TOP KNIFE
FIGHTER SURGEON COURSE

173 Fighter Wing
Kingsley Field Oregon

RSV-1E1

AEROMEDICAL ASPECTS OF NIGHT OPERATIONS

Criterion Referenced Objectives

- Identify the effects on night vision of contrast discrimination, night myopia, dark adaptation, drugs, tobacco, and hypoxia
- Identify the factors which contribute to circadian rhythm and the effects these factors have on aircrew performance

Overview

- Operational aspects of night vision
- Circadian rhythm/crew rest
- Spatial Disorientation
- Flight surgeon recommendations

Operational Aspects of Night Vision

- Contrast discrimination
- Night myopia
- Dark adaptation
- Drugs and tobacco
- Hypoxia

Useful Definitions

- Photopic vision – Light-adapted vision, primarily cones
- Scotopic vision – Dark-adapted vision, primarily rods
- Mesopic – Intermediate illumination

Contrast Discrimination

- At low illumination, visual acuity cannot be maintained
- Objects are discerned because of the contrast with their surroundings

Pilot's Advantage
Enemy's Disadvantage

- Fly below the enemy in dark areas over water
- Fly above the enemy in light areas – white clouds, desert, moonlit water
- Formations – Fly offset, not directly behind

Night Myopia

- With reduced illumination, a mild myopia will be noted in pilots with otherwise normal vision
- **PROBLEM:** Initial target acquisition
- **PROBLEM:** NVGs degrade vision
- **CORRECTION:** Eye rapidly readjusts when target "breaks out"

Dark Adaptation

- Requires 20-30 minutes in total darkness
- Each eye independent
- Depends on rods
- **PROBLEM:** Using red filters with cutoff of ~650 nm allows dark adaptation but problematic for presbyopia when trying to work in the cockpit
- **SOLUTION:** Night vision devices

Night Vision Devices

- Dark adaptation less important with modern systems requiring mesopic vision
- Avoid bright lights
- Close one eye
- Compatible cockpit lighting

NVG Capabilities

- Can see
  - Lighted objects >10 miles
  - Aircraft lights >50 miles
  - A lit cigarette >2 miles
- Can't see
  - Power lines / poles
  - Trees without leaves
  - Intervening ridge lines

NVG Limitations

- Reduced VA
  - 20/25 or 20/30 under *ideal conditions*
  - 20/40 *at best* in aircraft (Au or Pb canopies?)
  - May be 20/80 *or worse* at mean starlight and/or low contrast conditions, weather, and/or thumbprints!
- Limited FOV
  - more cranium movement, no peripheral cues = more risk for spatial D
- Monochromatic image - no color contrast
  - Limits object detection, recognition & distance estimation

NVG Limitations

- Goggle gain is regulated by the "auto brilliance control" circuit (ABC), designed to maintain constant image brightness (within limits)
- Aircraft lighting (internal or external) “seen” by the goggle can cause a decrease in gain and image contrast
- This results in a decreased ability to see outside the aircraft
  - This effect can range from undetectable to complete obscuration of the outside scene

NVG Foot Stomp

NOTHING

Turns Night Into Day

Except The Sun!!!

What can’t be seen must be learned!!

Goggle Glare

- "Goggle glare" possible in *some* devices
  - Diffuse haze across NVG image caused by normally compatible green light cockpit displays in specific angular relation (50-65° off axis) to optical axis of device
  - Controlled by LIF adapter, extension hoods (blocking light at bad angles) or minus blue filter (MBF) decreasing green light
- Newer goggles not susceptible

Drugs and Tobacco

- Drugs ineffective at aiding dark adaptation
- Vitamin A only useful for preexisting deficiency
- Tobacco: Effects controversial
  - Degradation of mesopic vision due to hypoxic effects of CO
  - Stimulatory effects of nicotine thought to have cause enhanced night vision in other studies
- You're a doc. Do the right thing.

Hypoxia

- Central vision relies on cones in the macula. Pilots use this central vision to read instruments.
- Hypoxia causes a rise in the cone threshold
- Degradation of night vision capability is 5% at 1100 m, 18% at 2800 m, and 35% at 4000 m

Circadian Rhythm Crew Rest

- Circadian Rhythm
  - Prevention of circadian desynchrony
  - Circadian Rhythm physiology
  - Fatigue
  - Exercise training and stress management programs

Circadian Rhythm

- “Internal Clock” ~ 25 hrs (range 21-30)
- Performance is cyclical
- Physiologic nadir from 0200-0600
- Dark/light cycle has physiologic and psychosocial roots

Circadian Rhythm
cont'd

- Adjustment of circadian rhythm takes days to weeks
- Typically allow a shift of 1-1.5 hrs (time zones) per day for recovery

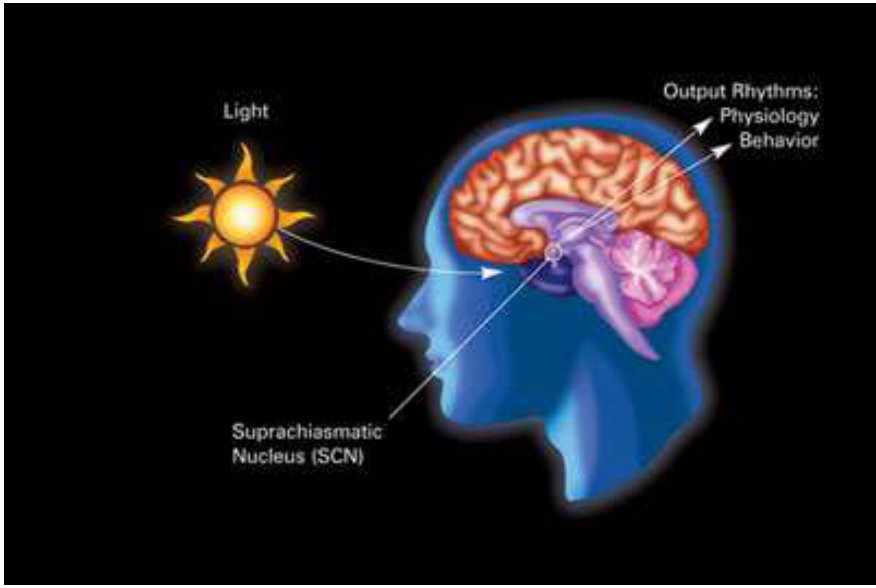
"This teddy bear and blankie are the only sleep aids the doctor had that aren't addictive."

Prevention of Circadian Desynchrony

- Allow 3 days for initial adaptation
- Full 2 weeks must be allowed for adaptation to a night schedule
- Personnel must maintain their night schedule, even on off days, or risk loss of adaptation

Circadian Rhythm Physiology

- Generated by internal "body clock" in the hypothalamic Suprachiasmatic Nucleus (SCN)
- Ambient light most powerful cue for adjusting internal clock
- Melatonin has a sedative effect



Fatigue

- Acute: Subjective feeling of tiredness experienced after demanding mental or physical activity
- Cumulative: Fatigue experienced over time resulting from a demanding workload and/or impaired rest
- Circadian: Transmeridian travel or shift of work schedules

Fatigue Alleviators

- Rest
- Attitude
- Training
- In flight naps
- Good hydration
- Understanding circadian rhythm and working with it
- Exercise

Sleep Deprivation

- Steady state of reduced arousal during periods of EEG-defined wakefulness
- Lower mood and motivation levels

Effects of Fatigue

- NASA studies revealed that fatigue has profound effect on aviation skills
- Complacency
- Communication
- Navigation

Exercise Training and Stress Management

- Good nutrition vital to fuel exercise *and* the brain
- Physical conditioning can mitigate effects of fatigue
- Work/rest schedules manipulated to maximize performance under sustained ops
- Pharmacologic aids when necessary

Sleep Quality

- Feeling rested on awakening
  - Sleep at nadir more restorative
  - Greater sleep inertia
- REM sleep (dream phase)
  - Less restful than slow wave sleep
- Slow wave sleep is deep, restful sleep occurring during first hour of sleep after prolonged wakefulness

Sleep Cycle

- Melatonin: *Not* approved for operational flying use
- Changes with age
- Circadian rhythm dictates quality of sleep
- More detailed info in briefing RSV-3A

Night Ops

The most deadly hazard in night ops is **Spatial Disorientation**

Spatial Disorientation

- Positive correlation with:
  - Night
  - Degraded visual environment (e.g. IMC)
  - Demanding mission profiles
  - Task saturation
  - Fatigue or circadian desynchrony
- Takeaway: It takes more mental energy than usual to fly on instruments

Flight Surgeon Recommendations

- Second Go: More experienced pilots. Let the less experienced guys go earlier at night
- Limit additional duties
- Restrict access to squadron when off duty
- Sleep rooms available
- Blackout curtains
- Comfortable rest environment: Dark, cool, real bed
- Proper diet
- Block schedule

Flight Surgeon Recommendations

- Land times restricted to 2230 when changing over to night ops, progressing no more than 1.5 hrs per night
- Maximum duty day of 10 hrs
- Minimum crew rest of 14 hrs
- Limit to one sortie per night
- Generic recommendations, mission requirements will dictate actual operations

Flight Surgeon Recommendations

- Periodically re-educate personnel and their families on crew rest and circadian rhythm
- Select most skilled and experienced for latest missions
- Encourage ops cancel for fatigue

Summary

- Operational aspects of night vision
- Circadian rhythm/crew rest
- Spatial disorientation
- Flight surgeon recommendations for night ops
- Next slide for quiz instructions

- Go to quiz
- Enter your answers on the answer sheet
- Print only one answer sheet for entire course
- Press ESC to go back to main menu