

***THE AGING MIND***  
*Understanding the Geriatric patient*  
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In the next ten years the number of older:

- Whites will increase by 97%
- African Americans by 265%
- Latino Americans by 530%
- Thousands of people will need mental health services

AGEISM

- Ageism is a part of the psyche of older adults and their families
- Ageism may lead to premature loss of independence, increased morbidity and mortality and depression
- Based on the faulty premise that medical and physiological conditions in older adults are a natural part of getting older
- Healthcare professionals make assumptions about their older patients based on age rather than functional status (Dr. Tom Perls, New England Centenarian study)

AGEISM

- Healthcare providers are “defensive” in their interactions with older adults, making negative assumptions including frailty, confusion, depression, neediness.
- Limited training in care and management of geriatric patients
- Only 10% of US medical schools provide course work or rotations in geriatrics.

AGEISM

“AGEISM: HOW THE HEALTHCARE FAILS THE ELDERLY”

Ageism: “A deep and profound prejudice against the elderly which is found to some degree in all of us”

(Robert N. Butler)

\*Alliance for Aging Research

[www.caregivingforcaregivers.com](http://www.caregivingforcaregivers.com)

Mechanisms that underlie aging:

- Genes for senescence, or the state of being old
- Oxygen radical accumulation
- Accumulation of AGE products
- Failure of DNA repair
- Telomere loss, or the buffer end of a chromosome programmed cell death

In normal people:

- Aging begins at about 11 years old
- Memory declines after 50
- Visual-spatial abilities and attention decline after 60
- Language and abstraction decline after 70
- Psychomotor slowing occurs by age 80

The aging brain:

- At about 30, the brain begins to grow smaller, By 75 a person has lost 100 grams of brain tissue
- Capillary density decreases
- Decline in the number of arterioles
- In animals this decreases ranges from 20% to 50%
- Catecholamine synthesis decreases
- MAO increases
- Free radicals impair the brain’s ability to function

WHY DO WE AGE?

DISEASE THEORY

- As we age, cumulative damage occurs in our cells, degrading our DNA and initiating cell death.
- Most of the damage appears to result from reactive oxygen species or “free radicals” which are produced mostly by the mitochondria (and also immune cells and other sources) and oxidize molecules and cellular structures.
- With aging, this damage increases to the point that the cell can no longer function normally and cell division stops (senescence) and then the cell dies (necrosis or apoptosis).

## Aging

- Cerebral blood flow is also gradually reduced by 15-20% as a result of aging.
- The brain shrinks in size starting at age 20. This is partially due to the death of neurons but mostly to the shrinkage of the remaining neurons as they prune back their multiple connections. Often this is accelerated due to non use.
- Low education, non challenging mental lifestyles and brain shrinkage are risk factors for memory dysfunction and cognitive deficits as well as Alzheimer's Disease.

## Upper GI:

- Stomach lining thins
- Vitamin and nutrient absorption decreases
- Nutritional deficiencies occur
- Metabolism slows
- Gastric reflux is common
- Ulcers and GI bleeding increase
- CETP gene longevity variants are 5 times less likely to level out
- These genes are located in the 16th chromosome
- Less atherogenic lipoprotein

## Upper GI continued:

- Dental problems make eating difficult
- 1 in 5 older adults experience Xerostomia, or dry mouth
- Subjects with Xerostomia have significant deficiencies of Fiber, Potassium, Vitamin B-6, Iron, Calcium, and Zinc
- Changes in taste and smell decrease intake
- Decrease in relaxation of the fundus of the stomach
- Higher levels of the satiating hormone, Cholecystokinin
- Cholecystokinin is a digestive peptide hormone of the gastrointestinal system responsible for the stimulation of the digestion of fat and protein

## Ages 70 and older lose:

- 50% breathing
- 30% cardiac output
- 20% metabolic rate
- 20% total body water

## Immune system:

- Susceptibility to illness increases
- Recovery takes longer
- Autoimmune disorders increase

- Volume of thymus gland in a 60 year old is less than 5% of a newborn
- Decrease in T cell response
- Decrease in immune function

## Muscles and mobility:

- People get shorter, smaller, and stiffer
- Flexibility is not lost except through disuse
- Muscle mass begins to decrease at age 30
- Joints degenerate
- Stamina decreases

## Hydration:

- Total body water decreases
- Electrolyte and body water level falls from 62% at age 25 to less than 50% at age 55
- Prone to dehydration
- Less thirst perception
- Tendency toward Hyponatremia
- Can be alcohol related

## Autonomic nervous system:

- Somatization increases
- Temperature regulation decreases
- Ability to maintain homeostasis decreases
- More response to stress
- Slower return to homeostasis after stress

## Vision:

- By 30, aging eyes produce less tears
- By 40, presbyopia appears
- By 50, brighter light is needed for reading
- By 60, pupils decrease to about one-third of the size they were at 20
- By 70, the pupil loses the ability to dilate
- Accommodation takes longer
- Night vision decreases
- Keeping a red light on in darkened rooms (such as the hallway or bathroom) is better than a regular night light
- Colors drop out

## Hearing:

- 71% of people over 70 have hearing loss
- 80% of the hearing impaired do not use hearing aids
- Hearing loss can lead to isolation and paranoia

## Taste:

- Taste buds decrease from 345 per papilla at 20 years old to 88 at 80 years
- Loss of taste and smell decreases appetite and increases poisoning risk
- Zinc deficiency causes taste disorder
- Sweet is the taste that stays the longest
- Flavor enhancement increases eating

## Macular Degeneration:

- Age-related macular degeneration affects 30% of people 75 years or older
- Changes in lifestyle, including lowering body mass index, exercising, and taking dietary supplements reduces risk
- The incidence of depression in AMD is higher than all other medical illnesses
- Vision therapy is effective in improving quality of life
- 34% of the patients taking *Lucentis* (ranibizumab) achieve at least a 50-percent improvement in vision
- Cytokines with depression cause central hypothyroidism
- TSH is suppressed and will not show up in test
- T3 is very important in the treatment of depression
- Armour natural thyroid medication is best

## The aging mind:

### Age Associated Memory Impairment

- Forgetting does not increase with age, but learning takes longer
- More repetitions are necessary
- Retrieval speed decreases, but accuracy does not

### The most frequent memory problems

- Names
  - Aimless wandering
  - Lost objects
- "I can't remember where I put that  
"I forgot they were there"

## Forgetting

- Hippocampus- the elongated ridges on the floor of each lateral ventricle of the brain, thought to be the center of emotion, memory, and the autonomic nervous system.
- Decreases 17% a year in someone 45 years of age and older
- Can be regulated with mental exercise

## Pain:

- 25 to 50% of elderly people in the community experience pain on a regular basis
- 85% of the elderly in residential facilities report chronic pain
- Pain can impair cognition
- Share pathways with emotion
- Chronic pain is an intrapersonal experience not a diagnosis
- Not all pain has an identifiable physical cause
- Chronic back pain can cause premature aging by shrinking the brain's gray matter as much as 11 percent in one year
- Equivalent to 10 to 20 years of normal brain aging
- Pain shares the same pathway of emotion and impairs cognition

## Aging and personality disorders:

- 10% of nursing home patients have a personality disorder
- 15% of nursing home referrals are because of personality disorders
- About 25% of elders with depression also have a personality disorder, usually dependent or compulsive
- They also have a poorer prognosis

## AGING & SLEEP ARCHITECTURE

### Aging impacts the structure of the sleep architecture.

- As we age, the patterns and amounts of the various sleep stages change.
- Young children have more REM sleep and deep stage 3 and 4 sleep than adults and the elderly.
- Stage 3 and 4 deep sleep is markedly reduced in older adults compared to young adults and children, often disappearing completely in the elderly.
- REM sleep does not change that much from adulthood into old age, staying at about 20%.

## Sleep:

- By our 40's we begin to increase REM and decreased delta sleep
- Excessive REM sleep causes depression
- This means resulting in less growth hormone, cortisol, and melatonin
- By our 50's, circadian rhythms change
- Most older adults have optimal times in the morning, whereas young adults have peak times in the evenings

## Sleep continued:

- Excessive REM sleep causes depression
- Sleeping late increases REM sleep, and thus may increase depression
- Depressed elders show an increase in REM density

## Sleep Apnea

- Apnea is often mistaken for depression
- One in five people with depression are more likely to have sleep apnea
- It is a cardiovascular risk factor
- Adults with sleep apnea are three times more likely to also have diabetes
- Many doctors prescribe Melatonin for children with sleep apnea

## Medications:

- People over 65 comprise 12% of the population, but take 30% of all prescribed medications
- The average number of drugs prescribed to patients over 60 is 15 per year
- Two-thirds of this population is taking at least one prescription drug
- Thirty-seven percent are taking at least five drugs
- Another 20% are taking seven or more medications at once

## Elderly and medications:

**The elderly spend four times as much on medications than the rest of the population. The majority are also taking herbs, vitamins, and supplements**

- 90% of those over age 65 suffer from side-effects
- 67% are not told anything about potential side-effects
- Side effects are often misdiagnosed as other illness and medicated

*Doctors give drugs of which they know little, into bodies, of which they know less, for diseases of which they know nothing at all.*  
**-Voltaire**

***Any symptom in an elderly patient should be considered a drug side-effect until proven otherwise.***

## Statin Drugs:

**The side effects of Statin drugs are:**

- Interfering with memory
- Increase in aggression
- Induces heart failure
- Causes ALS symptoms
- ALS has increased 3x since statin drugs have been on the market
- Changes in diet
- Decrease in cholesterol levels

## Does personality change?

- ❖ There are declines in neuroticism, extroversion, openness, and impulsiveness
- ❖ There are increases in agreeableness, conscientiousness, and suspiciousness
- ❖ Dependent, compulsive, and paranoid are the most common
- ❖ Antisocial and borderlines usually do not live long enough to get old

### Dementia:

Dementia refers to any disease which causes brain cells to die. It involves loss of function, memory and cognition.



### Risk Factors:

- Age
- Family history
- Family size
- Spouse
- Low life satisfactions
- Risk Factors
- Smoking
- Cholesterol
- Blood Pressure

### Understanding Dementia

- Two times as many women are diagnosed with alzheimer's as men
- Alzheimer's progresses more from the back of the brain than from the front
- Alzheimer's can begin 10-20 before the 1st symptoms develop

### Dementia continued:

- Chemotherapy/ Radiation
- Risk Factors
- Head Trauma
- Diabetes
- Exposure to toxins
- Cardiovascular disease
- Risk Factors
- High Alcohol Intake
- Surgery
- Long term stress

### Disorders that mimic Dementia:

- Hypothyroidism
- Hypercalcaemia
- B12 deficiency
- Neurosyphilis
- Subdural hematoma
- Medication toxicity
- Metabolic or endocrine disorders
- Dehydration
- Depression
- Brain Tumors
- Normal-pressure hydrocephalus

### Cont.

#### DEMENCIA

While some potentially reversible conditions, such as Hypothyroidism or vitamin B12 deficiency are often considered to be causes of dementia, no more than 1.5 percent of cases of mild to moderate dementia are fully reversible.

### Alzheimer's Disease

- AD risk increases with age but AD is not a part of normal aging. AD is caused by diseases that affect the brain
- Originally called Organic Brain Syndrome (OBS) caused by hardening of the arteries
- 1970 autopsy studies showed something else

### Risk Factors for Alzheimer's Disease

- Increasing age and sex
- Family history
- Amnesic mild cognitive impaired
- History of head trauma
- High blood pressure
- Strokes and TIAs
- Diabetes
- Estrogen deficiency
- Non-stimulating mental lifestyle

### AD

- Age related, irreversible brain disorder
- Decrease in memory, behavior, personality changes, decline in thinking abilities, These losses are related to breakdown of connections between nerve cells and death of many of these cells
- Average life after DX is 8-10 years
- Symptoms may begin as early as 60 years old with initial loss of recent memory

## Risk factors for Alzheimer's Disease

- Hypothyroidism
- Low level of education
- Low socioeconomic status
- Low level of physical activity
- Jobs with a low learning level
- Obesity
- Heart disease and high cholesterol
- Smoking and toxins
- Drug abuse

## Risk factors for Alzheimer's Disease

- High alcohol intake
- Chronic gum disease
- Low Omega-3 PUFA intake
- Diet low in fruits and vegetables
- Long term stress, anxiety, and depression
- Elevated homocysteine
- Several genetic markers

## Psychopharmacology

- Namenda - Blocks a messenger chemical known as neurotransmitter glutamate.
- Glutamate is released in excessive amounts when brain cells are damaged by Alzheimer's Disease, which causes the brain cells to be damaged further. Namenda can protect brain cells by blocking the release of Glutamate.
- Treatment for moderate to severe Alzheimer's Disease

## Psychopharmacology

- Medications and memory loss: Designed to slow the process of memory loss. Research still in early stages
- Not enough of a chemical called acetylcholine in the brains of people with Alzheimer's disease
- Medications prevent an enzyme known as acetylcholinesterase from breaking down acetylcholine in the brain
- Used in people with mild to moderate Alzheimer's disease. They are not effective for everyone and may only temporarily improve memory or delay memory loss. Functional improvement is very limited.
- Aricept, Exelon, Razadyne - Cholinesterase inhibitors
- Exelon approved medication for treatment of individuals with Parkinson's Disease.

## (Genetic Research) Apolipoprotein (APOE) (Protein)

- 91% of people with E4/E4 had AD.
- 20% without E4 had AD.
- Problem is not presence of E4/E4 but lack of E3.
- E3 seems to be main cholesterol maintenance gene.
- Also known as E2/E2 combination occurs in people with in people with rare disorder that results in M.I. before age 40.
- People with one E4 have highest total cholesterol level.
- APOE affects formation of plaques and possibly tangles.

## (Genetic Research) Alzheimer Chromosome Defect

- Chromosome 21 defect.
- 'House Keeping Gene', daily maintenance of cells.
- Regulates the composition of a common brain protein called Amyloid Precursor Protein (APP).
- When APP is 'fragmented' à abnormal protein amyloid.
- Decrease in suppressor T cells in AD (T cell is a WBC that switches off an immune system attack) therefore immune system goes unchecked.
- Aluminum

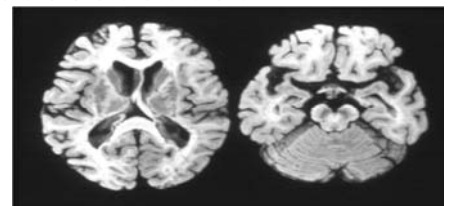
## Plaques

- Noted by Dr. Alzheimer in 1907.
- Outside neurons, composed of a protein core called Amyloid surrounded by debris from degenerating neurons.
- Healthy cells use enzymes called secretases in their surface to make amyloid.
- AD patients produce too much amyloid.
- Amyloid builds up 'plaque' on outside of brain cells à grows bigger à triggers an inflammatory reaction à kills innocent nerve cells.
- The 'normal function' of amyloid remains mysterious if there is in fact a 'normal function'.
- It is a protein polysaccharide complex (starch-like) produced and deposited in tissue during pathological states.

## Tangles

- Inside neuron and are neurofibrillary hairlike protein fibers called TAU purpose is to provide support for microtubules of the nerve cell.
  - Chemical changes cause TAU molecules to change shape, become twisted and 'Tangled' à eventually causing the cell to shrink and die.
- Results:**
- Wholesale degeneration of Acetylcholine producing neurons.
  - Acetylcholine neurons in highest # in cortex, hippocampus where short term memory begins.

## Alzheimer Disease Seven years after diagnosis...



## Gene Test:

Likelihood of Alzheimer's for a 75-year-old person (without intervention)

ApoE 4/4	80%
ApoE 3/4	60%
ApoE 3/3 or ApoE 2/4	45%
ApoE 2/3	20%

## Dementia Continued:

- If a patient does not have Dementia by age 80, there is almost a zero chance of developing it
- Transfusion loss of Nitric Oxide in the blood bank
- The first born child is less likely to have Dementia than the last child
- Chemotherapy/radiation: Strong drugs kill cancer cells as well as good cells. Especially in Breast Cancer patients
- Surgery: Anesthesia is a high risk factor

## Urine testing:

- Nymox Pharmaceutical has a urine test to detect Alzheimer's disease called *AlzheimerAlert™*
- In a random test of 122 people in the US, AlzheimerAlert distinguished Alzheimer's from healthy people in more than 90% of study participants
- The test detects neural thread protein which is elevated early in Alzheimer's

### Ampakines

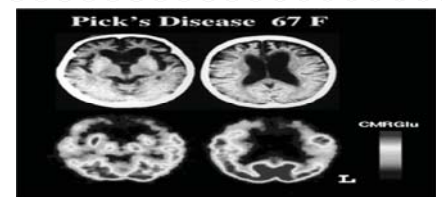
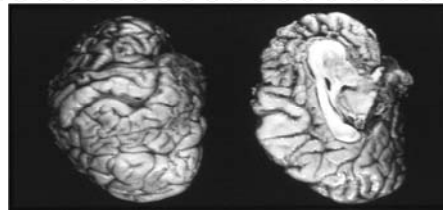
- Ampakines increases levels of a specific neurotransmitter in the brain, AMPA-Glutamate.
- Dopamine is associated with concentration, socializing, food seeking, sexual desire, motor neuron control - declines in brain aging.

## Frontotemporal Dementia

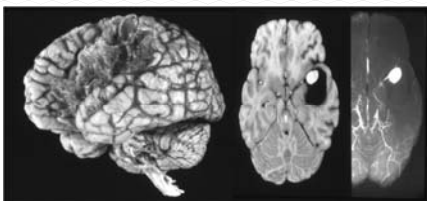
Presents with:

- Prominent changes in behavior or language
- Disinhibition and socially inappropriate behavior
- Language difficulty and memory unaffected
- Medications used to treat AD are not effective in, and may worsen, FTD symptoms
- Visuospatial skills deteriorate in patients with AD, and the ability to copy drawings is impaired
- AD patients start to lose this function when their MMSE scores are around 25, and cannot draw when MMSE drops to the teens
- In FTD coping skills may actually improve
- If MMSE score is 14 and the person can still do the pentagons, they do not have AD

## Degenerative Diseases



## Cerebrovascular Diseases and Aneurysms



## Low Density Lipoproteins(bad)/ High Density Lipoproteins(good)

Goal- Keep ration below 4.0

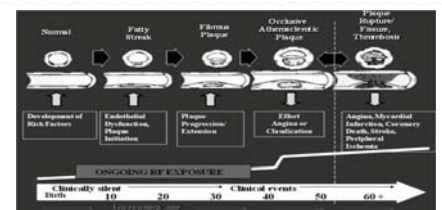
I.e.: If HDL is 50 mg/dl and

LDL is 150 mg/dl the

HDL/LDL ratio would be 3.3

Tx: HDL below 40 mg a HDL, a HDL of 60 is considered protective

## Atherosclerosis Process



## Strokes:

- **One out of six stroke victims will develop dementia in 1 to 4 years**
- **Strokes cause emotional and behavioral problems, and bizarre and unusual syndromes**

## Transient Ischemic Attacks:

- Slurred speech
- Loss of speech
- Difficulty understanding speech
- Dimness or loss of vision, usually in one eye, as if a shade or curtain is coming over it
- One-sided weakness, numbness, or pricking of face, arm, or leg
- Severe headache, recent new-onset headache
- Unexplained loss of coordination, difficulty walking, falls, dizziness
- Less common: Confusion, nausea and vomiting, Difficulty swallowing

## Basilar artery stroke:

- A Basilar artery stroke is a brainstem stroke
- Avolition (Decrease in the motivation to initiate and perform)
- Apathy
- Dizziness
- Pathologic laughing and crying
- Locked in syndrome (Patient is aware during the stroke but is unable to move or communicate verbally)

## Parkinson's Disease

- Parkinson's Disease (PD) is the most common neurodegenerative movement disorder affecting more than 500,000 people in the U.S.
- The disorder occurs in all races but is somewhat more prevalent among Caucasians.
- Men are affected slightly more than women.
- Symptoms of Parkinson's may occur at any age, but the average onset is 60
- It is rare in people younger than 30 and risk increases with age
- It is estimated that 5 percent to 10 percent of patients experience symptoms before the age of 40

## Parkinson Disease (PD)

- 500,000 people in the US
- 25% of PD patients develop AD
- Resting tremor, slowness in movement (Bradykinesia), increases muscle tone (cogwheel rigidity), postural instability.
- Dementia is a variable presentation of PD, occurs late in course of disease (20-60%).

## Parkinson Disease (cont.)

- Clinical Finding: Fine or pin rolling tremor usually begin in one hand and advances to ipsilateral foot
- Tremor eventually becomes bilateral and may involve feet, jaw, tongue, lips while sparing head/neck. Tremor pronounced at rest cannot be controlled cognitively, worse with stress, absent during sleep
- Positive Myerson's : Tapping about twice per second over the bridge of nose @ sustained blink response

## Treatment options for Parkinson's Disease

- Dopa Decarboxylase Inhibitor/Dopamine Precursors: Levodopa plus carbidopa Sinemet medication remains the frontline choice for most practitioners.
- Combining levodopa with carbidopa increases the amount of levodopa that reaches the brain.
- Levodopa is most effective in treating the Bradykinesia and rigidity but less effective in reducing the postural imbalance and tremors.

## Cont.

**Avoid tobacco (7 times the risk for Parkinson's)**

## Dementia with Lewy Bodies (DLB)

- Second most common form of neurodegenerative dementia after Alzheimer (AD).
- 10-15% of all cases of Dementia.
- Progressive decrease in cognitive function with presence of LB in cerebral cortex.
- Average age is 74.7 years as with AD 1:1 M/F ratio
- Dem. with LB experience a more rapid decline in AD
- Increase hallucinations and psychotic symptoms in DLB vs. AD.
- Most common delusion of DLB are misidentification i.e. people are in their house or patients home is not his. (similar to Charles Bonnet)
- Depression is significantly greater in DLB vs. AD.



## Lewy Bodies (LB)

1912.

- LB are found in PD cases in the large neurons (brain cells) that produce dopamine in the part of the brainstem called substantia nigra.
- LB are filamentous inclusions composed of a protein known as alpha- synuclein and are found within the neuron.
- Presence is uncertain other than as a degenerative by product

## Lewy Body Dementia

- Adult ADHD triples the risk of Lewy Body Dementia if carried over from childhood
- There are no significant differences between LBD and Alzheimer's in survival
- Visual hallucinations are an early sign

## Did you know?

**Having adult ADHD triples the risk of developing Lewy Body dementia.**

## Tremor and Abnormal Movement

**Awkwardness of Movement is Characteristic of Both Cerebellar and Basal Ganglion Lesion.**

I. Awkwardness of intended movement suggest lesion in cerebellum. Intention Tremor.

II. Awkwardness of involuntary movement (Resting Tremor, Chorea) are characteristics of Basal Ganglia Lesions. Tremor-at-Rest i.e. PD, loss of inhibitory influence of Dopamine.

III. Postural Tremor: present when body part is held in one position. Essential Tremors or Familial Tremors. Cause is unknown.

Test: Observe. Archimedes Spiral.

## Basal Ganglia Tremors

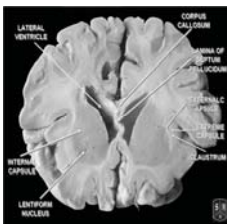
- Group of nuclei located in the grey matter deep in the cerebral cortex interconnects with the thalamus and brainstem
- Responsible for fine motor function control
- Resting Tremors.
- Cholinergic (Excitatory Activity )
- Dopaminergic (inhibitory activity)
- Balance out to aid in fine motor control
- Parkinson: Deg. In substantia Nigra most common cause

M = F over 40

## Basal Ganglia Tremors (cont.)

Excessive cholinergic activity @  
Hypertonia which is a tremor/ rigidity  
Substantia nigra

## The Basal Ganglia of the brain



## Postural Tremor

Absent at rest (usually) @ accentuated by extension of body part (arm)

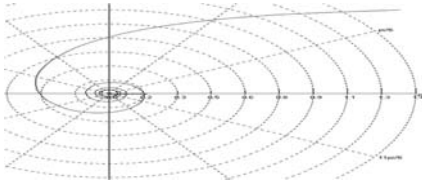
Stress muscle activity @ aggravates tremor

(ETOH) @ <sup>-</sup> tremor

## Thalamus

- Ovoid gray nuclear mass in lateral wall of third ventricle
- All sensory stimuli except olfactory are received by thalamus
- These impulses are associated, integrated, and then relayed through thalamocortical radiations to specific cortical areas
- Relay center from basal ganglia and cerebellum
- Center for appreciation of primitive cortical sensations of pain, crude touch, and temperature

## Archimedes Spiral



## SUNDOWNING

Sundowning is a behavioral pattern often associated with later stage Alzheimer's Disease. The person becomes irritable, agitated, even combative, usually in the afternoon or early evening.

## Sundowning:

- Aggitated
- Restless
- Irritable
- Confused
- Disoriented
- Demanding
- Suspicious

## Sundowning:

- 1 out of 5 Alzheimer's patients get "Sundown"
- Occurs more in middle stages of the disease
- Can occur in older patients without Dementia
- Etiology is uncertain but Dementia may have affect on the Circadian rhythm
- In care facilities it may be related to staff change or lack of structural activities

## SUNDOWNING

- Directly related to the late stage of Alzheimer's
- A 10-15 minute nap is the best treatment

## Caregiver Guilt:

- **Caregiver guilt is uncertainty. Once you are certain of your actions, guilt is reduced or eliminated.**

## Caregiver Guilt:

### D.A.R.K

- Doing: Working on effective solutions to reduce caregiver stress
- Accepting: You can only do so much to prevent or facilitate
- Recognizing: Recognizing when the individual is no longer the person you knew
- Knowing: Knowing when to say when

## Can Mature Nervous System Cells Regrow and Regenerate?

- Exciting new research is revealing that the central nervous system is a dynamic organ with the significant plasticity and capacity for repair and regeneration.
- Neurogenesis in the adult brain appears to be restricted to the discrete germinal centers.
- The peripheral nerves will take a longer time to repair after trauma and impulse conduction will also be slower as a result of age. This worsens if the patient is diabetic. It must be remembered that most areas of the brain do not regenerate and that there will be overall cell loss with aging after the age of 20.

## Avoiding Dementia:

- Exercise
- Antioxidants
- Anti-inflammatories
- Nutritional supplements
- Polymeal
- Poly Meals include wine, chocolate, fish, fruit, garlic, almonds, mediterranean meals, and no fat

## Medication error in the elderly

- Always think in pediatric doses, especially those with kidney disease
- All fluoroquinolones increase QT intervals which is a marker for ventricular tachycardia, which could result in sudden death
- Chronic kidney disease increases the  $\frac{1}{2}$  life of Bactrim, causing Bactrim toxicity (peaked T Waves, leg cramps, fever, chills, flu like symptoms)

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