memory (mild, moderate & severe). Each group (n=8) was randomly assigned to one of 3 learning

conditions: 1) errorless learning, self-generated; 2) errorless learning, experimenter generated; and 3) errorful learning. Results showed that regardless of severity level, subject recalled more information in the errorless learning conditions (with self-generated superior to experimenter generated) than in the errorful learning condition.

Constantinidou and Neils (1995) examined the effects of stimulus modality on verbal learning of patients with moderate-to-severe closed head injury and a matched control group. Results indicated that when information is presented visually (with and/or without auditory presentation of names) more information is learned than when information is presented within the auditory modality alone. As expected, patients learn new information at a significantly slower rate compared to controls.

Generally, it is thought that patients who experience post-traumatic amnesia (PTA) are not able to learn and retain new information, and as a result, cognitive rehabilitation is usually postponed until PTA has resolved. This tends to be true if using tasks of explicit or declarative learning and recall. Two studies were reviewed that reported that PTA patients were capable of learning and retaining new information when task demands were dependent on implicit/procedural learning. Glisky and Delaney (1996) evaluated implicit memory (priming using a stem completion task) and the use of vanishing cues when learning semantic information in a small number of TBI patients (n=8 & 4) who were still experiencing PTA and a matched control group. Findings revealed that learning and recall of information (once PTA has resolved) had occurred, albeit at reduced levels compared to controls. Ewert et al. (1989) also demonstrated procedural learning and retention in a group of 16 severely closed head injured participants and matched controls.

4.8.8 Memory Programs

Q30. What is the evidence for memory-retraining programs post ABI?

Answers

1. There is Level 2 evidence, based on a single RCT, that memory-retraining programs appear effective, particularly for functional recovery although performance on specific tests of memory may or may not change.
2. Mildly impaired patients appear to benefit more than severely impaired patients.

Discussion

Ryan and Ruff (1988) randomly assigned 20 severely brain injured individuals matched for age, gender, education, and time since injury, to either a memory retraining group or a psychosocial group (control). Treatment lasted for 6 weeks (4 days per week, 5.5 hours per day for each group). Initially, no differences were observed between groups on neuropsychological measures of memory. When groups were subdivided based on neurocognitive severity (mild vs. severe), results indicated that the mildly impaired group benefited more than the severely impaired group from memory retraining.

Freeman et al. (1992) conducted a matched-controlled treatment outcome study to evaluate executive and compensatory memory retraining in traumatic brain injured patients. 12 patients were included in this study; six who received remediation treatment, which involved

repeated presentation of various paragraphs, and six who received no treatment. A significant difference was found between the treatment group and the control group's post-training measures with the experimental group improving considerably more than the control group. Results suggest that memory remediation is effective for brain-injured patients with memory impairments.

Evans and Wilson (1992) examined the effects of a memory group that met weekly for 11 months (2 hours a week for approximately 48 weeks). Family and individuals reported an increase in using memory aides and strategies at 7 months and at 11 months compared to baseline (no objective measures were given and it is unclear if beneficial). Scores on neuropsychological measures of memory did not change over time. A main drawback of this study is the researchers' failure to describe the nature and content of the memory program.

Quemada et al. (2003) examined memory rehabilitation following severe TBI in 12 individuals (no controls). The program ran for 6 months (50 minute sessions 5 days a week for 5 months and then 3 days a week for one month) and followed a specified format utilizing behavioural compensation techniques, mnemonic strategies, environmental adaptations, and external and internal aides. Results indicated little improvement in standard measures of memory functioning, although patients and family members report meaningful functional gains (self-report and observed behaviour in everyday functioning).

Hux et al. (2000) examined the effect of training frequency on face-name recall. The study included 7 TBI patients with demonstrated memory impairment in a modified multiple-baseline design utilizing 3 training phases (daily sessions, twice a week session and 5 times a day). The phases were counterbalanced, thereby eliminating any order effect. Daily sessions as well as twice a week sessions were found to be more effective than sessions that occurred 5 times a day. Mnemonics and visual imagery strategies were effective for 4 of the 7 participants regardless of frequency of intervention sessions.

4.8.9 Pharmacological Intervention

4.8.9.1 Amantadine

Q31. What is the evidence for amantadine in treating memory deficits post ABI?

Answer

1. There is Level 4 evidence that amantadine does not help to improve learning and memory deficits based on the conclusions of a single group intervention study.

Discussion

Amantadine is a non-competitive N-methyl-D-aspartate receptor antagonist. Currently, it is used as an antiviral agent and as a prophylaxis for influenza A, for the treatment of neurological diseases such as Parkinson's Disease, and in the treatment of neuroleptic side-effects such as dystonia, akinesia and neuroleptic malignant syndrome (Schneider et al., 1999). It is also thought to work pre- and post-synaptically by increasing the amount of dopamine (Napolitano et al., 2005a).

One study was identified that investigated the effectiveness of amantadine as a treatment for the remediation of learning and memory deficits. Kraus et al. (2005) demonstrated that

the administration of amantadine over a 12-week treatment period does not improve measures of memory deficits or attention.

4.8.9.2 Donepezil

Q32. What is the evidence for the use of a cholinesterase inhibitor in treatment of attention disorders following TBI?

Answer

1. There is level 1 evidence, based on a single RCT, that donepezil improves attention and short-term memory.

Discussion

The effectiveness of the cholinesterase inhibitor, Donepezil, for improving cognitive functioning following brain injury was assessed in one study. Zhang et al. (2004b) conducted a randomized placebo controlled double-blind cross-over trial of 18 post acute TBI patients which demonstrated that donepezil significantly increased scores on tasks of sustained attention and short-term memory when compared to placebo. These improved results were sustained after the wash-out period.

According to ABIKUS Recommendations (2007):

Medication for Management of Memory

Donepezil (5-10 mg/day) is recommended to enhance aspects of memory function for patients with moderate to severe TBI in subacute and chronic periods of recovery (ABIKUS B, adapted from GPT, 1, p. 1482) (G39-p.22)

Methylphenidate in a dose of 0.30 mg/kg bid may be considered as an option to enhance learning and memory in persons who are within a few months of brain injury onset when other strategies are ineffective (ABIKUS B, adapted from GPT, 1, p.1483) (G40-p.22)

4.9 Rehabilitation of Learning and Memory Deficits Post ABI

Q33. Design a program for this patient's learning and memory deficits.

Answer

1. Cognitive rehabilitation should include the use of self instructional training/internal training (e.g. self cueing, self talk).
2. Cognitive rehabilitation should include the use of errorless learning for task specific learning for people with severe memory impairment.
3. The evidence for external aids is not very impressive
4. Pharmacological interventions do not appear to be overly impressive – the two drugs with some evidence of benefit include the anti-cholinesterases and methylphenidate.

Discussion

Not all patients respond equally to all intervention strategies and no study in the current review indicated whether severity of memory impairment (or memory profile) interacts with a particular external memory aid. Technology has increased the availability of external aids, although some seem more feasible to use than others (e.g., cell phones or hand-held recorders). Unfortunately, the studies reviewed did not specify the length of time subjects required to master compensatory strategies, or the nature of the long-term effects, if any.

Most studies examined only tasks of word list recall and paired-associate learning suggesting that the mnemonic strategies reviewed may not generalize to other types of information (particularly real-world or functional information outside the laboratory). Errorless learning appears to be one procedure that can be used to enhance learning conditions. One study highlighted the difference between severity of impairment and ability to benefit from internal strategies.

Frequency of intervention has an impact on learning and retention, although the exact parameters of this are unclear at the present time. The optimal duration of a program is also open for speculation. No studies reviewed examined the number of sessions required for memory groups to be effective and only one study evaluated a difference in effectiveness between mild and severely impaired individuals after sessions.

Pharmacologic interventions do not appear to be overly effective in improving learning and memory deficits, with perhaps the exception of anti-cholinergic esterase inhibitors.

According to ABIKUS Recommendations (2007)

Learning and Memory

Cognitive rehabilitation should include the use of self instructional training/internal training (e.g. self cueing, self talk). (ABIKUS A) (G37-p.22)

Cognitive rehabilitation should include the use of errorless learning for task specific learning for people with severe memory impairment. (ABIKUS B) (G38-p.22)

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