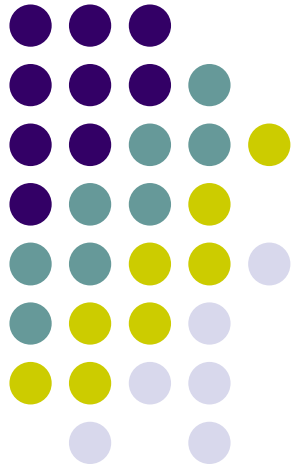
Traumatic Brain Injury in Combat and Assault Contexts

Dennis A. Kelly, Ph.D.

Pacific NW Neuropsychological Society Annual Meeting

04 March 2006



Disclaimer

The views expressed in this presentation are those of the author and do not reflect the official policy of the Department of the Army, Department of Defense, or U.S. Government.

Acknowledgement

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Defense and Veterans Brain Injury Center Washington, DC

for providing information and slides related to this topic

35¢

The Seattle Times

WEDNESDAY
January 16, 1991

WASHINGTON'S LARGEST NEWSPAPER ■ COPYRIGHT © 1991, SEATTLE TIMES COMPANY

WAR BEGINS

U.S. warplanes attack targets in Iraq, Kuwait

Associated Press and Reuters

The United States launched air attacks against Iraq early Thursday, Saudi time, hurling its mighty air force against an Arab power that for five months has held Kuwait in defiance of the rest of the world.

"The liberation of Kuwait has begun," President Bush declared in Washington.

In an address to the nation this evening, Bush said the U.S.-led allied forces would crush Iraq's chemical and nuclear weapons capability in the drive to liberate Kuwait.

He said the 28-nation coalition "exhausted all reasonable efforts" to reach a peaceful diplomatic solution to the Gulf crisis sparked by Iraq's August 2 invasion of Kuwait.

"Tonight the battle has been joined," Bush said in a nationally televised speech from the Oval Office.

"Our Secretary of State James Baker held an historic meeting in Geneva only to be totally rebuffed. In a last ditch effort the Secretary General of the United Nations Javier Perez de Cuellar went with peace in his heart and "came back from Baghdad with no peace at all. Now 28 countries on five continents having exhausted all efforts found they had no choice but to drive Saddam Hussein out of Kuwait by force."

"While the world waited, Saddam Hussein met every overture of peace with open contempt. While the world prayed for peace, Saddam prepared for war," Bush said.

"He subjected the people of Kuwait to unspeakable atrocities. Among those maimed were innocent children."

Bush said U.S. air forces concentrated their attacks on Iraqi military operations throughout Iraq.

Intense reaction at home

Times staff

News of the bombs that fell in Baghdad this afternoon was greeted with horror, anger and hope here in Washington State.

Reaction was intense. Some cheered the news. Others cried. Some people made new plans. Others tore up old ones.

"We're in shock and we're absolutely appalled and in total opposition to what the Bush administration is doing," said George Potratz of the Seattle Coalition for Peace in the Middle East. "We're pledged to oppose this war in every way that we can."

"It's about time," said Skip Funk, a 43-year-old commercial fisherman from Tacoma whose wife, Lt. Col. Donna Funk, is stationed in the Gulf.

At the Veterans of Foreign Wars Post 2995 in Bellevue, veterans were riveted to the television as the news of war hit.

"I had mixed feelings," said Kenny Johnson. "In one way I was glad to see us finally stand up to Hussein. On the other hand, I have a 19-year-old son, and I don't want to see him join and go through what I went through."

Richard Paul, an ex-Marine who served in Vietnam, said that, as he watched a television reporter in Saudi Arabia describe the noise of the American jets taking off, "the thing that came back to me was all the noises of war."

"My first thought was 'that s.o.b.,'" said Don Gordon, an Air Force veteran who served in Vietnam from 1968-69 referring to Bush's decision to begin the war. "I thought he would allow a little more time. I can understand him playing football politics, but I

THE GROUND WAR: Complete coverage on Pages A2-A6 PAGE A2

Seattle Post-Intelligencer

A HEARST NEWSPAPER

WEDNESDAY MORNING FEBRUARY 27, 1991 35 CENTS

Iraqis in full retreat

The Associated Press

In a picture taken from television, soldiers unfurl the Kuwaiti flag in Kuwait City yesterday, marking freedom from Saddam Hussein's forces.

Allies enter Kuwait City; U.S. armor cuts off Guard

P-I News Services

DHAHRAN, Saudi Arabia – Iraqi troops were in headlong retreat across most of Kuwait today, the U.S. command said, and allied forces entered Kuwait City, a smoking wreck, after its Iraqi occupiers fled the capital of the nation they conquered Aug. 2.

The Kuwaiti flag was raised this morning in Sabat Square in central Kuwait City as a small group of Kuwaiti soldiers sang the national anthem. The ceremony was shown on CNN.

Baghdad radio announced this morning that its withdrawal from Kuwait was complete. The report was monitored by Iran's news agency.

Allied officials said the vanguard of allied armored columns punched through to the Euphrates River in Iraq, cutting the main line of retreat for the Republican Guard.

Powerful American and British armored forces farther south, near the Iraqi border with Kuwait, girded for a battle with Guard tank units if they chose to make a last stand.

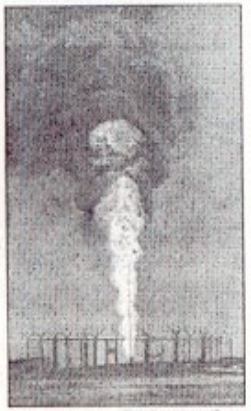
Thousands of allied tanks under the command of the U.S. VII Corps were lining up against Guard units west of the Iraqi city of Basra for what the allies said could be the decisive battle of the war.

President Bush said Iraqi losses amounted to a rout, and allied generals predicted privately the war could end within a few days.

All night long, American warplanes pummeled Iraqi tanks, armored personnel carriers and trucks on the road leading north from Kuwait City as they sought to reach Basra, pilots said.

The movement created a column 25 to 30 miles long, three or four abreast in places, and except for a few surface-to-air missiles, they were defenseless against the F-15, F-111 and F-16 fighter-bombers that came at

See **WAR**, Page A6



The Associated Press

Flames spew from an oil well in Kuwait set ablaze by Iraqi troops.

Stark reality, joy set tone in freed capital

The Associated Press

KUWAIT CITY – There was joy amid the ruins.

Residents who cowered under the Iraqi juggernaut for nearly seven months raced into the streets of their once-prosperous city yesterday to embrace the first wave of allied forces.

Kuwaiti resistance leaders waved their weap-

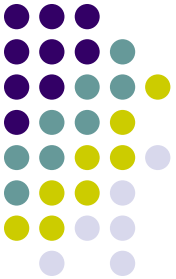
U.S. aims at rout of Iraq

Only unconditional surrender acceptable,

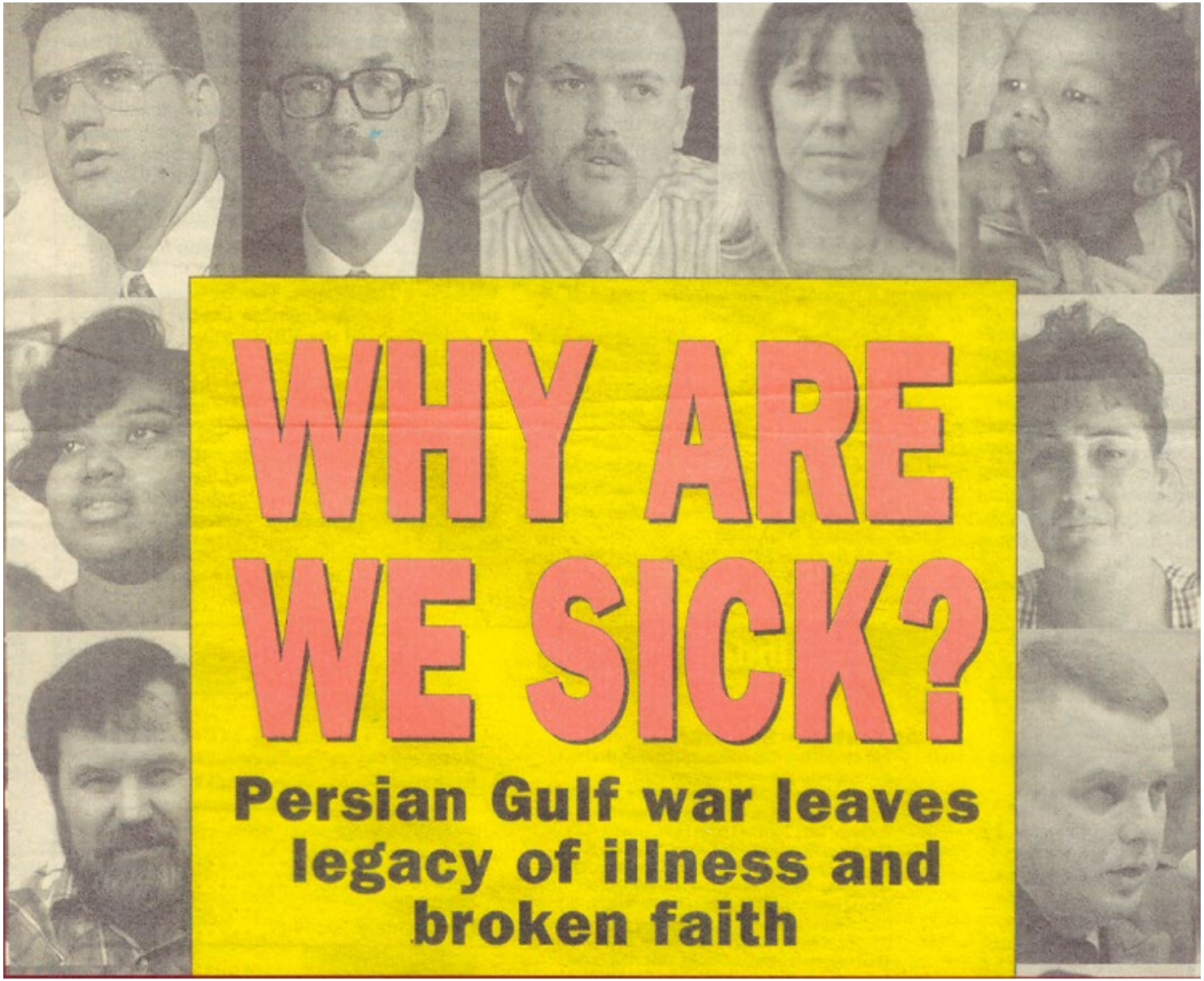
THE "GOOD NEWS"

- Only 47 days – shortest war in U.S. history
- Fewer than 300 deaths and 400 wounded (only 147 combat deaths)
- Compared with estimated 100,000 Iraqi soldiers killed and 300,000 wounded
- Mass chemical and biological attacks did not occur

THE “BAD NEWS”



- Reports of frequent sounding of chemical alarms, dead animals
- Reports of strange, debilitating symptoms
- Beginning with reservists, then spreading to active duty, family members, then from Americans to other nationalities



WHY ARE WE SICK?

Persian Gulf war leaves legacy of illness and broken faith

Gulf War II -- “Shock & Awe”

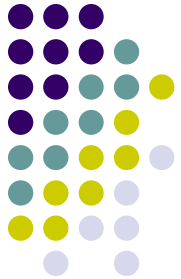
- Focused on psychological destruction of the enemy's will to fight through rapid physical destruction of military forces
- More cruise missiles were launched in first day of War than in first 40 days of Gulf War I
- 80 percent precision-guided, as compared with 10% in Gulf War I


TURKEY
SYRIA
IRAQ
JORDAN
SAUDI

Jean-Marc Bouju / AP

Eric Feferberg / AFP

Gulf War II



- The “Bad News:”

  As of this date,

  * Almost 2,300 troops killed in Iraq
  * Almost 300 troops killed in Afghanistan
  * Almost 18,000 wounded in action

- The “Good News:”

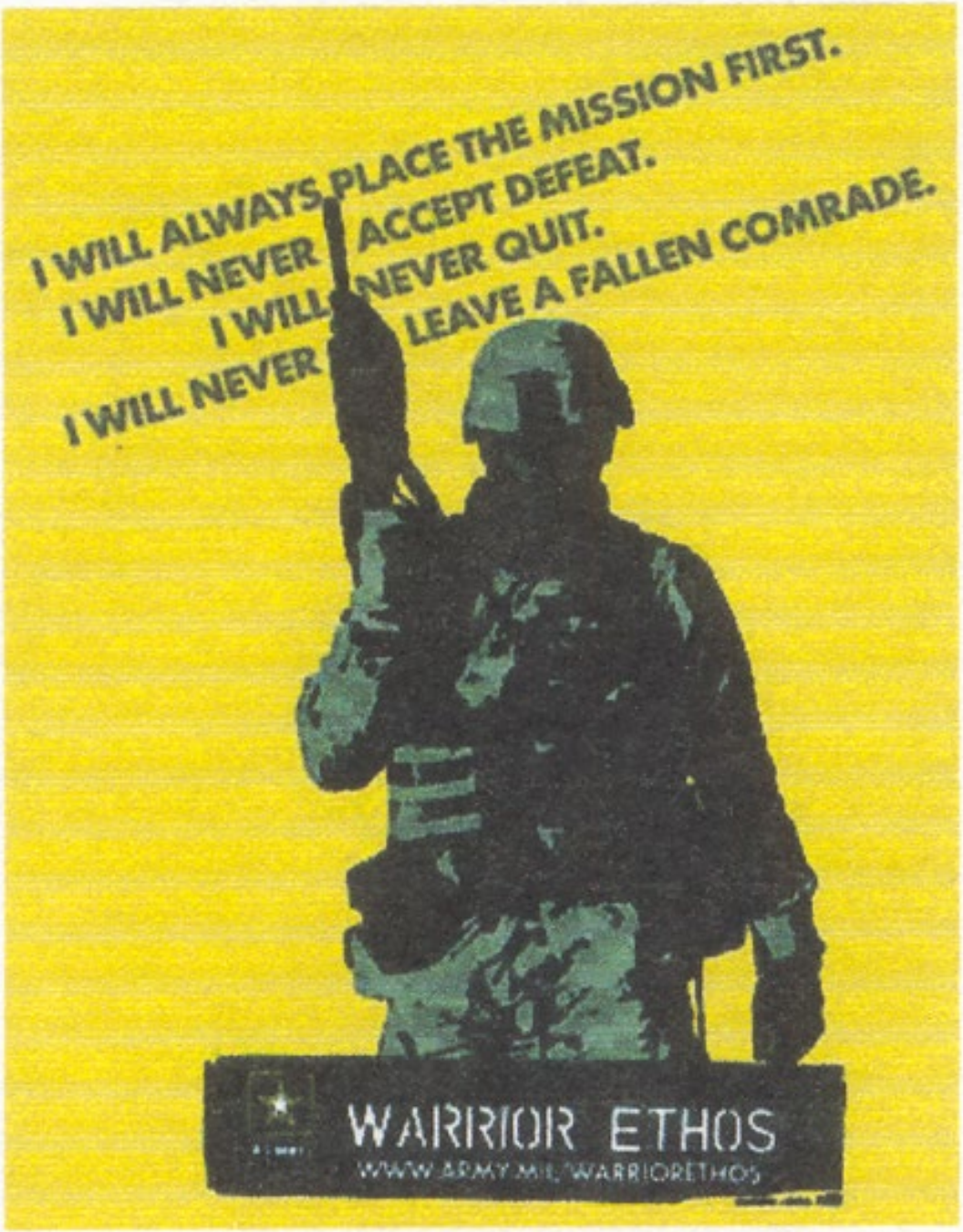
  ???

Health Screening of the Troops

- More pre- and post-screening than in previous wars
  - Health Risk Assessment (HRA)
  - Soldier Wellness Assessment Pilot Program (SWAPP)
- Both good and not-so-good news
  - Validity of self-report?

Challenges for the Current Force

- War is the norm, peace is the exception
- Our adversaries seek adaptive advantage through asymmetry
- We have near peer competitors in niche areas
- Conventional Force on Force conflicts are still possible
- There is an enormous pool of potential combatants armed with irreconcilable ideas
- Our homeland is part of the battlespace
- We are adapting to these challenges NOW


I WILL ALWAYS PLACE THE MISSION FIRST.
I WILL NEVER ACCEPT DEFEAT.
I WILL NEVER QUIT.
I WILL NEVER LEAVE A FALLEN COMRADE.
WARRIOR ETHOS
WWW.ARMY.MIL/WARRIORETHOS

Traumatic Brain Injury Description

Severity	GCS	LOC	PTA
Mild	13–15	<20 min-1 hr	<24 hr
Moderate	9–12	1 – 24 hrs.	> 24 hrs. - <7days
Severe	3–8	>24 hrs.	>7 days

GCS = Glasgow Coma Scale
LOC = Loss of consciousness
PTA = Posttraumatic amnesia

Concussions

Grade 1

- Transient confusion
- No loss of consciousness
- Symptoms or mental status abnormalities resolve in 15 minutes or less

Grade 2

- Transient confusion
- No loss of consciousness
- Symptoms or mental status abnormalities last more than 15 minutes
- Anterograde amnesia 5 minutes or less

Concussions

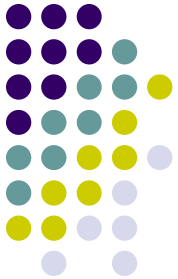
Grade 3

- Any loss of consciousness, either brief (seconds) or prolonged (minutes)
- Symptoms or mental status abnormalities last more than 15 minutes
- Brief anterograde amnesia and retrograde amnesia

Grades 4 & 5

- Above symptoms plus unconsciousness between 5-10 minutes and longer than 10 minutes respectively

Immediate Signs of Concussion (may occur within seconds to minutes)



- Slurred or incoherent speech
- Gross incoordination
- Disorientation
- Impaired attention – vacant stare, delayed responses, inability to focus
- Impaired memory
- Emotional reactions out of proportion

Later Signs of Concussion (may occur within hours to days)

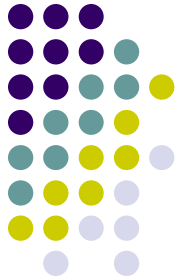
- Persistent headache
- Nausea or vomiting
- Difficulty concentrating
- Difficulty remembering
- Drowsiness or easily fatigued
- Irritability/easily angered
- Dizziness/vertigo
- Bothered by loud noise or bright lights
- Anxiety and/or depression
- Sleep disturbance

Post Concussive Syndrome

- Nearly 15% of patients with mild head injury continue to complain of symptoms 1 year or more after their injury
- Lingering symptoms and continuing cognitive deficits may occur for weeks or months after injury
- Associated with concussions of

  Grades 2-5

Post Concussive Symptoms in Mild TBI



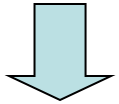
- Natural history is recovery within weeks/months
- A small percentage will have persistent symptoms
- Repeat concussions – more morbidity

Complications in Recovery (cf. Erin Bigler)

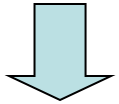
- Effects of CHI can be “silent”
- Day of injury scans often not reliable markers of what future holds in store
- F/U scans over 2-3 years often show brain deterioration, even for moderate CHI’s
- CHI represents a risk factor for later dementia
- Mental health problems are common following CHI (more severe CHI’s typically report fewer problems due to lack of awareness)
- Above effects are exacerbated with repeated CHI’s

Typical Geographic “Flow” for Injured Soldiers

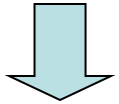
U.S. Military Hospital in Balad, Iraq



Landstuhl Regional Medical Center, Germany

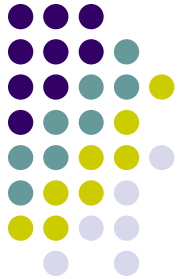


Walter Reed/ Bethesa, Wash. D.C.



Local MTF’s/Units

Defense and Veterans Brain Injury Center (DVBIC)



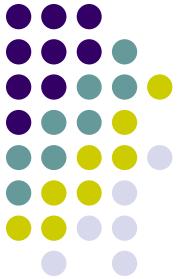
- DVBIC, founded in 1991 as Defense and Veterans Head Injury Program (DVHIP)
- The DVBIC mission:
  - conduct clinical research
  - ensure optimal clinical care
  - education for military, veterans, and their families.
- Military Sites: Walter Reed, San Diego Naval, Wilford Hall AirForce/Brooke Army Medical Center
- Richmond, Minneapolis, Palo Alto, Tampa
- 1 civilian community reentry program – Va NC

Blast Injuries

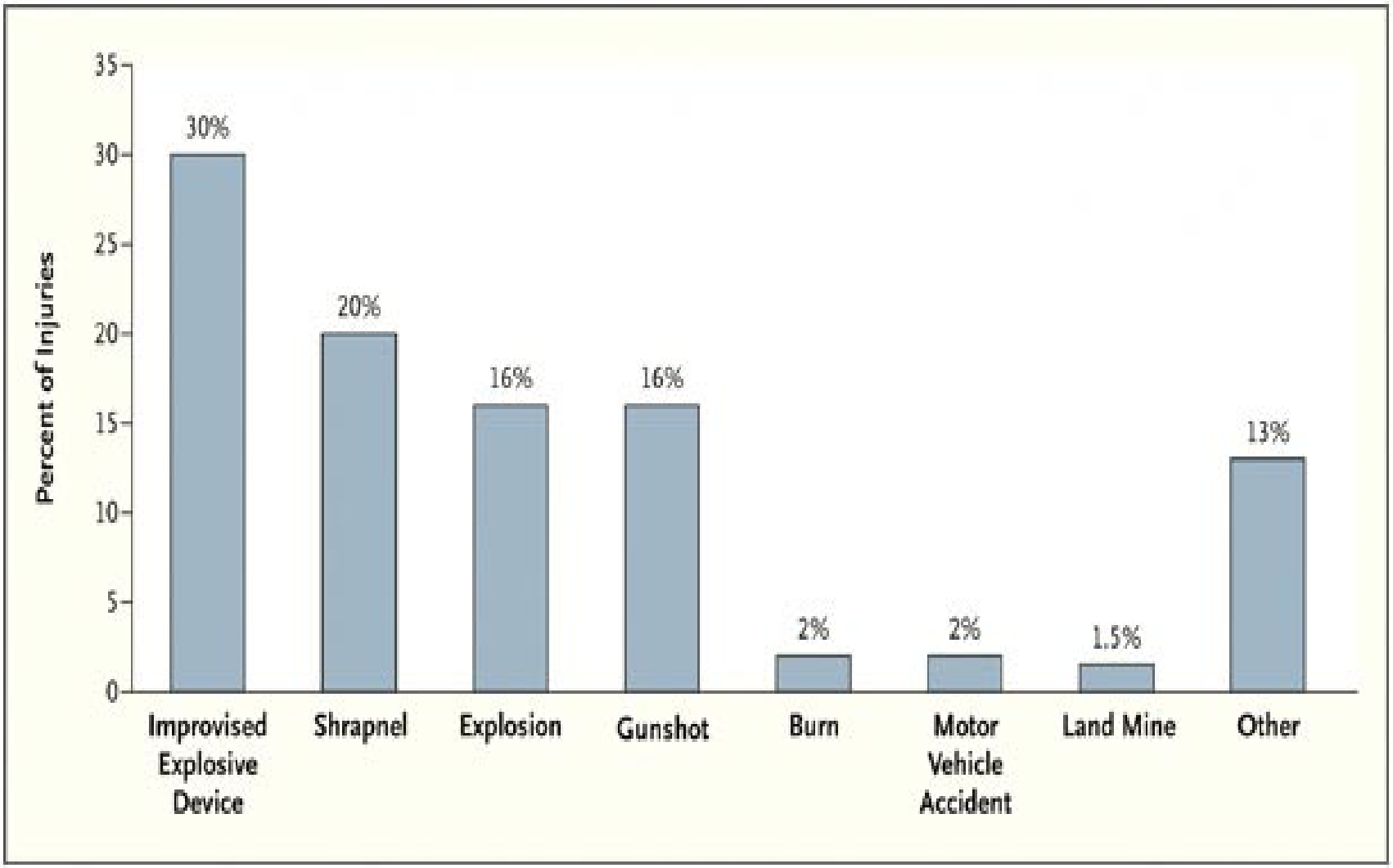
- 59-70% of blast-exposed patients from Iraq and Afghanistan admitted to Walter Reed had brain injury

- Concern that “silent” brain injuries potentially could represent another “Gulf War Syndrome”

Types of Blasts Common in Iraq & Afghanistan



- Mortars
- Land Mines
- Rocket-Propelled Grenades (RPG's)
- Charges to open buildings
- Improvised Explosive Devices (IED's)


Percent of Injuries
35
30
25
20
15
10
5
0
30%
20%
16%
16%
2%
2%
1.5%
13%
Improvised Explosive Device
Shrapnel
Explosion
Gunshot
Burn
Motor Vehicle Accident
Land Mine
Other

Walter Reed Iraq/Afghanistan TBI Experience

Initial 433 patients with TBI seen at WRAMC from 1/03 to 4/05

- 68% of injuries were due to explosion/blast
- 88.5% were closed TBI
- 95.4% were male, with a modal age of 21 years
- Post Traumatic Amnesia (PTA) $\leq$ 24 hours: 43%
- Mortality after reaching Walter Reed was 0.9%

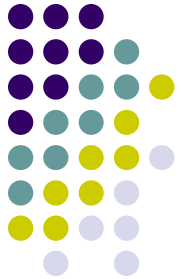
Warden et al., Journal of Neurotrauma 2005; 22:1178

Walter Reed TBI Experience (cont.)

- Complications - 14% shock; 9.5% hypoxia; 25% skull fracture; 18.7% subdural hematoma; and 1.5% epidurals
- 6% had seizures
- 19% had limb amputations; lower extremity most common
- 91 % reported post concussive symptoms:
  - headache (47%)
  - memory deficits (46%)
  - irritability/aggression (45%)
  - attention/concentration difficulties (41%)
- Of 43% with a psychiatric symptoms noted, depression was the most common (27%).

Warden et al., Journal of Neurotrauma 2005; 22:1178

DVBIC TBI Screening, Evaluation – WRAMC



- Those at risk based on mechanism of injury
- Any LOC, impaired memory for or after the event
- Symptom Screen, Cognitive Screening (RBANS) and/or full neuropsychological evaluation
- Audiologic, neurologic, psychiatric psychosocial evaluation; EEG; MRI as clinically indicated

Combat Experiences

N = 3671	Army %	Marines %
Saw dead bodies	93	94
Been shot at	93	97
Know someone wounded or killed	86	87
Saw injured or killed Americans	65	75
Responsible for enemy deaths	48	65
Engaged in hand-to-hand combat	22	9
Were wounded	14	9

Hoge, C.W., et al. (2004). Combat duty in Iraq and Afghanistan: Mental health problems and barriers to care. NEJM, 351.

Reasons for Not Seeking Help

- Would be seen as weak → 65%
- Unit leadership might treat them differently → 63%
- Members of unit might lose confidence in them → 59%
- Difficult to get time off for treatment → 55%
- Unit leaders would blame them for the problem → 51%
- It would harm their career → 50%
- Difficult to schedule an appointment → 45%

Kevlar Pro and Con

- Kevlar body armor and helmets – shield wearer from shrapnel and bullets
- However, not well-padded and provides little protection from concussion injuries
- Reduce penetrating injuries seen in previous wars but may actually increase concussion injuries

Blast Injuries

Multifactorial injury mechanisms:

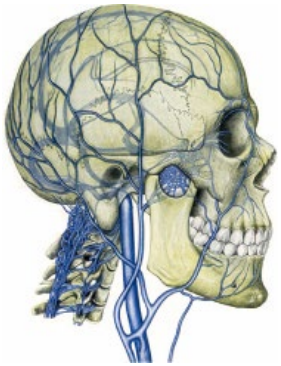
1. **Primary**: Direct exposure to overpressurization wave – velocity >/= 300m/sec (speed of sound in air)
2. **Secondary**: Impact from blast energized debris – penetrating and nonpenetrating
3. **Tertiary**: Displacement of the person by the blast and impact
4. **Quaternary**: Burns/Inhalation of gases

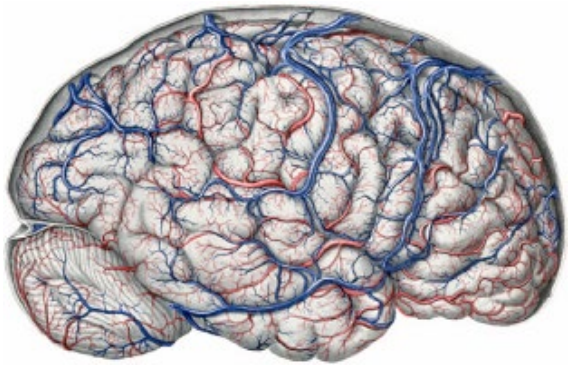
- May be combined with MVA in war theater

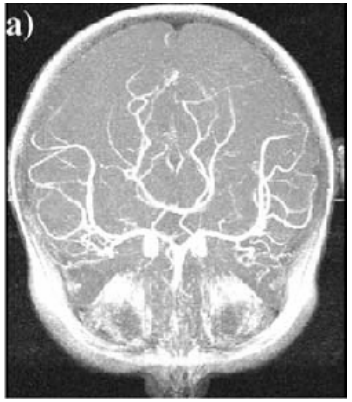
Shock Wave & Brain Injury

Potential Mechanisms

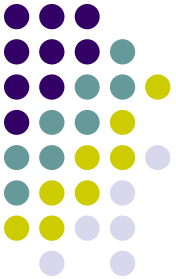
- **Biomechanical** – Coupled fluid-structures interaction during compression wave propagation in brain parenchyma, inertial shear/deformation of brain tissue, damage to axons, glia, and blood-brain barrier (BBB).
- **Hemodynamic** – Blood and pressure distribution in brain, local hemorrhage, edema, hematoma, increased ICP
- **Neurobiologic** – DAI, rise of intracellular Ca^{++}, apoptosis
- **Metabolic** – inflammatory response, hypoxia, ischemia







Co-Morbid Conditions



- Sleep Disorders
- Hearing Loss
- Pain
- Emotional Disturbances

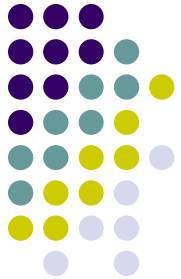
MAMC Patient Groups 2004-2005

- Blast Exposures/Injuries (N = 25)

- "Blast Plus" -- Multiple Blast Exposures and/or other neurologic/medical conditions (e.g., Hx. sleep apnea, prior TBI) (N = 20)

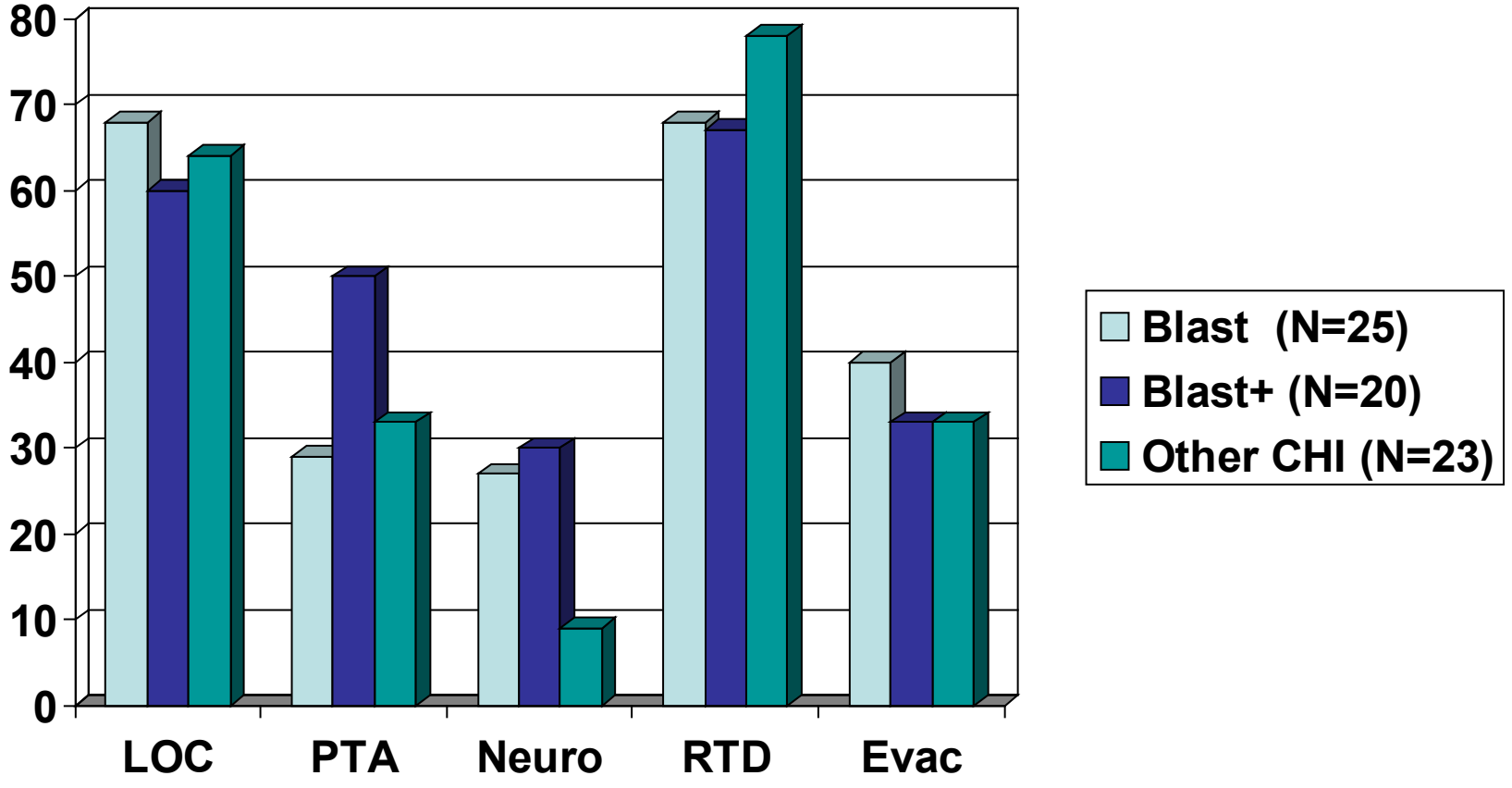
- Head Injuries due to other factors (e.g., MVA, falls) (N = 23)

MAMC Patient Groups 2004-2005

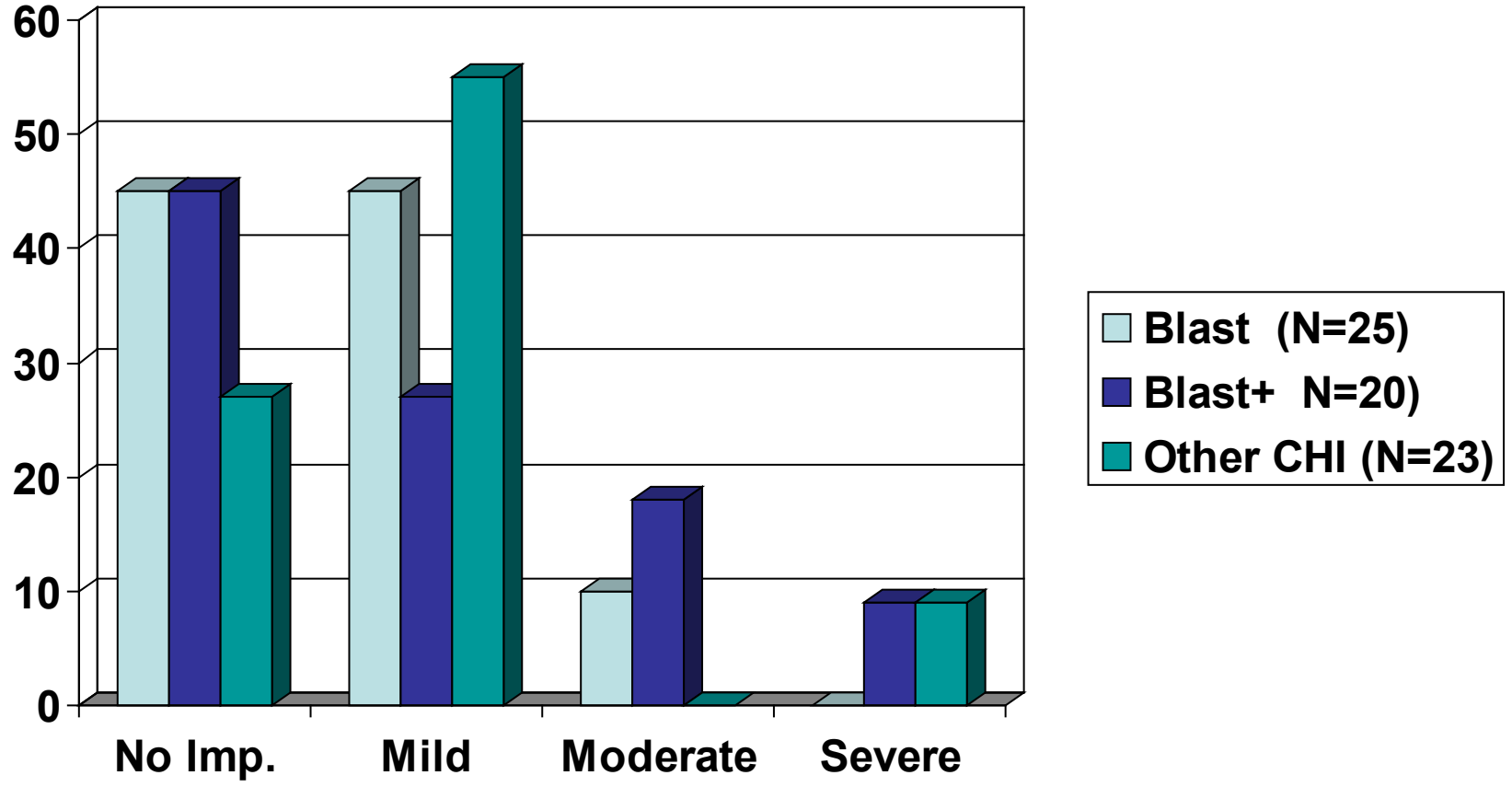


- Reported LOC ranged from “seconds” to “2 days”
- Reported PTA ranged from “less than 30 minutes” to “1-2 weeks”
- 52% undergoing Medical Evaluation Boards – received full HRB
- Almost all of remainder received ½ day battery

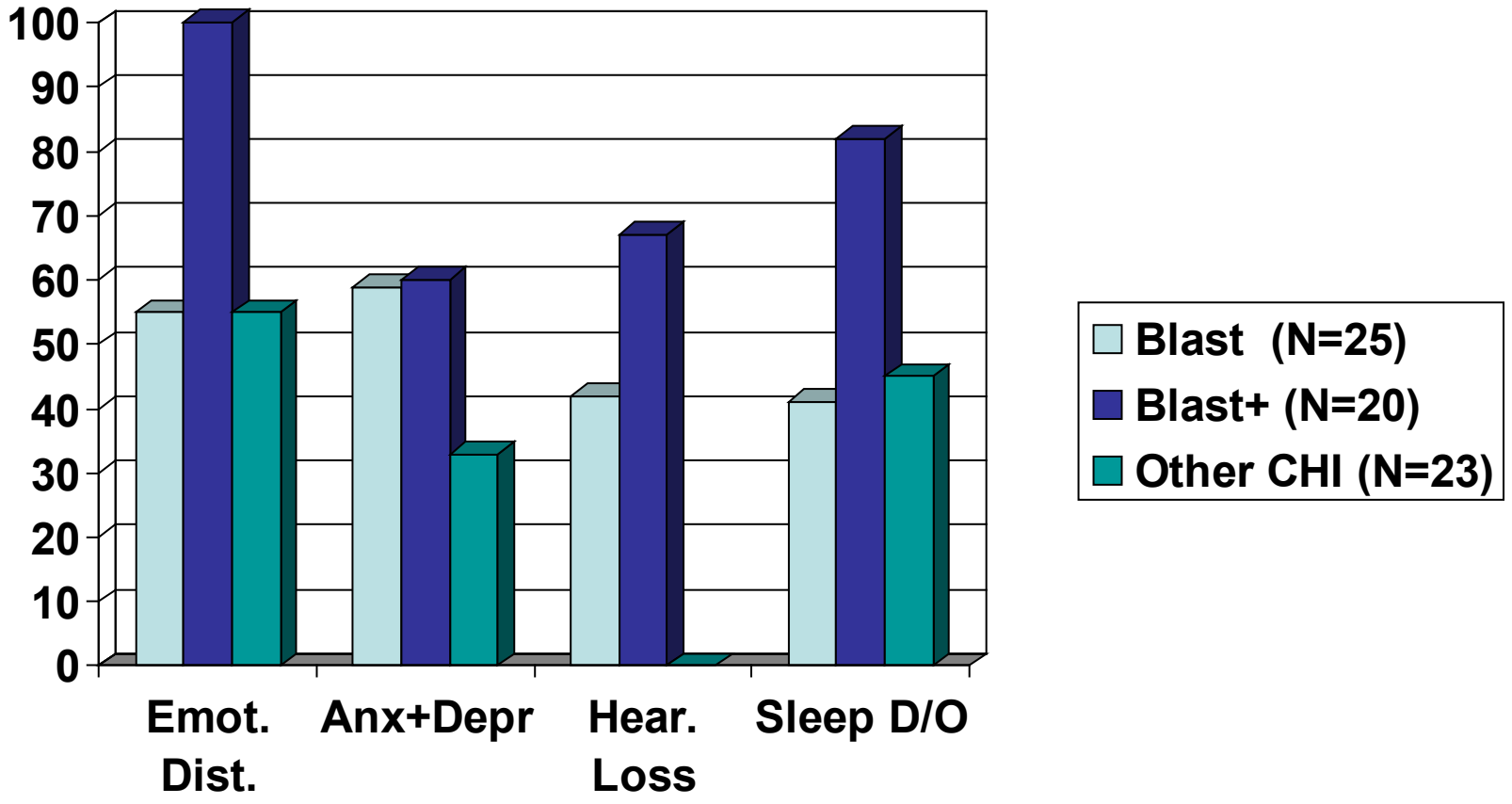
MAMC Iraq/ Afghanistan Returnees (Percentages)



MAMC Returnees – Degree of Npsych. Impairment (Percentages)



MAMC Returnees – Co-Morbidities (Percentages)



MAMC Summary

- Generally moderate concussions (Grades 3-4) – LOC's but mostly brief
- Most soldiers returned to duty and completed deployment
- Generally little to mild impairment on formal neuropsychological evaluation
- Relatively high degree of co-morbid conditions, such as emotional disturbance
- "Blast Plus" group showed slightly more neuropsych. impairment and more co-morbid conditions

CompanyCommand

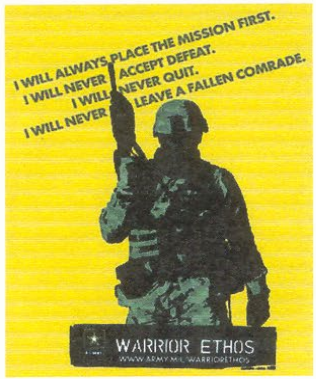
Building Combat-Ready Teams

To: Company Commanders

From: Company Commanders

CC *is* company commanders. We are in an ongoing professional conversation about leading Soldiers and building combat-ready teams. Company Commanders connect at: http://CompanyCommand.army.mil

Developing the "Killer Instinct" in Your Soldiers



"This training is designed to be uncomfortable—physically first, then mentally—to take Soldiers to dark places, under control, so that if they are ever taken there by the enemy, it's not their first time."

Company commander introducing that morning's combatives training to his Soldiers

One part of the warrior ethos is ferocity in combat, and the innate capability and powerful motivation to kill the enemy and to never give up—regardless of the circumstances. One question we have been wrestling with in the CC forum lately is, "How do we cultivate this killer instinct in our Soldiers?"

In this article, we will present some excerpts from the conversation that is still ongoing in the CC forum. Our desire is that the article sparks thinking and conversation about this critical subject, both in your unit and in the forum.

The Mindset

George Corbari

B/5-7th ADA (Patriot), 69th ADA BDE, V Corps

At the crux of this discussion is the "warrior mindset." It's not about being 6'2" and 240 pounds of anger—it's about making conscious choices about how you think. The killer instinct is a combination of confidence, concentration, and tenacity. Those qualities are next to worthless without the physical skill and ability to complete the task—but so, too, are the physical abilities without the proper mindset.

We train mental toughness not by throwing people who can't swim into the water, but by teaching people how to deal with extreme situations, by teaching people how to focus effectively, by teaching Soldiers the importance of confidence and how to build and maintain that personal confidence. Here's a mindset TTP that commanders can use before every mission:

When rehearsing actions on the objective, do more than just discuss the mechanics of the fight. Help Soldiers really visualize the battlefield by integrating all five senses. Talk about what they'll see, hear, smell, touch and even taste. For those who haven't been there, the details of combat won't be such a shock to them.

The Personal Nature of Killing

Clete Goetz

642nd EN CO, 548th CSB, 10th MTN DIV

Killing someone becomes more difficult as the means of their demise becomes more personal. For example, strangling or stabbing someone is more abhorrent psychologically to the average person than shooting someone through open sights. I recommend you read Dave Grossman's *On Killing*.

Incorporating combatives, knife-fighting techniques, take-downs, etc., will help to create killers. If you can train Soldiers to stab someone, you can expect them to shoot the enemy when required. You must create the mindset in them that killing the enemy is an acceptable action when given the permission to do so by legitimate authority.

Combatives as a Vehicle

Matt Michaelson

SS-21 OPFOR RS '95, B/4-5th ADA & D/4-5th ADA, 1st CAV DIV

Our Soldiers' ability to react—and even act—under duress, pain, and seemingly insurmountable odds remains the hallmark of the warrior ethos. Tenacity against the enemy must be trained, expected, and demanded—but

Killer Instinct

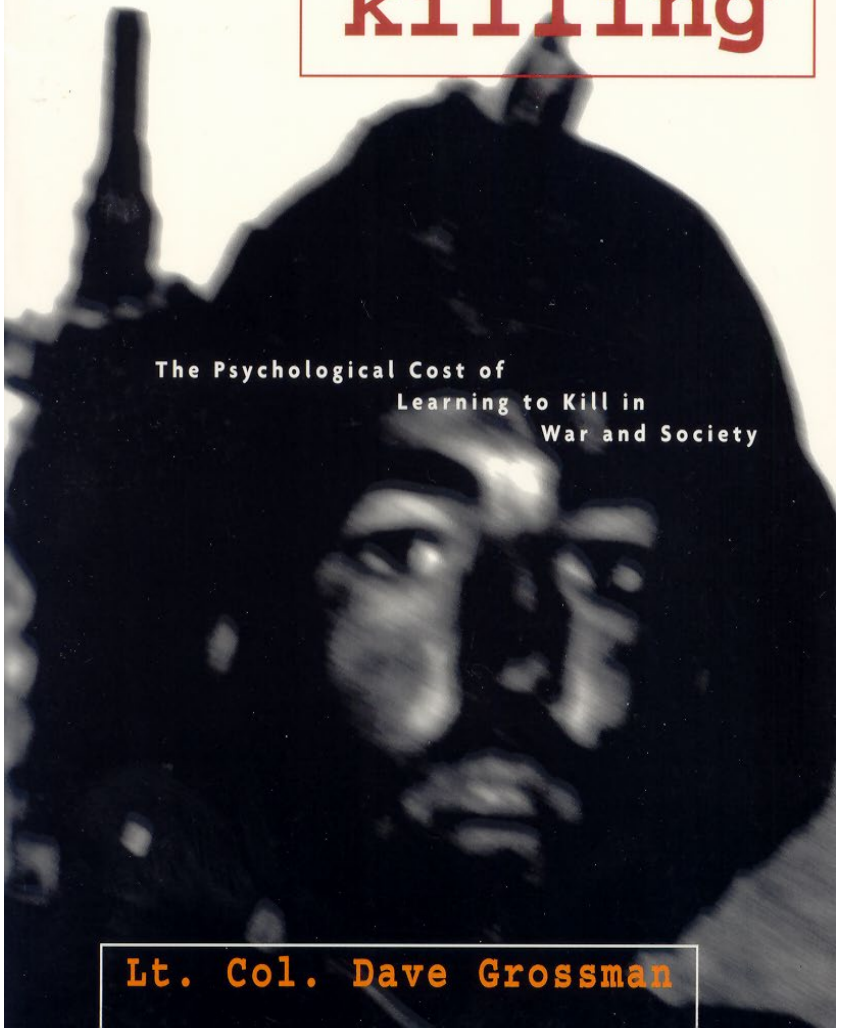
"The biggest problem I see in developing the killer instinct is getting people to overcome some longstanding habits fairly quickly. Soldiers must acknowledge that as humans, they are predatory by nature. It's only recently that our culture's habits have been less aggressive, less predatory. We must put Soldiers back in touch with their nature as such…Once you have learned to kill mentally, The physical part is easy. The hard part is turning it off when necessary."

Dr. Nate Zinsser, Center for Enhanced Performance, USMA

"An illuminating account of how soldiers learn to kill and how they live with the experience of having killed."

—*Washington Post*

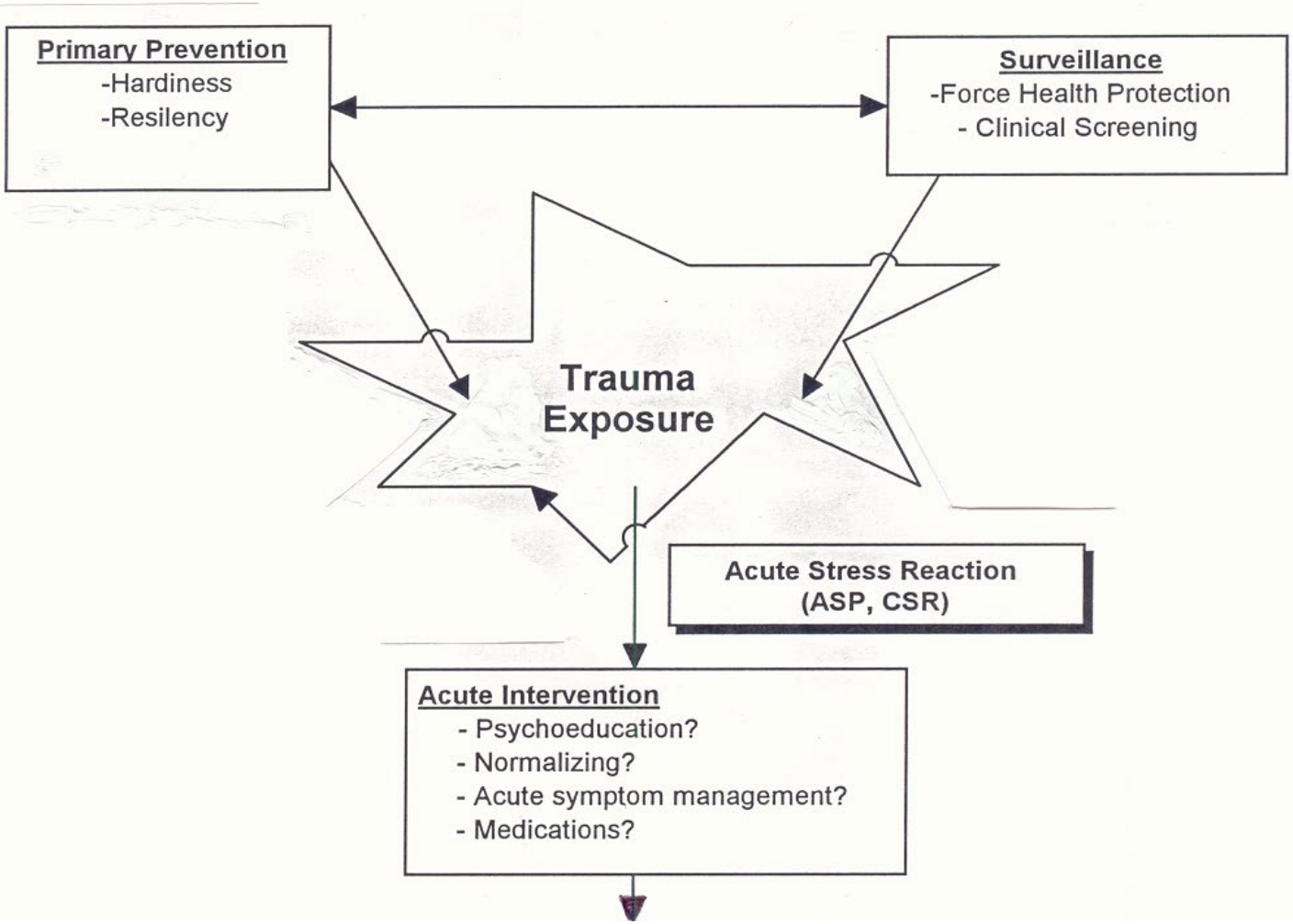
on killing

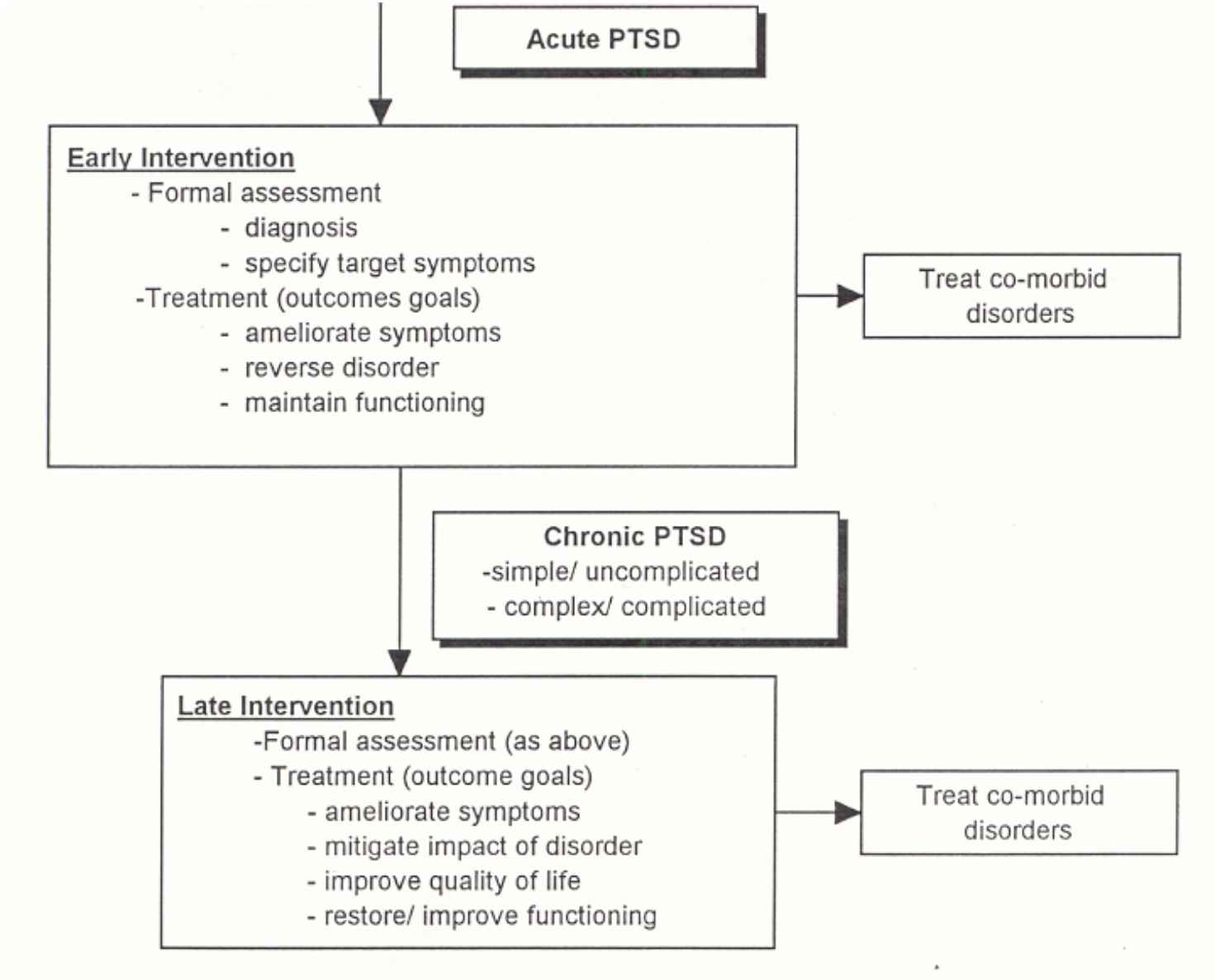


The Psychological Cost of Learning to Kill in War and Society

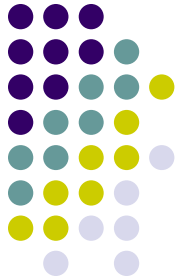
Lt. Col. Dave Grossman

DoD/VA Guideline(s) for Management of Traumatic Stress



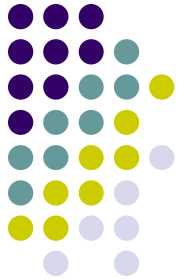

Acute PTSD
Early Intervention
- Formal assessment
- diagnosis
- specify target symptoms
-Treatment (outcomes goals)
- ameliorate symptoms
- reverse disorder
- maintain functioning
Treat co-morbid disorders
Chronic PTSD
-simple/ uncomplicated
- complex/ complicated
Late Intervention
-Formal assessment (as above)
- Treatment (outcome goals)
- ameliorate symptoms
- mitigate impact of disorder
- improve quality of life
- restore/ improve functioning
Treat co-morbid disorders

Medical and Physical Evaluation Boards



- Medical Evaluation Board collects data relevant to soldier's fitness for duty
- Physical Evaluation Board determines fitness and compensation (if appropriate)
- "Ratable" conditions
- Special case of PTSD
  - May require collateral information /sworn statements that alleged stressor occurred and that person really has sx.
  - Must be "severe" stressor
  - May be "combat stress reaction" instead
  - Traditional principles of combat psychiatry (e.g., Proximity, Immediacy, Expectancy → "PIE")

Neurobiological Effects in Psychological Trauma



- Dysregulation of the norepinephrine, hypothalamic-pituitary-adrenocortical (HPA), thyroid, endogenous opioid, and serotonin systems
- Neurochemical correlates of chronic physiologic arousal lead to reduced regulation of autonomic reactions and reduced capacity to respond normally to both internal and external stressors.
- Glucocorticoids and hippocampal atrophy (Robert Sapolsky)
- Neurobiology of Childhood Abuse (Martin Teicher)
- “Vicious Circle” when TBI is added?

Summary

- TBI in the current combat environment is common, with multiple blast exposures for many soldiers
- Service members often returned to duty prematurely
- Service members typically show “warrior ethos”
- Our population showed mild formal neurocognitive impairment, but this was often in association with co-morbid conditions (e.g., sleep disorder, PTSD) that complicated symptom picture

Areas for Study

- Concussion Management in Theater
  - Assessment - cognitive – Standardized/Military Assessment of Concussion;
    - Other symptoms – instruments for Post Concussive Sx
  - Education for first providers re: management. In general, if symptomatic (and if possible) – rest; protect from new injury

- Pre-and post-deployment screening that uses more than self-report

- Relationship between TBI and co-morbid conditions such as sleep disorder and PTSD

- Factors of resilence