Postoperative Cognitive Dysfunction in the Elderly

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How I Got Started
Cognition

- The process of thought
Cognitive Dysfunction

- Advances in surgery and anesthesia
- More elderly
- Multiple medical problems
- Undergoing complicated surgeries
- CNS dysfunction increasing post op
- Polypharmacy
Two main categories

- Post op delirium
- Mild neurocognitive disorder – post op cognitive dysfunction (POCD)
- no diagnostic code for this condition
Original study

- Bedford 1955
- Retrospective observational report
- 251 elderly patients – surgery with anesthesia
- Anesthesia could have lasting effects on cognitive function
- 7% extreme dementia
- Conclusion “operations on elderly people should be confined to unequivocally necessary cases”
Delirium

- An acute change in mental status, with inattention and altered level of consciousness that tend to fluctuate during the course of the day
- Overall incidence post op 5 – 10 %
- Varies with type of surgery
- Occurs in 10 – 40% of elderly
Post op delirium

- Associated with increased morbidity and mortality
- Delayed functional recovery
- Prolonged hospital stay
Delirium - post op features

- Impaired cognition
- Fluctuating levels of consciousness
- Abnormalities in memory and perception
PO Delirium

- Costly to patient – morbidity and mortality
- Costly to Medicare - $4 billion per year spent on diagnosis and treatment
PO delirium – clinical features

- Changes in consciousness and cognition over a brief period of time
- Disorientation
- Language difficulties
- Impairment in learning and memory
- Emotional problems
- Intermittent labile symptoms - anxiety, fear, anger, irritability and depression
PO delirium

- Bedside tests
  - Assess orientation, short term memory, language, perception, and motor function
- Mini Mental Status Exam
- Abbreviated Mental Test
- Confusion Assessment Method
Confusion Assessment Method (CAM)

- Developed to assist non-psychiatrically trained clinicians in the rapid and accurate diagnosis in the clinical setting
- Criteria provide standardized rating of delirium
- Can be used by any clinician or trained lay observer
- Most commonly used – adapted to DSMIV criteria
- High inter observer reliability
- Validated against psychiatric diagnosis
- Sensitivity of CAM vs psychiatric diagnosis is 94% to 100%, specificity is 90% to 95%
Table 71-5  – DSM-IV Diagnostic Criteria for 293.0 Delirium

| A. | Disturbance of consciousness (i.e., reduced clarity of awareness of the environment) with reduced ability to focus, sustain, or shift attention |
| B. | A change in cognition (e.g., memory deficit, disorientation, language disturbance) or the development of a perceptual disturbance that is not better accounted for by a preexisting, established, or evolving dementia |
| C. | The disturbance develops over a short time (usually hours to days) and tends to fluctuate during the course of the day |
| D. | There is evidence from the history, physical examination, or laboratory findings that the disturbance is caused by the direct physiologic consequences of a general medical condition |

PO Delirium

- Wide range of reported incidence – 0 – 73.5%
- Factors vary – age, type of surgery, diagnostic criteria, preop medical status
PO Delirium

- Emergence delirium – transient restlessness immediately post op (any age group)
- Interval delirium – most common, occurs between 2\textsuperscript{nd} and 7\textsuperscript{th} PO day
- Occurrence rate 10% in elderly
- High risk with elderly and ortho (joint replacement and hip fracture) 24-50%
- Cardiac surgery, 3-47%
Causes

- Global CNS dysfunction - 2 categories
  - 1) Metabolic encephalopathy
  - 2) Neurological injury
CNS functioning

- O2 and nutrient delivery
- Effective removal of waste products
- Appropriate neurochemical milieu
Causes

- Drug induced or somatic disturbances
- Hypoxia, hyperglycemia
- Interference with supply for normal metabolism causes global dysfunction
Causes

- Reduced cerebral oxidative metabolism may lead to abnormalities in the neurotransmitter systems
- Cerebral acetylcholine synthesis – sensitive to hypoxia
- Central cholinergic pathways – regulation of memory processing and alertness
Causes

Surgical Trauma

Stress related neuroendocrine disturbances

Decreased level of active thyroid hormone

Increased level of cortisol

Release of cytokinines
Causes

- Change in hormone levels alter neurotransmitter and amino acid concentrations in the brain
- Provokes delirium
Causes

- Neurological injury
- Cerebral infarction – embolic or thrombotic vascular occlusion
- Diffuse loss of neuronal tissue without overt infarction
Mechanism of Brain Injury

**INSULT**

Primary energy failure *(Minutes)*
- \(Na^+\) overload
- Excitotoxicity

Reperfusion

Cerebral metabolism transiently recovers
- \(Ca^{++}\) overload
- ROS, NO

Secondary phase *(Hours to days)*
- Between 6-72 h after insult
  - Mitochondrial dysfunction
  - Caspases activation

Hypoxic ischemic brain injury

**Therapeutic Window:**
- Hypothermia
- Other

**Interventions NEED TO BE WITHIN 6 hrs of insult**

**Immediate**
- Necrotic cell death

**Delayed**
- Apoptotic cell death
Mechanism of Brain Injury

- Hepatic dysfunction
- Hyperthermia
- Hypothermia
- Electrolyte disturbances
- Hypoglycemia
- Hyperglycemia
- Renal dysfunction
- Endocrine dysfunction

Metabolic encephalopathy
Mechanism of Brain Injury

- Hypoxia
- Seizure
- Infection (encephalitis, meningitis)
- Hypertensive encephalopathy
- Cerebral edema
- Low CPP
- Embolic or Thrombotic stroke
Risk Factors for post op delirium
Patients at Risk

- Severe illness → ASA 2
- Diminished cognitive and physical functioning pre op
- Clinical indicators – abnormal electrolytes (esp. Na+), hx of dementia, depression, and cerebrovascular disease, low albumin levels
- Advanced age
Risk factors

- Increasing age (>75)
- Hx of psychosis
- Poor medical status - Parkinson’s
- Psychiatric illness – dementia, depression, personality disorder
- Nutritional deficiency – thiamine
- ETOH and benzodiazepine withdrawal
- Head trauma
- Anticholinergic drugs
Table 71-6 -- Predisposing and Precipitating Factors for Postoperative Delirium

<table>
<thead>
<tr>
<th>Factor</th>
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</thead>
<tbody>
<tr>
<td>Demographic characteristics—age &gt;65 yr and male</td>
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<tr>
<td>Cognitive impairment or depression</td>
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<tr>
<td>Functional impairment</td>
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<td>Sensory impairment, especially visual and hearing</td>
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<tr>
<td>Decreased oral intake</td>
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<tr>
<td>Drugs—polypharmacy, alcoholism, psychoactive, sedatives, narcotics, anticholinergic</td>
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<tr>
<td>Comorbidity—severe illness and neurologic disease</td>
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<td>Some types of surgery—high-risk surgery (American Heart Association guidelines) and orthopedic</td>
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<tr>
<td>Intensive care unit admission</td>
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<tr>
<td>Pain</td>
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<tr>
<td>Sleep deprivation</td>
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<tr>
<td>Immobility/poor physical condition</td>
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Associated Perioperative Factors

- Impaired Cerebral Oxygen Supply
- Hypotension
- Hypoxemia
- Anemia

O2 delivery depends on CBF and arterial O2 content
Associated Perioperative Factors

- **Medications and drug combos**
- Drugs with central anticholinergic action
- Anticonvulsants
- Inhalational anesthetics
Associated Perioperative Factors

- **Metabolic Abnormalities**
  - Electrolyte imbalance – hyponatremia, hypocarbia, dehydration
  - Hypoglycemia
  - Endocrine disease
Associated Perioperative Factors

- Infection/Fever - sepsis
- Medical complications/ICU environment
- Sundowner’s syndrome
Perioperative Factors

- Several large studies have found no difference between general and regional anesthesia in the incidence of delirium.
Perioperative Factors

- **Cardiopulmonary bypass**
  - Depression of CBF – autoregulation impairment
  - Micro-emboli
Major Physiologic Changes in Elderly

- Loss of functional reserve in all organ systems
- Brain – decrease in gray and white matter (neuronal shrinkage)
- Brain weight decreases 2-3 GM/yr after age 60
Major Physiologic Changes in Elderly

- Increase space between surface of brain and skull
- Decrease in neurotransmitters – dopamine, serotonin, acetylcholine, norepinephrine
- Impaired vision, hearing
Major Physiologic Changes in Elderly

- Decreased motor speed
Major Physiologic Changes in Elderly

- CBF decreases, CMRO2 remains stable
- Decrease in lean body mass
- Decrease in total body water
- Increase in body fat
- Chronic diseases
Sensitivity of elderly

- CNS effects of barbiturates
- Inhalationals
- Benzos
- Opioids
- Demerol – most deleteriogenic opioid
Anticholinergics

- inhibit parasympathetic nerve impulses by selectively blocking the binding of the neurotransmitter acetylcholine to its receptor in nerve cells
- nerve fibers of the parasympathetic system are responsible for the involuntary movements of smooth muscles present in the gastrointestinal tract, urinary tract, lungs
- Antidepressants
- GU antispasmodics
Anticholinergics

- H1 antihistaminics
- Anxiolytics
- Antiepileptics, antipsychotics
Anticholinergics

- Antiasthmatics
- Anti Parkinson drugs
- Atropine
- Scopolamine
- Non cholinerginic antimuscarinics – antihistamines
Treatment

- Recognition and management of underlying causes
- Glucose, electrolyte levels, ABG, CXR, Hgb, Hct, blood cultures
- Dehydration, malnutrition – assess fluid balance
- Provide adequate ventilation, oxygenation, hemodynamic support from the start
- Don’t automatically sedate!!!
Treatment

- Control of post op pain
- Association between high pain levels and delirium
- Pharmacological treatment of choice is Haloperidol
Prevention

- Evaluate and assess – optimize medical condition prior to surgery
- Detailed history of medications
- Maintain good oxygenation, normal BP and electrolyte levels
- BIS
- Control post op pain
- Minimize polypharmacy
- Avoid anticholinergics
Post Op Cognitive Disorder (POCD)

- Characterized by impairment of:
  - Memory
  - Concentration
  - Language comprehension
  - Social integration
- May be detected days to weeks after surgery
- May remain as a permanent disorder
Cognitive Dysfunction Syndrome in dogs

- Turns away when someone pets him
- Gets confused
- Doesn’t recognize you
- Barks at night for no reason
- Doesn’t wag like it used to
- Accidents indoors
- Sleeps more
- Less active
- Wanders
- Disoriented
- Doesn’t run to greet the kids
POCD – socioeconomic implications

- Loss of independence
- Extra nursing care – high rate
- Discharge to LTC facility
Post Op Cognitive Dysfunction

- **Diagnostic Criteria**
  - Memory impairment – reduced ability to learn or recall information
  - Disturbance in executive functioning – planning, organizing, sequencing, abstracting
  - Disturbance in attention or speed of information processing
  - Impairment in language (comprehension, word finding)
POCD

- Cardiac surgery
- Seen in 50 - 80% at discharge
- Decrease to 20 – 60% several months later
POCD – Pump Head

- 261 patients having bypass surgery were tested for their cognitive capacity (i.e. mental ability) at four different times:
  - before surgery, six weeks, six months, and five years after bypass surgery
- Patients were deemed to have significant impairment if they had a 20% decrease in test scores.
Cognitive impairment does occur after bypass surgery.

The incidence of cognitive impairment was greater than most doctors would have predicted.

42% of patients had at least a 20% drop in test scores after surgery.

The impairment was not temporary, as many doctors have claimed (or at least hoped)

The decrease in cognitive capacity persisted for 5 years

Study criticized for, among other things, not having a suitable control group
POCD

- Non cardiac surgery
- 25% of patients >60 demonstrated dysfunction 1 wk after surgery, 10% 3 months later
- Control group deteriorated by 3%
POCD

- First and Second International Study of POCD – 2 largest studies of noncardiac POCD
- International, multicenter studies
- Association between 1 yr mortality and POCD
- 1 yr after surgery some patients still exhibit impaired cognition
Anesthetic Techniques

- Inpatient procedures
- Sevo vs Desflurane – no significant difference
- General vs spinal – no significant difference
- Hypotension during surgery – no significance
POCD

- POCD after noncardiac surgery associated with:
  - Increased mortality
  - Risk of leaving the labor market prematurely
  - Dependency on social security payments
POCD in Elderly (short stay surgery < 24 hrs)

- GA vs procedure in office
- Sample, n = 101 over 70
- TICS scores before, 1 wk after and 6 weeks after
- Scores significantly better at 6 weeks (home environment)
POCD in Elderly (short stay surgery < 24 hrs)

- Theory of cognitive reserve, activity, education, employment
- Scores better between younger groups and group 85 or >
- Large majority HS diploma
POCD - diagnosis

- Methods of detection and diagnosis are unreliable
- Neuropsychological tests with low sensitivity may not detect functional impairment
POCD

- Pathophysiology not clearly understood
- No clear strategy for prevention at this time
Who is at Risk???????
Risk Factors

- Elderly patients with multiple health problems
- Low EF
- Preop meds
- Hypothermia
- Hypotension
- Hypoxia
Risk Factors

- Catecholamines
- Anticholinergics
- Cerebral hypoperfusion/microemboli
- Glycemic control
- Carotid endarterectomy – conflicting data
- CPBP
Prevention and Intervention

- No evidence it can be successfully treated
- Early recognition, early initiation of safety measures and supportive care
- Education of family members
- Early recognition (prevent injury) – driving, returning to work
Future Research

- Discovery of the mechanism responsible for age-related increased incidence
- Identify the phenotypic expression that predisposes elderly patients to the development of POCD
- Institution of preop intervention techniques – “mental exercise training pre op as well as post op therapy
- Multidisciplinary approach
References