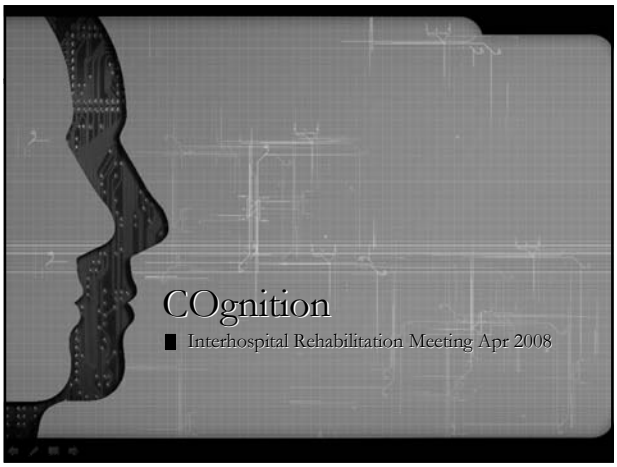

- Epidemiology of CO poisoning
- Cognitive impairment after CO poisoning
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Epidemiology

- Charcoal burning- second commonest method adopted by 15-55 yrs old (accounted for 1/3 suicide deaths since 2001)
- Incidence incr. from 6% to 28% between 1998 – 2001
- No accurate statistics on prevalence of attempted suicide
- Estimates from HA figures - 10 times the number of completed suicide occurring in the territory
- NTWC (3/05-2/07) : most of the CO poisoned (27/29) patients committed suicide

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Cognitive impairment after CO

Table 2. Human responses and approximate ambient CO air levels at various carboxyhemoglobin concentrations.

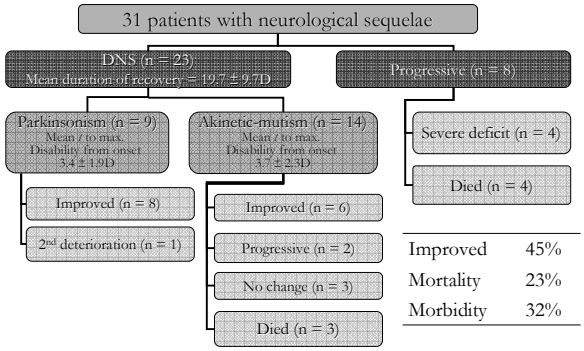
%HbCO	CO concentration producing HbCO saturation (ppm)*	Human responses and situations associated with HbCO levels
0.3–0.7	1–3	Normal range due to endogenous CO production
1–5	5–30	Selective increase in blood flow to compensate for reduced blood oxygen-carrying capacity; with advanced cardiovascular disease, cardiac reserve may be insufficient to compensate; major urban expressway CO levels may reach 25 ppm during peak traffic levels
5–9	30–60	Visual light threshold increased; chest pain occurs with less exertion in patients with angina pectoris; one to three pack per day cigarette smokers have similar HbCO levels
10–20	65–150	Slight headache; visual evoked response abnormal; may be lethal for those with severely compromised cardiac function; CO levels may exceed 100 ppm during weather inversions
20–30	150–300	Throbbing headache; fine manual dexterity abnormal; dizziness, hyperpnea, and palpitations with exertion
30–40	300–700	Severe headache; nausea; vomiting; confusion; increased heart and respiratory rates especially with exertion; syncope
40–50	500–700	Progressive worsening of all symptoms; vision, hearing, and intellect impaired; incoordination
50–60	700–1,000	Coma and convulsions
60–70	1,000–2,000	Coma, cardiorespiratory depression, lethal if untreated
94	10,000	Coma without headache, nausea, and vomiting
99	50,000	May induce fatal cardiac arrhythmia and death without significantly elevating carboxyhemoglobin

%HbCO, carboxyhemoglobin blood saturation. Data from O'Donoghue (8).
*Approximate CO concentrations producing noted blood HbCO saturation (ppm).

Cognitive impairment after CO

- Neuropsychiatric sequelae occurring in up to 67% of survivors
- Commonly categorized as:
  - Persistent neurological sequelae
    - 71% at discharge and 62% during FU
  - Delayed neurological sequelae

Disease course



Lee et al. Mov Disord. 1994 Sep;9(5):550-8

Delayed Neuropsychiatric Syndrome

- The onset was relatively sudden after the apparent clear period which ranged from 2 to 40 days (mean 22.5 days).

Min SK. Acta Psychiatr Scand. 1986 Jan;73(1):80-6.

- Delayed neurologic sequelae were diagnosed 2.75% of the total group
- Of 36 patients followed up for two years, 27 (75%) recovered within one year
- No clinical or laboratory results predict which patients are at risk for this complication, but advanced age appears to be a risk factor.

Choi IS. Arch Neurol. 1983 Jul;40(7):433-5.

Delayed Neuropsychiatric Syndrome

The most frequent symptoms were

- Cognitive
  - Apathy,
  - Dull facial expressions,
  - Dementia, such as amnesia and disorientation,
  - Mutism,
  - Irritable distractibility,
- Parkinson-like
  - Hypokinesia,
  - Urinary and/or fecal incontinence,
  - Gait disturbance and abnormal neurological signs and reflexes.

Delayed Neuropsychiatric Syndrome

- Parkinsonism was diagnosed in 9.5%
- All showed encephalopathy with mildly to severely impaired cognitive functions
- Levodopa and anticholinergic drugs were not effective.
- Of 16 patients followed up for 1 year, 13 (81.3%) recovered spontaneously within 6 months.

Choi IS. Eur Neurol. 2002;48(1):30-3.

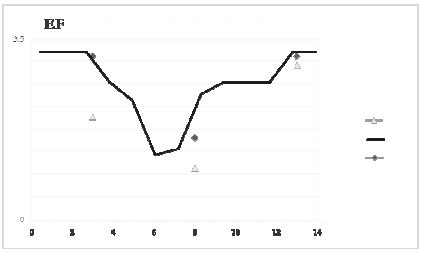
Chinese population

- Occurred from 14 - 45 D after recovery from the acute stage of initial impaired consciousness (1-7D)
- Manifestations included cognitive impairment, akinetic mutism, sphincter incontinence, gait ataxia and extrapyramidal syndromes
- MRI revealed lesions in the subcortical white matter and basal ganglia.
- The cognitive impairment improved greatly in the following few months, but the involuntary movements were improved only slightly.

Hsiao CL. Acta Neurol Taiwan. 2004 Jun;13(2):64-70.

Delayed Neuropsychiatric syndrome

- NTWC: 1/29 developed DNS
- However no formal cognitive screening for all patients



Commonly reported cognitive impairments

- Short term memory
- Poor attention and concentration
- Visual spatial ability
- Executive dysfunction
- Slow processing speed
- Parietal symptoms
  - Agnosia
  - Acalculia
  - Ideomotor apraxia
  - Ideational apraxia
  - Constructional apx

- Epidemiology of CO poisoning
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Pathophysiology

- Postmortem finding including petechial haemorrhage, multifocal necrosis and demyelination
- The regions most commonly involved include the globus pallidus and the deep white matter.
- The mechanisms are uncertain
- Tissue Hypoxia
  - Regions of vulnerability e.g. 2nd/ 3rd layer of cortex; white matter; basal nuclei and Purkinje cells of cerebellum
  - Competition to bounding of Hb
  - NO mediated vasodilatation

Pathophysiology

- NO mediated? Reoxygenation injury to the CNS
  - may be responsible for DNS
  - Thro its effort on the adherence of neutrophils to the endothelium via adhesion molecules
  - Neutrophil adherence to the microvasculature xanthine oxidase activation, oxidative radical formation, oxidative damage, and ultimately brain lipid peroxidation
  - Degradation of unsaturated fatty acids leading to reversible demyelination of CNS lipids

Pathophysiology

- Excitotoxicity (i.e., glutamate-mediated neuronal injury)
- Increased atherogenesis
- Involvement with cytochrome P-450, and
- Apoptosis

Kao LW. Emerg Med Clin N Am 22 (2004) 985–1018

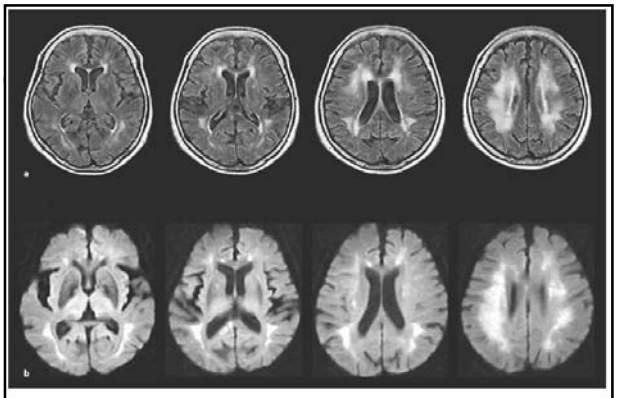

Fig. 1. Fluid attenuation inversion recovery (**a**), and isotropic diffusion-weighted (**b**) brain MR images of patient 1 on admission to our hospital. These images show extensive widespread hyperintense lesions in the cerebral white matter, globus pallidus, and the genu of the corpus callosum.

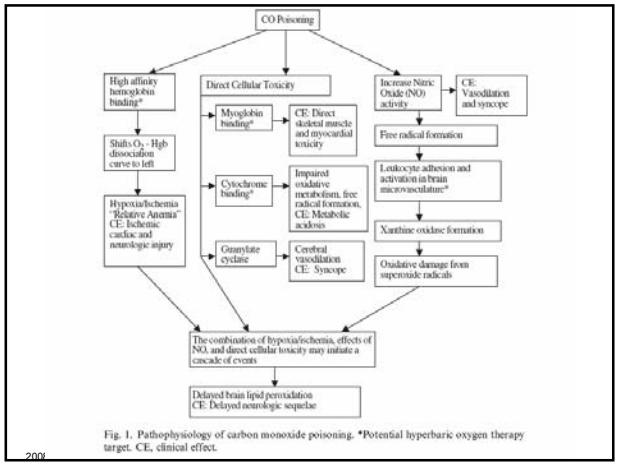

Fig. 1. Pathophysiology of carbon monoxide poisoning. *Potential hyperbaric oxygen therapy target. CE, clinical effect.

- Epidemiology of CO poisoning
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HYPERBARIC OXYGEN FOR ACUTE CARBON MONOXIDE POISONING

LINDELL K. WEAVER, M.D., RAMONA O. HOPKINS, PH.D., KAREN J. CHAN, B.S., SUSAN CHURCHILL, N.P., C. GREGORY ELLIOTT, M.D., TERRY P. CLEMMER, M.D., JAMES F. ORME, JR., M.D., FRANK O. THOMAS, M.D., AND ALAN H. MORRIS, M.D.

VOLUME 347 OCTOBER 3, 2002 NUMBER 14

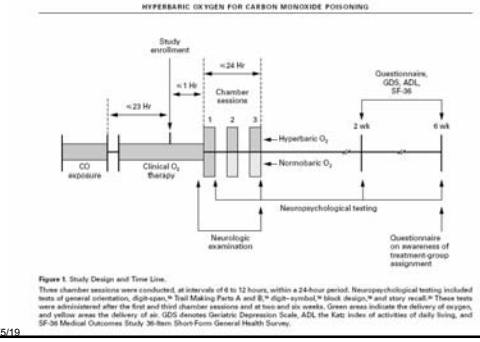


Figure 1. Study Design and Time Line.
Three chamber sessions were conducted, at intervals of 6 to 12 hours, within a 24-hour period. Neuropsychological testing included tests of general orientation, digit-span,* Trail Making Parts A and B,* digit–symbol,* block design,* and story recall.* These tests were administered after the first and third chamber sessions and at two and six weeks. Green areas indicate the delivery of oxygen, and yellow areas the delivery of air. GDS denotes Geriatric Depression Scale, ADL the Katz Index of activities of daily living, and SF-36 Medical Outcomes Study 36-Item Short-Form General Health Survey.

How the cognitive outcome be measured and compared?

- Convert scale into binary variable
- T score < -2 [2 SD below the mean of demographically corrected standardized T scores] for any single neuropsychological subtest
- If two or more subtests with T-score were > -1
- If the patient reported cognitive symptoms, then any single neuropsychological subtest with T-score < -1

TABLE 2. OUTCOMES AT 6 WEEKS, 6 MONTHS, AND 12 MONTHS AFTER ENROLLMENT.*

OUTCOME	HYPERBARIC-OXYGEN GROUP (N=76)	NORMOBARIC-OXYGEN GROUP (N=76)	UNADJUSTED ODDS RATIO (95% CI)†	P VALUE
	no./total no. (%)			
Cognitive sequelae				
At 6 wk				
Intention-to-treat population	19/76 (25.0)	35/76 (46.1)	0.39 (0.20–0.78)	0.007
Patients with complete data	18/75 (24.0)	31/72 (43.1)	0.42 (0.21–0.85)	0.01
Results on cerebellar testing before treatment				
Normal	16/69 (23.2)	23/59 (39.0)	0.47 (0.22–1.02)	0.05
Abnormal	1/3 (33.3)	9/11 (81.8)	0.11 (0.01–1.92)	0.18
At 6 mo				
Intention-to-treat population	16/76 (21.1)	29/76 (38.2)	0.43 (0.21–0.89)	0.02
Patients with complete data	10/58 (17.2)	21/59 (35.6)	0.38 (0.16–0.90)	0.03
At 12 mo				
Intention-to-treat population	14/76 (18.4)	25/76 (32.9)	0.46 (0.22–0.98)	0.04
Patients with complete data	9/62 (14.5)	18/66 (27.3)	0.45 (0.19–1.10)	0.08
Symptoms				
Reported by patient at 6 wk				
Difficulties with memory	21/75 (28.0)	37/72 (51.4)	0.37 (0.19–0.73)	0.004
Difficulties with attention or concentration	24/75 (32.0)	31/72 (43.1)	0.62 (0.32–1.22)	0.17

*The five patients who did not have data on neuropsychological tests at six weeks were assumed to have cognitive sequelae at that time point. Cognitive sequelae present at 6 or 12 months were assumed not to be due to carbon monoxide poisoning if they had not been present at 6 weeks.[24,25] Patients with cognitive sequelae at 6 weeks who had missing data at 6 or 12 months were assumed to have cognitive sequelae at those time points.

†The normobaric-oxygen group was the reference group. CI denotes confidence interval.

Can this be prevented?

- After adj for cerebellar dysfunction before tx and for stratification variables, HBO_2 still appeared to be the more effective therapy (odds ratio, 0.45 [95 %CI, 0.22 to 0.92]; P=0.03).
- Patients tx with HBO_2 were less likely to have cognitive sequelae at 6w than were those treated with NBO_2
- Failure to complete the chamber sessions was more common in the HBO_2 group (14/76 [18.4 %] vs. 3/76 [3.9%], P=0.005).
- Cognitive sequelae among patients who completed 3 HBO_2 sessions (15/62 patients [24.2 %]) was not significantly different from those who did not (4/14 patients [28.6%], P=0.74).

Drop out

- Anxiety (7),
- Tympanic-membrane rupture (1),
- Cough (1).
- Difficulty with equalization of middle-ear pressure (4)
- Failure to return for treatment (4)

Hyperbaric oxygen for carbon monoxide poisoning (Review)

Juurlink DN, Buckley NA, Stanbrook MB, Isbister GK, Bennett M, McGuigan MA

THE COCHRANE COLLABORATION®

Weaver 2002

This is the only positive study published to date in which control patients received sham treatment in a hyperbaric chamber. While the design of this trial is generally superior to previously published ones and the effect size of HBO appears large, this trial's interpreta-

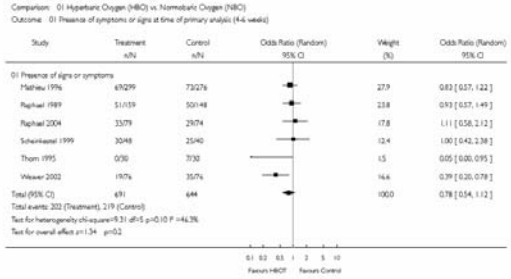
xide poisoning (Review)

- The originally intended endpoint was DNS but the primary outcome of all neurological sequelae was reported
- Group mean scoring identified no group difference between HBO and NBO

NBO were within the normal range. Finally, patients enrolled in the NBO arm of this appeared more ill than those in the HBO arm, with a longer mean exposure (22 hours vs. 13 hours) and a greater prevalence of cerebellar signs at baseline (15% vs. 4%, respectively). The degree to which this influenced outcomes, in particular trail-making (which may be hampered by cerebellar dysfunction), is not known.

GRAPHS AND OTHER TABLES

Analysis 01.01. Comparison 01 Hyperbaric Oxygen (HBO) vs. Normobaric Oxygen (NBO), Outcome 01 Presence of symptoms or signs at time of primary analysis (4-6 weeks)



Hyperbaric oxygen for carbon monoxide poisoning (Review)

Juurlink DN, Buckley NA, Stanbrook MB, Isbister GK, Bennett M, McGuigan MA

Implications for practice

Existing randomized controlled trials of HBO vs. NBO in the treatment of non-pregnant adults with acute CO poisoning provide regarding the effectiveness of HBO.

All published studies have limitations that threaten and may invalidate their conclusions.

Based on the results of these trials,

It is possible that some patients, particularly those with more severe poisoning, may derive benefit from treatment, but this remains unproven.

All 5 DNS occurred in HBO group (4.8%) (Scheinkestel 1999)

- Epidemiology of CO poisoning
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Neuropsychological assessment

- Cognition
- Emotionality
- Executive functioning

Lezak MD, Neuropsychological Assessment, 3rd Ed.,Oxford University Press, New York, 1995.

Goals of a clinical neuropsychological assessment

1. Establish pathology (~diagnosis)
2. Characterize cognitive deficit
3. Measure change

Issues concerning neuropsychological inference

- Emotionality / Personality
  - How do changes (e.g. depression) affect NP performance?
- Age effects
  - How does age affect NP performance?
- Malingering
  - Are the observed NP deficits real?
- Practice effects
  - How meaningful is repeated testing?

Practice effects

- Change measures are important in NP - e.g. tracking a neurodegenerative illness, or pre-post surgery comparisons
- Practice effects can be reduced by parallel batteries
- Statistical techniques (control change)
- BUT - "novelty" may be crucial factor in some tests (e.g. executive)
- Not clear that patients adopt the same strategies when repeating tests

Classes of cognitive functions

(Completely arbtrary, but seems to guide NP testing)

- Intelligence (current / premorbid)
- Laterality
- "Receptive functions"
  - perception - mainly visuoperception e.g. Agnosia
- "Expressive functions"
  - mainly speech, also action e.g. Apraxia, aphasia
- Learning & Memory
  - Short term / longterm, encoding / retrieval etc e.g. Amnesia
- Executive Functions
  - Planning, decision making, allocation of attention etc e.g. Dysexecutive syndrome

Pre-morbid intelligence

It is important to have an idea of what P's intellect was like *before brain injury.*

National Adult Reading Test (NART- Nelson, 1978)

- Based on findings that language is relatively robust and remains constant when other cognitive abilities (e.g. memory) are declining, as in, for example SDAT
- List of words, *all of which are irregular in spelling (e.g. CHORD ACHE* AISLE DEPOT…. SYNCOPE DEMESNE CAMPANILE)
- P reads the words and a note is made of number of pronunciation errors - formula => NART IQ score
- There are equations to convert the NART score to WAIS-R and WAISIII IQ scores
- Considered reliable unless P has a specific reading or visual problem
- Recently, however, there have been concerns about its robustness, also scorer bias is possible.
- Such measures allow an indirect measure of change

Reliability

- The consistency with which the same information is obtained
- In the absence of intervening variables (e.g., illness, injury, new learning), scores should remain stable
  - Interrater reliability
  - Intrarater reliability
  - Test-retest reliability

Validity

- How well the test measures what it purports to measure.
  - Construct validity - Does the test measure what it is supposed to measure?
  - Concurrent validity - Do new tests correlate highly with existing tests or independent measures of the construct in question?
  - Face validity - Does the test appear to measure what it is supposed to measure?
  - Ecologic validity - Does the test predict real-life ability?

Carbon monoxide neuropsychological screening battery (CONSB)

- The general orientation test
  - 10-item list that measures the patient's orientation to TPP
- Wechsler Adult Intelligence Scale–Revised subtests –
  - Digit span,
  - Digit–symbol, and
  - block design
- The Trail Making Test Part A & Part B
- The story-recall subtest of the Denman Neuropsychology Memory Scale

Developed to screen those potentially benefit for HBO

Messier LD et al. J Clin Psychol 1991;47:675-84

Commonly reported cognitive impairments

Short term memory	Digit span (rev)
Poor attention and concentration	Digit span
Visual spatial ability	Block Design
Executive dysfunction	Trail Making B
Slow processing speed	All

Executive Functions

- The ability to initiate the use of individual component skills, monitor their performance and use this information to adjust their behaviour

  Burgess, P.W. & Alderman, N. (1990) *Rehabilitation of dyscontrol syndromes following frontal lobe damage: A cognitive neuropsychological approach.*, In R.I.I. Wood & I. Fussey (Eds.), Cognitive Rehabilitation in Perspective. Lawrence Erlbaum Associates, pp. 183-203.

- Other important behavioural processes have been ignored

Cicerone K et al. J Cognitive Neuroscience 2007; 18: 1212-1222.

Executive dysfunction

- Terms such as dysexecutive syndrome, the supervisory system, and frontal lobe functions
- Challenging to define and measure.
- Much of what is known about EF is based on patients with DLPFC lesions
- Frontal patients is often taken as a proxy for the presence of executive problems
- Due to the interconnectivity between the lateral frontal and posterior regions, diffuse pathology such as DAI can also cause EF

Executive Functions

- The following schema divides what has been loosely termed "executive functions" into 4 domains that follow anatomy and evolutionary development:
  1. Executive cognitive functions,
  2. Behavioral self-regulatory functions,
  3. Activation regulating functions, and
  4. Metacognitive processes (Stuss, in press).

Executive Cognitive Functions

- To control and direct lower level, more modular or automatic functions
  - Planning
  - Monitoring
  - Activating
  - Switching
  - Inhibiting
- Working memory and inhibition are fundamental

Behavioral Self-regulatory functions

- Medial frontal regions connected with limbic system
- Involved in emotional processing
- Incl. the acquisition and reversal of stimulus-reward associations
- Useful in behaviour reinforcement

Activation Regulating Functions

- Key in self regulation
- Initiating and energizing behaviour appropriately and
- To attain individual goals
- Pathology in this area lead to apathy and abulia

Metacognitive Processes

- Frontal poles (esp. right)
- Personality
- Social cognition
- Autonoetic consciousness
- Self awareness

Serious problem or seriously problematic

- An apparent impairment may be a reflection of a broader executive dysfunction
- Memory problems may stem from difficulties in self organization and initiation

Routine vs. non-routine

- Routine activities (simple ADL) benefit from procedural learning, which min. deliberate planning and the attentional resources that support it.
- Simple ADL like toothbrushing are often carried out "on automatic pilot" and with a fixed sequence that may not be readily available to conscious report.
- Moreover, these activities are brief and context driven, which makes them less dependent on working memory for storing and manipulating goal-action representations.

Example for EF - Shopping

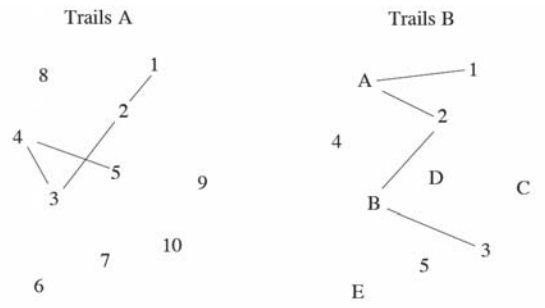
- There are many interdependent subgoals that must be prioritized and ordered.
- Realizing some of the subgoals may take time, and, during when, there are distractions that must be resisted.
- In contemporary theories of the frontal lobes, controlled (supervisory) attention is assigned a key role in prioritizing and planning an activity, working memory in bridging temporal delays, and inhibitory systems in controlling and resisting interference

Example of EF - Meal preparation

- Failure to assemble the necessary ingredients,
- Misinterpretation of written instructions (e.g., focusing on irrelevant details),
- Repeated checking of instructions,
- Sequencing–omission errors (e.g., omitting key steps or carrying out steps in the wrong order)

These test were chosen

- Practical employed in emergency setting
- Can be administer in short period of time
- Patient are able to respond despite encumbrances
- Sufficiently sensitive in detecting true deficits
- Capable in detecting general and specific deficits
- Can be administered by trained nurse



The time difference for completing B compared to A is increased in patients with FL lesions (although again, the specificity is doubtful)

Trail making test

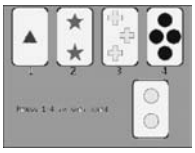
- Visual scanning
- Numeric sequencing
- Visuomotor speed
- Shifts in organization
- Recall and recognition
- Useful tools to identify frontal lobe problem

Table 19.1 Summary of some strengths and weaknesses for selected tests of executive dysfunction

Test	Strengths	Weaknesses
Wisconsin Card Sorting	Extensive research base Good norms Moderate sensitivity Moderate ecological validity	Poor specificity Potentially confusing for clients
Verbal fluency	Extensive research base Good norms High reliability Quick and easy to administer and score Moderate sensitivity Normally distributed Moderate ecological validity	Low specificity Highly influenced by premorbid verbal IQ
Cognitive Estimation	Derived from theory	Poor sensitivity Poor specificity Poor ecological validity Poor psychometric properties Poor norms
Brixton Spatial	Derived from theory	Modest normative sample
Anticipation Test	Moderate sensitivity Moderate specificity Quick and easy to administer and score Normally distributed	Coarse-grained scoring (Sten scores) Limited research base as yet
Hayling Sentence	Derived from theory Moderate sensitivity Moderate specificity	Modest normative sample Coarse-grained scoring (Sten scores) Limited research base as yet
Behavioral Assessment of the Dysexecutive Syndrome	Derived from theory Very high ecological validity Moderate sensitivity (six elements)	Limited research base as yet Low sensitivity (most subtests) Specificity unknown
Dual task methods	Derived from theory High ecological validity Good specificity	Not yet fully standardized and normed Potential problem with unreliability

Wisconsin Card Sorting

- Measures:
  - Concept formation
  - Ability to shift between these concepts
  - Ability to utilize feedback to modify response
- Sensitive in discrimination patient vs. control
- Poor ability to localize lesion
- Moderate ecological validity
  - Correlate significantly with DEX
  - Predictor of subsequent community reintegration



Verbal fluency

- Generate words by initial letters in fixed time
- Sensitive to executive fx because normally words are retrieved based on their meaning
- Retrieve by initial letter is non-routine
- Requires suppression of words that are semantically related
- Significantly related with ratings of everyday executive problems
- Correlated well with Disability Rating Scale

Dual Task

- Great potential to capture what is a core executive process
- E.g. combining digit span with paper-&-pensil tracking task

Behavioural assessment of dysexecutive syndrome (BADS)

- Rule Shift Card Test
- Action Program Test
- Key Search Test
- Temporal Judgment Test
- Zoo Map Test
- Modified Six Elements Test
- The Dysexecutive Questionnaire (self/ other rated)

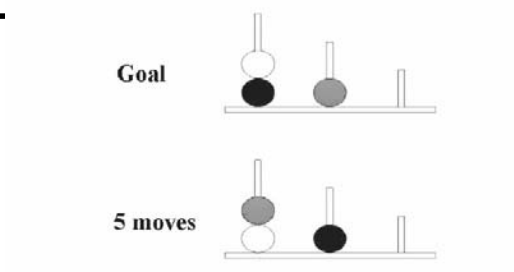


Figure 1: An example of a five move Tower of London problem. Participants are instructed to plan in their head the moves they have to make before they execute the movements by the computer-mouse.

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Cognitive rehabilitation

- Cognitive rehabilitation is a "systematic, functionally oriented service of therapeutic activities that is based on assessment and understanding of the patient's brain-behavioural deficits" (Cicerone 2005).
- Facilitates the development of behavioural and cognitive strategies which have a positive impact on the structural and functional recovery of the damaged brain, and improve the quality of life of the individual in general (Robertson 2001).

Cognitive rehabilitation

- Disturbances of EF are most likely to be evident when the patient is required to assume responsibility for the application of compensatory strategies (Shallice & Burgess, 1991) or to cope with novel situations (Godefrey & Rousseaux, 1997).
- Disturbances of EF often coexist with impaired self-awareness, representing an additional challenge to rehabilitation.
- Only a small number of studies have examined the efficacy of rehabilitation interventions that target specific aspects of EF

Problem solving

- Patients were trained to reduce the complexity of a multistage problem by breaking it down into manageable subgoals.
- Subjects identified as poor problem solvers on formal tests of planning and response regulation.
- The experimental intervention included training in problem orientation, problem definition and formulation, generation of alternatives, decision making, and solution verification.

Von Cramon DY Neuropsy Rehabil1991:1; 45–64.

Problem solving

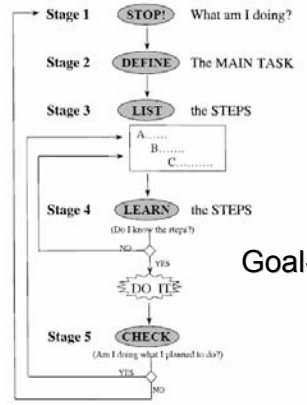
- When compared with memory training, the participants who received the problem solving training demonstrated significant gains on measures of planning ability and improvement on behavioral ratings of EF, such as awareness of cognitive deficits, goal-directed ideas, and problem-solving.

Von Cramon DY Neuropsy Rehabil1991:1; 45–64.

Goal-management training

- Based on theory of goal neglect
- Training to evaluate the current problem state ("What am I doing?") was followed by
- Specification of the relevant goals (the "main task")
- Partitioning of the problem-solving process into subgoals (the "steps").
- Participants were then assisted with the learning and retention of goals and subgoals ("Do I know the steps?") and finally
- Taught to self-monitor the results of their actions with the intended goal state ("Am I doing what I planned to do?"), and in the event of a mismatch the entire process was repeated.

Levine B et al J International Neuropsychol Society. 2000:6; 299–312.



Goal-management training

Fig. 1. Flowchart used to illustrate the five steps in goal manage-
ment training.

Levine B et al J International Neuropsychol Society. 2000:6; 299–312.

Table 2. Goal Management Training (Robertson, 1996)

Stage in model (Figure 1)	Goal management process	Activities
1. STOP!	Orienting and alerting to task	*Trainer*: Provide orienting "catchphrases" (e.g., "Wait a minute!"). *Patient*: Select a catchphrase, or generate own catchphrase.
2. Define main task	Goal setting	*Trainer*: Explain concepts of goal-setting and prioritizing.
3. List steps	Partitioning goals into subgoals	*Patient*: Write main task and subgoals for situations from own life. *Trainer*: Give additional examples of subgoal definition. *Patient*: List main task and subgoals for trainer-provided situations (e.g., power outage). Perform room layout task, focusing on listing subgoals. *Trainer*: Give feedback on room-layout performance.
4. Learn steps	Encoding and retention of subgoals	*Patient*: Perform proofreading task and evaluate own performance. *Trainer*: Give feedback on proofreading performance. If there were errors, readminister the task up to two times. Introduce encoding enhancement techniques (e.g., visualization), and their application to proofreading task. *Patient*: Perform a second proofreading task. *Trainer*: Give feedback and readminister once if necessary.
5. Check	Monitoring	*Patient*: Provide example from own life of going off-task. *Examiner*: Provide an additional example of going off-task. Illustrate feedback loop from monitoring to orienting–alerting (Stage 1).

Goal-management training

- Participants who received the GMT demonstrated significant reduction in errors and prolonged time to task completion (which was interpreted as an indication of their increased care and attention to the tasks) on two of the three outcome measures.

Levine B et al. J International Neuropsychol Society. 2000:6; 299–312.

Emotional self regulation

- "Higher functioning" but with documented, persistent impairments in social/vocational functioning,
- Average of 4 years post injury.
- Both groups received 2 to 3 hr of small group intervention per week for 24 weeks.
- The conventional treatment consisted of group exercises intended to improve cognitive skills and support for coping with emotional reactions and changes after injury.

Rath, JF. Neuropsy Rehabili 2003; 13: 461–488.

The problem-solving intervention

- Incorporating strategies for addressing underlying emotional self regulation and logical thinking/ reasoning deficits.
- Also attend to both motivational, attitudinal and affective processes and problem solving skills
- Group exercise include roleplay

Rath, JF. Neuropsy Rehabili 2003; 13: 461–488.

Emotional self regulation

- However, brain injured patients have greater difficulties in modulating emotional response and expression, and once emotional overreactions occur, they tend to overwhelm cognitive processes which lead to inaction or impulsive decision
- To observe physiological arousal and emotional changes

Rath, JF. Neuropsy Rehabili 2003; 13: 461–488.

Emotional self regulation

- Only the problem-solving group treatment resulted in significant beneficial effects on measures of executive cognitive functioning, self-appraisal of clear thinking and emotional self-regulation, and objective observer ratings of interpersonal problem-solving behaviors in naturalistic simulations.
- These gains were maintained at 6 months after treatment, but did not translate into significant improvements on a measure of community integration.

Rath, JF. Neuropsy Rehabili 2003; 13: 461–488.

Self regulation skills

Emergent awareness: "Can you tell me how you know that you experience (main difficulty)?"

Anticipatory awareness: "When are you most likely to experience (main difficulty), or in what situations does it mainly occur?"

Motivation to change: "How motivated are you to learn some different strategies to help overcome your (main difficulty)?"

Strategy generation: "Have you thought of any strategies that you could use to help cope with your (main difficulty)?"

Strategy selection: "What strategies are you currently using to cope with your (main difficulty)?"

Effectiveness of strategies: "How well do the strategies that you are using for (main difficulty) work for you?"

Self Awareness

1. Self-awareness of deficits;
2. Self-awareness of the functional implications of deficits; and
3. Ability to set realistic goals

Sickness Impact Profile

Examples of questions from each category of the American English version of the SIP, with Chinese translations*

Examples of translations from each of the 12 categories

Sleep and rest:	I spend much of the day lying down in order to rest 日間大部份時間我都臥床休息。
Emotional behaviour:	I have attempted suicide 我曾經企圖自殺。
Body care and movement:	I do not have control of my bowels 我不能控制大便。
Home management:	I am not doing any of the regular daily work around the house that I would usually do 我以前常做的家務，現在已完全沒有做。
Mobility:	I am not now using public transport 我現在沒有使用公共交通工具。
Social interaction:	I am not going out to visit people at all 我現在完全沒有外出探訪親友。
Ambulation:	I do not walk at all 我現在完全沒有步行。
Alertness behaviour:	I forget a lot—for example, things that happened recently, where I put things, appointments 我的記性很差。
Communication:	I am having trouble writing or typing 我書寫或打字有困難。
Work:	I am working shorter hours 我工作的時間較前短。
Recreation and pastimes:	I am not doing any of my usual physical recreation activities 我完全沒有做我以前常做的體能活動及娛樂。
Eating:	I am eating special or different food—for example, soft food, bland diet, low salt, low fat, low sugar 我現在只能吃特別餐，例如：軟軟的食物，糖尿餐等等。

TG Short et al.Hong Kong Med J 1998;4:375-81

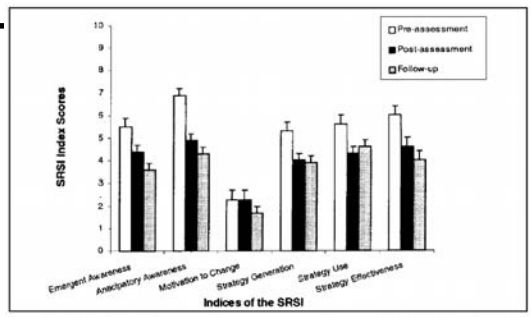


Figure 3. The group's mean scores for the six indices and average skill index of the Self-Regulation Skills Interview (SRSI) during pre-assessment and post-assessment ($n = 21$).

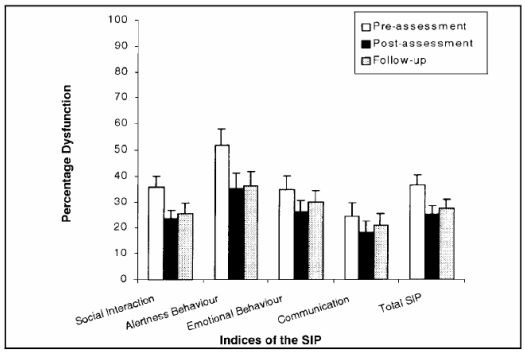


Figure 4. The group's mean scores on the categories and total psychosocial dysfunction score on the Sickness Impact Profile (SIP) during pre-assessment and post-assessment ($n = 21$).