NEUROLOGICAL ASSESSMENT

STUDENT HANDBOOK

DAN® SOUTHERN AFRICA

NEUROLOGICAL ASSESSMENT STUDENT HANDBOOK

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This programme meets the current recommendations from the October 2015 Guidelines Update for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care issued by the International Liaison Council on Resuscitation (ILCOR)/American Heart Association (AHA).

3rd Edition, January 2016

First edition published October 2006.
Second edition published January 2012.

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1 Neurological Assessment Course Overview

According to the American Heart Association 2011 update, stroke is the third-leading cause of death and the leading cause of long-term disability.[1] Familiarising first aid providers with a stroke assessment tool is part of the 2015 American Heart Association Guidelines update for CPR and ECC (emergency cardiac care).[2] Decompression illness (DCI) is a much less common cause of neurological injury. The overall incidence of this diving-related injury is 2-4 cases per 10,000 dives.[3]

Regardless of underlying cause, the presence of a neurological injury is frequently revealed by performance of a neurological assessment.

The Neurological Assessment course trains participants to perform a basic neurological examination as part of the initial medical evaluation. There are two primary goals of this programme:

1. Provide first responders with the skills necessary to discover signs of acute neurological injury
2. Minimise treatment delays through rapid activation of emergency medical services (EMS)

Successful completion of the Neurological Assessment course includes demonstrating skill competency and passing a final knowledge assessment. Upon completion, you will receive a provider card indicating that you have been trained in basic neurological assessment techniques.

First Responder Roles and Responsibilities

First aid is the provision of initial care for an injury or illness. The three key aims of first aid are to (1) preserve life, (2) prevent the condition from worsening and (3) promote recovery. All skills performed in an emergency should be within the scope of one's training. Maintain skills and knowledge proficiency by participating in supervised practice sessions and reading current literature.

Reading this handbook without instruction and practice will not make someone competent to complete a neurological assessment.

Prerequisites

There are no prerequisites for this programme.

Retraining

Emergency-response skills deteriorate with time. Retraining is required every two years to maintain Neurological Assessment Provider certification. Your Neuro Instructor can provide information about retraining programmes. In addition, regular practice is encouraged, when possible, to retain skill proficiency.

Continuing Education
Other first-aid programmes that may be available through your HMLI instructor include Basic Life Support: CPR and First Aid, Emergency Oxygen for Scuba Diving Injuries, Neurological Assessment, and CPR: Health-Care Provider with First Aid. Two additional programmes that encompass content from multiple courses are Dive Emergency Management Provider and Diving First Aid for Professional Divers.

While certification in these programmes is not required for participation in the Neurological Assessment course, it is strongly recommended that you obtain training in these essential lifesaving skills.

How to Use this Handbook
Each chapter in this student handbook contains three distinct features.
- The beginning of each chapter has a list of questions to assist with learning. This is the information you should look for as you read the material, complete the knowledge development sections, and participate in class discussions
- Boxes with the word "NOTE" provide explanations that are important for understanding the material just presented
- Boxes labeled "Advanced Concepts" contain additional information beyond what is required for this course. It is enrichment for those students who want to know more

Terminology
To help readers who may be unfamiliar with some medical terms introduced in this student handbook, a glossary of terms is provided in the back of this book. Familiarity with basic medical terminology will enhance the quality of communications with emergency and health-care workers.

2 Nervous System Overview

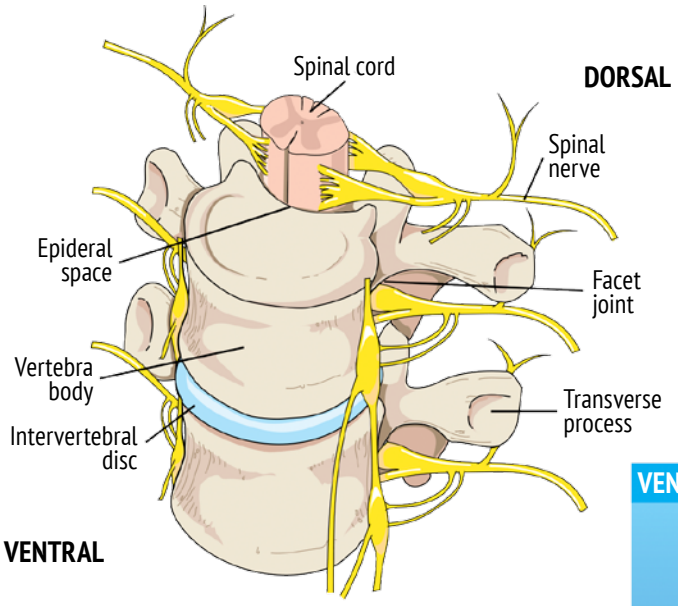
CHAPTER 2 OBJECTIVES

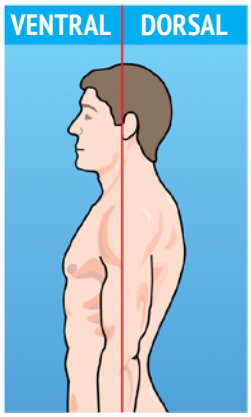
1. What are the primary components of the nervous system?
2. What is the functional unit of the nervous system?
3. What are possible causes of interruptions along neural pathways?

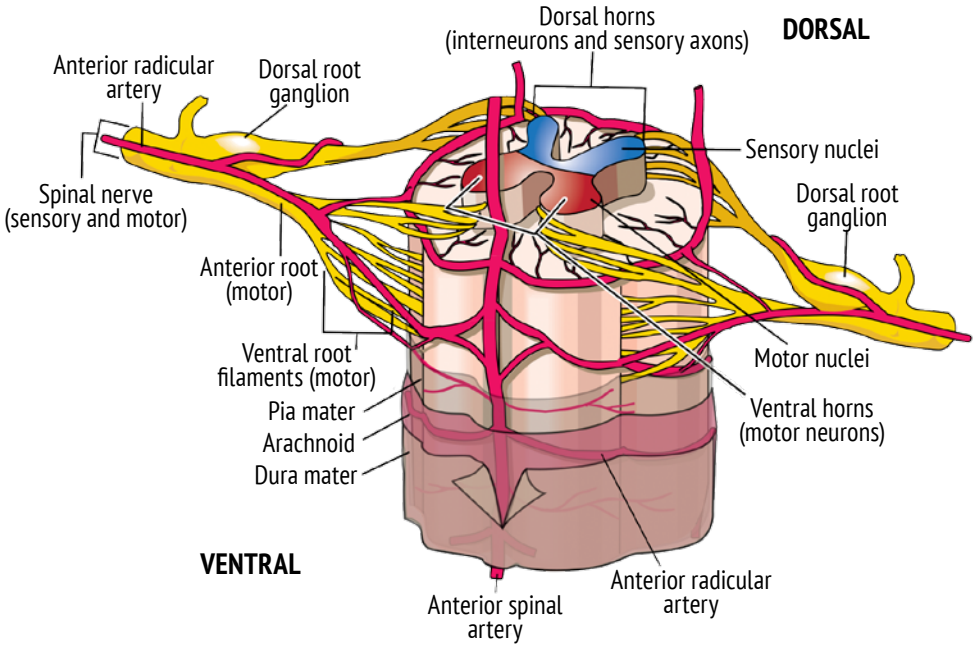
The primary components of the nervous system are the brain, spinal cord and nerves. The brain and spinal cord form the central nervous system, and the nerves that extend from the spinal cord or brain out to the body comprise the peripheral nervous system. The functional unit of this system is the nerve cell or neuron.

The spinal cord is the interface between the central and peripheral systems, and contains the nerve tracts or columns that conduct impulses either to or from the brain. Sensory tracts travel up the dorsal or posterior columns and motor tracts are located along the ventral or anterior columns.

Trauma, stroke or DCI may result in interruptions of nerve pathways at any point along a tract or peripheral nerve and may cause symptoms or signs of neurological injury. This course will provide you with the skills needed to test for and recognise prominent signs of possible neurological compromise.


Spinal cord
DORSAL
Spinal nerve
Epideral space
Facet joint
Vertebra body
Transverse process
Intervertebral disc
VENTRAL


VENTRAL
DORSAL


Dorsal horns (interneurons and sensory axons)
DORSAL
Anterior radicular artery
Dorsal root ganglion
Sensory nuclei
Spinal nerve (sensory and motor)
Dorsal root ganglion
Anterior root (motor)
Motor nuclei
Ventral root filaments (motor)
Ventral horns (motor neurons)
Pia mater
Arachnoid
Dura mater
VENTRAL
Anterior radicular artery
Anterior spinal artery

CHAPTER 2 REVIEW QUESTIONS

1. **The nervous system consists of the**
   a. brain, spinal cord and nerves
   b. vertebrae and skull
   c. heart, lungs and brain
   d. head, torso and limbs

2. **Neural pathways may be interrupted by**
   a. stroke
   b. decompression illness
   c. trauma
   d. all of the above

Answers to review questions are on Page 37.

3 Stroke

CHAPTER 3 OBJECTIVES

1. What are the two kinds of stroke?
2. How do strokes manifest?
3. What is the leading cause of long-term disability?
4. How does prompt medical intervention affect injury and disability from a stroke?
5. What are the signs and symptoms of stroke?
6. What does the mnemonic FAST mean?

Brain injury can result from external trauma (blunt injury, falls) or from interruptions in blood flow within the brain. The latter of these is known as a cerebral vascular accident (CVA) or stroke. Strokes are a medical emergency that can result in permanent neurological injury, disability and death. They result from either blood-vessel blockage (usually from a blood clot, also known as a thrombus) or from blood-vessel rupture that causes bleeding (haemorrhage) (See Figure 1A on Page 8). Some haemorrhagic strokes may be associated with sudden severe headaches.

Stokes can manifest with sudden loss of motor function (inability to move an affected part of the body), inability to understand or formulate words, or loss of a visual field. Approximately 85% of strokes are thrombotic and are not usually associated with headache[1] (See Figure 1B on Page 8). Most strokes come on suddenly, are painless, and the persons suffering from them may be unaware of their occurrence. Denial of symptoms by the victim is common and can lead to delayed treatment resulting in poor outcomes.

Figure 1A

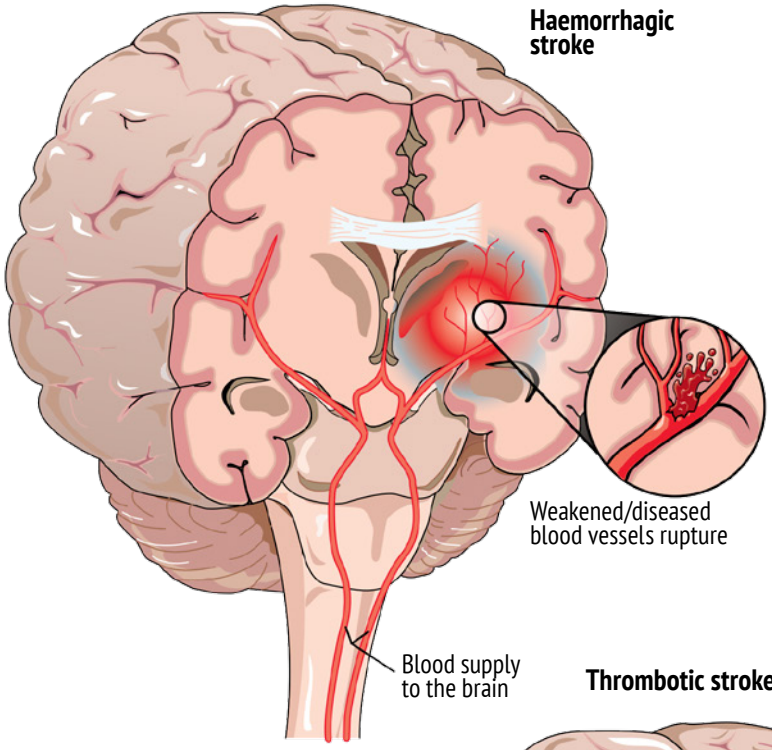
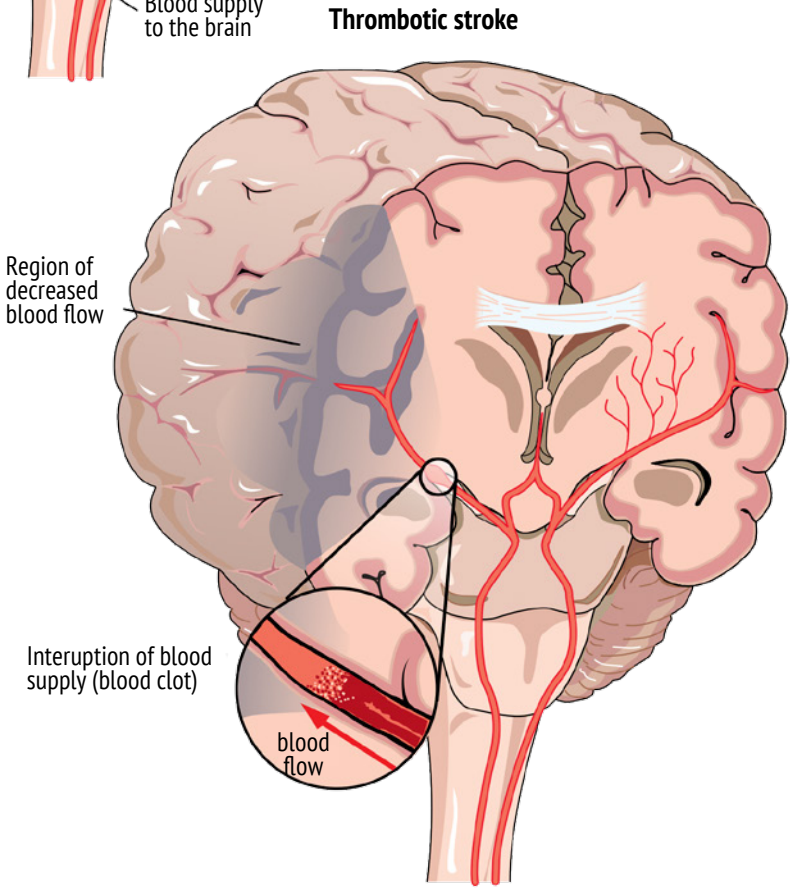


Figure 1B



Stroke is the leading cause of long-term disability and the third-leading cause of death. The sooner acute injury is detected and emergency services alerted, the greater the chances that medical treatment will reduce injury and disability.

Signs of stroke include facial droop, inability to raise or move an arm, and slurred, garbled or nonsensical speech. If any or all of these are present, call EMS immediately.

To help you remember key signs, use the mnemonic **FAST**

F Facial droop

A Arm weakness

S Speech difficulty, sudden severe headache

T Time (note the time and call EMS immediately)

Remember: Use FAST first, then call emergency medical services.

Facial Droop
Facial droop occurs on one side of the face and may involve either the left or right side. This is usually associated with speech difficulty or reduced vocal clarity.

Arm Weakness
The presence of arm weakness can be assessed by asking the injured person to raise both arms and bend (extend) his wrists. Ask the person to hold that position for about 10 seconds. Watch for lowering of an arm or straightening of a wrist.

Image depicts a normal response.

Speech
Inability to speak clearly or verbalise is cause for immediate concern. As mentioned earlier, speech difficulty or reduced clarity is often associated with facial droop.

Time
Call 10177 (or your local emergency medical services number) immediately if any of these symptoms are present.

The FAST examination is an easy way to determine if signs of neurological injury are present. Whether from stroke, trauma or diving-associated injury, if signs are present, call EMS.

Other stroke symptoms include:
- SUDDEN numbness or weakness of face, arm or leg — especially on one side of the body
- SUDDEN confusion, trouble speaking or understanding
- SUDDEN trouble seeing in one or both eyes
- SUDDEN trouble walking, dizziness, loss of balance or co-ordination
- SUDDEN severe headache with no known cause

Once EMS is activated, complete the full Neurological Assessment. Your findings will help medical personnel determine injury progression and create a clinical baseline to which future changes can be compared.

> Determining basic vital signs is the first step in a neurological assessment.

CHAPTER 3 REVIEW QUESTIONS

1. **Strokes may be caused by a blood clot or bleeding**
   a. True
   b. False

2. **Strokes may be evident by**
   a. sudden loss of motor function
   b. inability to formulate or understand words
   c. loss of visual field
   d. all of the above

3. **Stroke is the leading cause of long-term disability**
   a. True
   b. False

4. **Prompt medical intervention may reduce the possibility of permanent disability**
   a. True
   b. False

5. **FAST stands for**
   a. facts, attitude, sensitivity, talent
   b. face, arms, speech, time
   c. feet, arms, spine, toes
   d. face, ankles, stability, touch

Answers to review questions are on Page 37.

NOTES:

NOTES:

4 Decompression Illness

CHAPTER 4 OBJECTIVES

1. Which two conditions compose decompression illness?
2. What are the most common signs and symptoms of decompression illness?

The term decompression illness (DCI) describes signs and symptoms arising either during or subsequent to decompression and encompasses two different, but potentially linked, processes

- decompression sickness (DCS)
- arterial gas embolism (AGE)

DECOMPRESSION SICKNESS

DCS results from bubbles of dissolved inert gas (nitrogen or helium) that form within tissues or blood. The size, quantity and location of these bubbles determine the location, severity and impact on normal physiological function. Besides the anticipated mechanical effects that can cause tissue distortion and blood-flow interruption, bubble formation may trigger a chain of biochemical effects. These include activation of clotting mechanisms, systemic inflammation, leakage of fluids out of the circulatory system and reactive vasoconstriction (narrowing of blood vessels). These effects may persist long after bubbles are gone and may play a significant role in the duration and severity of clinical signs and symptoms.

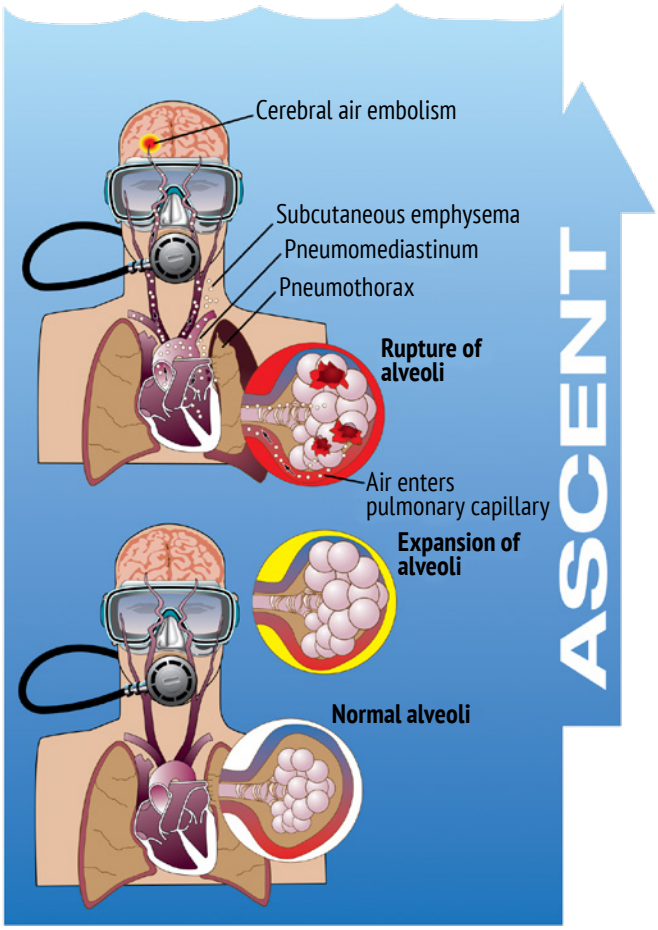
While the presence of bubbles affect on us on a systemic level, specific signs and symptoms are thought to result from either bubble accumulation or its impact on specific areas. Examples include joint pain, motor dysfunctions and skin rash.

Important aspects about DCS to remember include:

- Symptom onset usually occurs after surfacing but can occur during ascent
- Factors contributing to bubble formation include excess nitrogen, rapid ascent and decreasing ambient pressure (such as when flying after diving)
- DCS symptoms may differ throughout the body
- Any area of the body may be involved

ARTERIAL GAS EMBOLISM

AGE in divers typically results from lung-overexpansion injury (pulmonary barotrauma). The greatest risk for this injury occurs in shallow water and may result from breath-holding in as little as 1.2 m of seawater. Lung-tissue trauma can allow the entrance of breathing gas into the blood vessels returning to the heart (pulmonary veins). These bubbles can cause rapid and dramatic effects if they are transported to the brain. AGE is the most severe result of pulmonary barotrauma and often presents suddenly either near or at the surface.



Pulmonary barotrauma with subsequent AGE and representation of brain (cerebral) injury. Recreated by Divers Alert Network from Lancet.[4]

The primary risk factor for AGE is breath-holding during ascent. Other potential risk factors include any condition that could trap air, such as lung infections, asthma and previous lung trauma.

COMMON SIGNS AND SYMPTOMS OF DCI

Injured divers may have one or more of the following signs and symptoms, which are ranked in order of initial presenting symptom. This frequency is based on Project Dive Exploration (PDE) data from 2,346 recreational dive accidents reported to DAN from 1998 to 2004.[4]

- **Pain** (initial symptom in 40% of cases). Commonly associated with neurological symptoms, the pain has been characterised as a dull, sharp, boring or aching sensation in or around a joint or muscle. It may begin gradually and build in intensity or be so mild that it is disregarded
  - Movement of the affected joint or limb may or may not make a difference in the severity of the pain. The pain may be out of proportion to the amount of work or exercise the diver associates with the discomfort and may be referred to as unusual or just a "different" type of pain

    - DCI pain can be difficult to distinguish from normal aches and pains. Symptoms can mimic other illnesses such as viral infections, muscle or joint pain, or fatigue from exertion and other nonspecific discomforts
- **Numbness and paraesthesia** (initial symptom in 27% of cases). Paraesthesia/anaesthesia/dysaesthesia are terms that refer to altered sensations and may present as abnormal feelings (paraesthesia), decreased or lost sensation (anaesthesia) or hypersensitivity (dysaesthesia). Paraesthesia is commonly characterised as a pins-and-needles sensation. These altered sensations may affect only a small patch (or patches) of skin and may go unnoticed by the diver until they are revealed by a thorough medical evaluation. A diver may complain that an extremity has "fallen asleep" or a "funny bone" has been hit. Numbness and tingling most often occur in the limbs and may be associated with complaints such as a cold, heavy or swollen sensation
- **Constitutional symptoms** (initial symptom in 14% of cases). These are generalised symptoms that do not impact a particular part of the body. Examples include extreme fatigue, general malaise and nausea
    - *Extreme fatigue:* It is not unusual to be fatigued after a scuba dive or other physical activity. The fatigue associated with DCI is typically more severe and out of proportion with the level of exertion required by the dive. The diver may want to lie down, sleep or ignore personal responsibilities such as stowing gear or cleaning equipment
- **Balance and equilibrium** (initial symptom in 6% of cases)
    - *Vertigo (spinning sensation):* Vertigo presenting during or after the dive should be considered a serious symptom suspicious of inner-ear/vestibular involvement. There are several causes not related to DCI for such symptoms, and these include round- or oval-window rupture (associated with difficulty equalising), alternobaric vertigo (each ear experiencing a different pressure exposure) and caloric vertigo (each ear experiencing a different temperature exposure)
    - *Dizziness:* A feeling of unsteadiness, which may also be characterised as lightheadedness, is commonly associated with nausea
- **Muscular weakness** (initial symptom in 4% of cases). This symptom may present as difficulty walking due to decreased muscular strength or limb paralysis
- **Cutaneous** (skin) symptoms (initial symptom in 3% of cases). Skin signs are often located on the chest, abdomen, back, buttocks or thighs. Rashes commonly migrate (move to different parts of the body). Affected areas may be tender or itch and are thus often confused with allergies or contact dermatitis
- **Altered mental status** (initial symptom in 1.2% of cases). Symptoms may include confusion, personality changes or speech disturbances (slurring of words or nonsensical speech)
- **Bowel and bladder** (initial symptom in 0.04% of cases). Spinal cord DCS may injure the nerves responsible for bladder and bowel control. Sometimes people will require urinary catheterisation

NOTE

Any suspicion of neurological symptoms should prompt immediate use of oxygen therapy and transportation to a medical facility.

OTHER SIGNS AND SYMPTOMS OF DCI

- **Lymphatic DCS:** Identified as an initial symptom in 0.3% of cases, this symptom is often characterised as localised swelling affecting the trunk and shoulders
- **Altered level of consciousness:** Identified as an initial symptom in 0.4% of cases
- **Audiovestibular or inner-ear DCS:** This is an alteration of balance or hearing that can be associated with vertigo
- **Visual disturbance:** Loss or blurring of vision or loss of visual fields
- **Difficulty breathing due to DCI:** This may be the result of pulmonary barotrauma or a severe form of DCS known as the chokes (a rare but life-threatening condition caused by an overload of venous gas emboli that severely affects cardiorespiratory function). There are also many other causes of respiratory compromise not necessarily related to or associated with DCI — all of which should elicit medical evaluation
- **Convulsions** are rare

Remember the FAST examination is an easy way to determine if signs of neurological injury are present. Whether from stroke, trauma or diving-associated injury, if signs are present, call EMS to facilitate entry into advanced medical care and a full neurological examination.

After reading about the symptoms described above, you will notice that many are related to the nervous system.
For more information about dive emergencies and how to provide first aid to injured divers, refer to the DAN Emergency Oxygen for Scuba Diving Injuries course.

CHAPTER 4 REVIEW QUESTIONS

1. **Decompression illness includes AGE and DCS**
   a. True
   b. False

2. **Pain, numbness and paraesthesia are the most common signs of decompression illness**
   a. True
   b. False

Answers to review questions on page 37.

5 Conducting a Neurological Assessment

CHAPTER 5 OBJECTIVES

1. When should an emergency assistance plan be activated if you suspect a neurological injury?
2. What are the basic areas of a neurological assessment?
3. What functions are evaluated in the "mental function" part of the neurological assessment?
4. What functions are evaluated in the "cranial nerves" section of the neurological assessment?
5. How do motor-function deficits manifest?
6. How are balance and co-ordination evaluated?

When faced with a possible neurological injury, regardless of cause, remember the FAST first principle. Once a problem is identified or you think injury is likely, there are some initial actions to take.

1. Call your local EMS number immediately
2. If the injury is diving related, provide oxygen first aid
3. Be prepared to initiate basic life support (CPR)

Once EMS has been activated, conduct the neurological assessment described in this course. A neurological assessment should be completed only on a conscious individual. Their responses and your observations facilitate the process. The information you gather may influence the initial treatment and subsequent impact of the injury. In the case of diving accidents, your assessment may also convince an injured diver of the need for oxygen first aid. Fortunately, most diving injuries are not life threatening, and there is frequently time prior to EMS arrival where it is both appropriate and helpful to perform this examination.

NOTE

Performing a neurological assessment should never interfere with EMS activation, evacuation or essential first aid measures.

TAKING A HISTORY

The patient's history is a critical aspect of all medical evaluations. Understanding what happened (the events leading to the injury) as well as any underlying medical issues can often enable a more accurate context for the assessment.

The mnemonic SAMPLE provides a guide to collect relevant information. This portion of the evaluation is done first and precedes the actual neurological examination.

- **S**igns/symptoms
- **A**llergies
- **M**edications
- **P**ertinent medical history
- **L**ast oral intake
- **E**vents leading to the current situation

Part of the initial history includes recording pulse and respiration rates (vital signs). Vital signs, which help provide a baseline of the individual's condition, should be monitored because they may indicate a change in the individual's condition. Each measurement is recorded in a per-minute format. To quicken the process, count each for 30 seconds and multiply by two.

DIVE HISTORY

In the case of injured divers, additional important information includes a description of all dive profiles during the 24 hours leading up to the injury. Information recorded should include maximum depths, dive times, use of safety stops, surface intervals, breathing gasses and any problems experienced during the dives. When possible (and if appropriate), obtain additional information about the incident from the diver's buddy or other observers. DAN's Injury Report Summary slate is useful for recording the dive profile and other relevant information.

Symptoms are often underreported because many people consider dive-related injuries an admission of error. Therefore, the seemingly simple act of a diver talking about his or her symptoms should get your attention and prompt you to ask more questions.

THE FOUR FUNCTIONAL AREAS OF A NEUROLOGICAL ASSESSMENT

This convenient division allows the examiner to focus on specific nervous-system functions and simplifies documentation of abnormal findings.

- Mental function
- Cranial nerves
- Motor function
- Co-ordination and balance

As you conduct the neurological exam, if you find a deficit, verify that EMS has been called. If the patient has been scuba diving, place him on oxygen and continue the exam.

In the case of severe neurological injury, assessment of certain vocal or motor responses may not be possible. If the injured person is unable to speak or move a particular limb, note the deficit and proceed to the next part of the examination.

In the case of garbled, slurred or nonsense speech, defer the medical history and mental function portions of the examination. Focus on what you can assess, and tell medical personnel your findings.

Mental Function

A key component of neurological examinations is an assessment of mental function. This is a subjective process that is susceptible to bias based on factors such as age, education, stress, language barriers and cultural background.

This portion of the examination begins with "orientation" and starts with simple questions. Ask the individual his name, current location, approximate time and reason for being there. These four questions are often referred to by the description "person, place, time, and event" and are written as "alert and orientated (A&O) x 4" – when the individual answers each question appropriately. In the event that questions are answered incorrectly, note what was asked and the response.

The level of consciousness the injured person is exhibiting should be recorded during the assessment, using the terms

- **A**lert
- **V**erbal stimulus
- **P**ainful stimulus
- **U**nresponsive

These terms are abbreviated as A V P U on the neurological assessment slate. Be aware that the individual's level of consciousness can change during or even after the assessment. If changes do occur, note the change and the time it happened.

Once the levels of orientation and responsiveness are determined, further questions can help assess mental functions such as memory, speech, comprehension and computational skills. As with the initial questions for orientation, these are particularly prone to individual differences that may make their interpretation difficult. What is important to note is a change from the person's baseline and not a comparison of their mental ability relative to yours. Some people may be able to tell you that their memory is off, and in other cases, a close friend or relative will provide a reference point for subtle changes.

Cranial Nerves

There are 12 pairs of nerves emanating from the skull that control the special senses and muscles of the eyes and face. Neurological injury from DCI or CVA may affect one or more of the cranial nerves.

Cranial-nerve injury commonly results in facial-movement asymmetry. Examples may include facial droop, loss of certain eye movements and slurred speech. Deficits or injuries are frequently detected during your initial interactions as you watch for facial asymmetry or alterations in eye movements.

Motor Function (Strength)

Neurological injury may affect motor control. Symptoms of injury may range from weakness to paralysis. Proper examination of strength entails comparison with the other side of the body. This process often detects or confirms subtle abnormalities.

DCI rarely affects both sides of the body simultaneously. When it does, the abnormality is obvious and can affect both arms and/or legs. Strokes are usually confined to the brain, and these effects typically influence one side of the body, including the head and neck.

Any sign of weakness or paralysis, no matter how slight the abnormality, should prompt you to seek immediate emergency medical assistance and professional medical evaluation.

Co-ordination and Balance

If the injured person's responses at this point are normal, then assess co-ordination and balance. DCI and CVA may cause nerve-cell injury or impairment of the cerebellum or spinal proprioception tracts, affecting co-ordination and balance (For more information, see Advanced Concepts on Page 21). Co-ordination is evaluated using a finger-nose-finger test (see Page 31). To assess balance, have the injured person walk a straight line and then perform a Romberg (or Sharpened Romberg) test (see Page 31).

NOTE

Balance, speech and co-ordination may also suffer temporary impairment from alcohol intoxication or use of certain medications.

ADVANCED CONCEPTS

Proprioceptors, which are specialised sensory nerves located within muscles and tendons, provide the brain with feedback about movement and muscular activity. These special sensors convey movement information up the spinal cord to the brain. An example of proprioception is seen with the small posture adjustments that occur while standing still. Even slight changes in body position result in muscular stretch that can result in quick postural adjustments.

ADVANCED CONCEPTS

Nerve tracts refer to "bundles" of nerve fibers within the spinal cord that convey messages either to or from the brain. Sensory nerve tracts, located primarily in the dorsal horns of the spinal cord, convey information up the cord to the brain. Motor tracts, primarily located in the ventral horn, convey movement directives from the brain.

CHAPTER 5 REVIEW QUESTIONS

1. **EMS should be called**
   a. as soon as you suspect a neurological injury
   b. after you have conducted a neurological assessment
   c. a period of time after the first assessment so you can advise EMS if there are changes
   d. only if requested by the injured person

2. **All of the following are evaluated as part of a neurological assessment except**
   a. mental function
   b. cranial nerves
   c. motor function
   d. flexibility
   e. co-ordination and balance

3. **Mental function evaluates**
   a. orientation to person, place, time and event
   b. memory and speech
   c. comprehension and computational skills
   d. all of the above

4. **Which of the following is not part of the cranial nerves evaluation?**
   a. Facial droop
   b. Eye movements
   c. Grip strength
   d. Slurred speech

5. **Motor functions may be classified as normal, evidence of weakness or paralysis**
   a. True
   b. False

6. **The Romberg test assesses**
   a. motor function
   b. cranial nerves
   c. mental status
   d. balance

Answers to review questions are on Page 37.

6 Skills Overview

SKILL OBJECTIVES

1. **FAST assessment**
   - Conduct a FAST assessment on a simulated patient suspected of having a neurological impairment
2. **History**
   - Interview a patient in a simulated scenario using the SAMPLE mnemonic to identify previous medical history and determine where he might have acute problems or feel discomfort. Record findings in a usable format
3. **Vital signs**
   - Demonstrate the proper technique to determine a person's pulse rate and breaths per minute, counting each for 30 seconds then multiplying by two
4. **Mental function**
   - Determine an individual's level of consciousness in a scenario with a simulated injury
   - Using interview techniques, assess an individual's
     - speech and language abilities
     - orientation to person, place, time, and event
     - short-term memory
   - Assess an individual's ability to do calculations using a standardised protocol
5. **Cranial nerves**
   - Assess control of eyes and facial muscles using simple commands
   - Assess an individual's ability to hear by rubbing or snapping fingers 30 cm from the ear
6. **Motor function (strength)**
   - Assess strength of muscle groups using muscle isolation and resistance
7. **Co-ordination and balance**
   - Assess an individual's co-ordination using a finger-nose-finger exercise
   - Determine the presence of functional balance using a straight walk and a Romberg test

FAST ASSESSMENT

Objective

- *Conduct a FAST assessment on a simulated patient suspected of having a neurological impairment*

Have the patient remain seated during the assessment.

- Ask the patient to smile. Observe his face for asymmetry. Is one side drooping? Is the smile equal on both sides?
- Ask the patient to extend and raise both arms straight out in front. Can he raise both arms? If so, do both arms remain up or does one drift down?
- Ask the patient to repeat a simple phrase. Are all the words clear? Is there any slurring? Is the speech garbled?
- If any abnormal signs are present, call 10177 or your local EMS number immediately

F Facial droop

A Arm weakness

S Speech difficulty, sudden severe headache

T Time (note the time and call EMS immediately)

TAKING A HISTORY

Objectives

- *Interview a patient in a simulated scenario using the SAMPLE mnemonic to identify previous medical history and determine where he might have acute problems or feel discomfort*
- *Record findings in a usable format*

As noted previously, getting information about conditions that may influence the individual's assessment is important.

To help you remember what information to gather when taking a history, use the mnemonic SAMPLE.

- **S**igns/symptoms
- **A**llergies
- **M**edications
- **P**ertinent medical history
- **L**ast oral intake
- **E**vents leading to the current situation

The neurological assessment slate includes an area for recording your findings.

TAKING VITAL SIGNS

Objective

- *Demonstrate proper technique to determine a person's pulse rate and breaths per minute, counting each for 30 seconds then multiplying by two*

Take the individual's pulse, and note his respiratory rate. Each measurement is recorded in a per-minute format. To quicken the process, count each for 30 seconds and multiply by two.

Pulse. To take a pulse, place your index and middle finger on the inside of the patient's wrist just proximal (toward the heart) to the base of the thumb, and apply gentle pressure. Refrain from using your thumb to take a pulse. The pulse your thumb may be confused with the injured person's pulse and result in a false measurement.

Normal adult pulse rates are between 60 and 100 beats per minute, and may be lower in athletes.

Respirations. Prior to counting breaths per minute, you will already have a sense of the person's level of respiratory distress from your previous questions. If he is unable to finish sentences or is visibly short of breath, more immediate respiratory aid may be necessary.

In an attempt to minimise self-consciousness and the potential influence your observations may have on respiratory rate, try to count without letting the individual know that you're monitoring his breathing. It may be helpful to have a bystander count respirations, or you can continue to hold the individual's wrist after taking his pulse for a full minute while you count respirations for the second 30-second interval.

Normal adult resting respiratory rates are between 12 and 20 breaths per minute.

Signs and symptoms. Record any signs and symptoms. In the case of pain, attempt to describe the severity, quality (sharp, dull, throbbing), its location and association with movement. Document symptom-onset times, their progression and a description of all first aid provided.

Performing a Neurological Examination

Perform a neurological examination only on a conscious, breathing person and always ask permission prior to initiating any physical contact. As with most medical examinations, it is a good idea to have a third party present during the examination to help eliminate concerns about improper contact. A typical neurological assessment should take about 10 minutes.

The neurological examination begins with simple conversation. This introduction facilitates some initial evaluation and builds rapport. As you move through the examination, be sure to record your findings as well as the time the examination was performed. If subsequent examinations are performed, each should be recorded in the same manner.

MENTAL FUNCTION

Objectives

- *Determine an individual's level of consciousness in a scenario with a simulated injury*
- *Using interview techniques, assess an individual's*
  - *speech and language abilities*
  - *orientation to person, place, time, and event*
  - *short-term memory*
- *Assess an individual's ability to do calculations using a standardised protocol*

Begin your mental-function assessment by simply talking to the person. You've already been doing this while taking the history, and this observation will help you form an opinion about the person's mental status. Although the individual may appear normally alert, answers to the following questions may reveal underlying changes and should be a standard part of every evaluation.

Level of Consciousness (AVPU)

On your slate, indicate the person's level of consciousness using the AVPU acronym:

- **A**lert
- **V**erbal stimulus
- **P**ainful stimulus
- **U**nresponsive

If he is responding to you timely and appropriately, note on your slate he is "alert." If not, record his level of responsiveness according to the following descriptions:

- Responds to verbal stimuli (verbal)
  - You may need to shout at times
- Responds to painful stimuli (painful)
  - If he is unresponsive to verbal stimuli, check for a response to painful stimuli such as a sternal rub
- Unresponsive
  - If the person is unresponsive, immediately begin basic life support

Orientation to Person, Place, Time, and Event

- **Person:** Ask the injured person his name and if he knows who you are
- **Place:** Ask the injured person if he knows where he is
- **Time:** Ask the injured person the time, date and year
  - Time perception can vary, especially in an accident. As an alternative, consider asking about what period of the day it is (e.g., morning, afternoon or evening)

Example of a sternal rub on an unresponsive person

- **Event:** Ask the injured person if he knows why he is there or why you are having this conversation
  - Ask him to describe the events leading to the incident and about the event itself. Ask him to explain what he was doing prior to the event. Alternately, he should be able to identify that you are performing the exam because you are concerned about a possible injury or illness

The ability to answer these questions correctly is noted as A&O x 4 (alert and oriented to person, place, time, and event).

Speech and Language

- Assess ability to understand, follow directions and communicate effectively
  - Can the individual both understand and respond?
- Test ability to follow a command by asking him to close his eyes and stick out his tongue
- Test ability to communicate by asking him to say a simple phrase such as "red, white and blue," or "no ifs, ands or buts." Any simple phrase will do
- Next, point out three easily identifiable objects and ask the individual to tell you what they are. Examples may include a mask, pen, watch, light, scuba tank, snorkel or fins. Any easily recognisable combination of three should suffice

Abstract Reasoning

Test abstract reasoning by asking the injured person to describe relationships between objects such as cat and mouse, father and son, water and dirt, student and teacher or classroom and school.

Such questions are an attempt to determine the individual's ability to describe the connection between ideas or words.

Calculations

Assess the patient's ability to perform simple arithmetic by asking the person to count backward from 100 by sevens. An alternative is to ask him to repeat his phone number in reverse

- Many people struggle with this task. The goal is to see if they can figure out the next answer. Most evaluators don't force people to count down to single digits

100	99	98	97	96	95	94	**93**	92	91
90	89	88	87	**86**	85	84	83	82	81
80	**79**	78	77	76	75	74	73	**72**	71
70	69	68	67	66	**65**	64	63	62	61
60	59	**58**	57	56	55	54	53	52	**51**
50	49	48	47	46	45	**44**	43	42	41
40	39	38	**37**	36	35	34	33	32	31
30	29	28	27	26	25	24	**23**	22	21
20	19	18	17	**16**	15	14	13	12	11
10	**09**	08	07	06	05	04	03	**02**	01

Short-Term Memory

Ask the injured person to repeat back to you the three objects previously identified during the speech and language examination.

CRANIAL NERVES

Objectives

- *Assess control of eyes and facial muscles using simple commands*
- *Assess an individual's ability to hear by rubbing or snapping fingers 30 cm from the ear*

The next step of the exam assesses facial movement and hearing.

Eye Control

This exam assesses the ability of the injured person to symmetrically move his eyes in all directions. Hold your finger about 1 m away from his face, and while he keeps his head still, move your finger to the right, left, up, down and diagonally. Record any direction the injured person cannot follow with his eyes.

Facial Control

To evaluate the facial muscles, start by asking the injured person to tightly close his eyes and then smile. Watch for symmetry of facial movement and skin creases. Facial-muscle movement and skin creases should be essentially the same on each side of the face. Any asymmetry should be noted.

Hearing

Test hearing by holding your hand about 30 cm from the injured person's ear and rubbing together your thumb, index and middle fingers. Check each ear separately. Do not attempt to determine hearing loss; instead assess if hearing is symmetrical or if one side is reduced.

If the surroundings are noisy, this test may be difficult to perform. An alternative to rubbing your fingers is to speak in a quiet voice in each ear.

MOTOR FUNCTION (STRENGTH)

Objective

- *Assess strength of muscle groups using muscle isolation and resistance*

Evaluate the strength and symmetry of specific muscle groups. Note any differences between right and left sides. Hand dominance as well as a history of previous injury are important items to include in your evaluation and your report to medical personnel.

The primary muscle groups tested are the shoulders, biceps, triceps, finger spread, grip strength, hip flexors, quadriceps, hamstrings and feet.

Check each muscle group independently by providing gentle resistance. Record strength as normal, weak or paralysis.

Assess shoulder strength by first bringing up the elbows level with the shoulders and hands level with the arms. Instruct the individual to resist while you push down and then pull up on the elbows.

Test bicep and tricep strength by supporting the elbow with one hand (to isolate the muscle group being tested) and asking the injured person to push and pull against your hand.

Test the ability to spread fingers by attempting to squeeze fingers together, two at a time.

Test grip strength by asking the person to grip two of your fingers in each hand and squeeze as tightly as he can.

To test hip flexors, ask the person to raise his foot off the ground. Then apply gentle downward pressure above the knee and ask the person to raise his knee. Do this for each side.

Isolate the quadriceps and hamstrings by placing your hand under the thigh just above the knee, supporting the foot just off the ground.

Test the quadriceps and hamstrings by asking the injured person to resist your pressure as you gently but firmly push, then pull, the lower leg, just above the ankle of each leg.

To test the injured person's foot strength, ask him to pull up his foot against your hand and to press down against your hand.

Strength deficits that the person was not previously aware of or that did not exist prior to injury are of particular importance.

CO-ORDINATION AND BALANCE

Objectives

- *Assess an individual's co-ordination by using a finger-nose-finger exercise*
- *Determine the presence of functional balance by using a straight walk and a Romberg test*

If the injured person's responses at this point are normal, then assess co-ordination and balance.

Finger-Nose-Finger Test

To test co-ordination, stand or sit in front of the person, holding your finger approximately 45 cm from the person's face. Ask him to touch your finger with his index finger and then to touch his nose and touch your finger again.

- Repeat this several times
- Continue the movement with his eyes closed
- Perform this with both the left and right arms

Minor differences may occur between right and left on any of these exams. Significant variations should be included in your notations.

Walking

Test balance by asking the person to walk forward about 3 m while looking straight ahead.

Note if movements are smooth and if the individual can maintain balance without looking down or requiring support.

Be prepared to catch or support the person if he is unsteady or starts to fall. Performing this test may be difficult while on a moving vessel.

Record whether the person was able to stand and walk without assistance or support. Note on the slate the degree of any assistance that was required.

Balance and Equilibrium: Romberg and Sharpened Romberg

- Romberg
  - Ask the person to stand with her feet together and arms up and out to her sides. Ask her to close her eyes and remain in that position for 60 seconds
- Sharpened Romberg
  - Ask the person to stand with his feet in a heel-to-toe stance and his arms crossed. Once he is stable, ask him to close his eyes and remain in that position for 60 seconds. As with the Romberg, be prepared to catch or support him if he shows signs of falling

NOTE

The Sharpened Romberg test is difficult to perform for many "neurologically normal" people. It is a more sensitive test than the Romberg but may lead to false signs of acute neurological deficit.

7 Summary

As with any injury or sudden illness, prompt action is always important. Remember to use the FAST first approach. Any sign of obvious injury should prompt immediate activation of EMS.

Performing this neurological assessment soon after an incident may provide valuable information to the physician responsible for treatment. If the results of any of these tests are abnormal, you should suspect injury to the nervous system.

In some cases, you may be unable to perform certain aspects of a neurological examination. If this occurs, simply note which tests were omitted and the reason they weren't performed.

In the case of injured divers, after activating EMS, provide emergency oxygen and call DAN-SA (0800 020 111 (local) or +27 828 10 60 10 (int.)). Training for administering oxygen is available in the Emergency Oxygen for Scuba Diving Injuries course. Contact your Neuro Instructor for more information.

If assistance is not readily available, repeat the neurological assessment (excluding the history) and record findings every 60 minutes — or more frequently if the condition visibly changes. Repeating examinations can help emergency personnel appreciate how a person's condition has changed over time.

Glossary

acute – rapid onset, brief and severe

alveoli – microscopic air sacs in the lungs where gas exchange occurs with the circulatory system

anaesthesia – general or local insensibility to pain and other sensation induced by certain interventions or drugs

arachnoid – the serous membrane forming the middle of the three coverings of the brain and spinal cord

arterial gas embolism (AGE) – gas bubbles in the arterial system generally caused by air passing through the walls of the alveoli into the bloodstream

asymmetry – disproportion between two or more like parts; lack of symmetry

audiovestibular – of or pertaining to the auditory functions of the inner ear and the vestibule of the ear

axons – a long, slender projection of a nerve cell, or neuron, that typically conducts electrical impulses away from the neuron cell body

barotrauma – physical damage to body tissues caused by a difference in pressure between an air space inside or beside the body and the surrounding fluid

cardiorespiratory – pertaining to the circulatory and respiratory systems

cerebral – of, relating to or affecting the brain or cerebrum

cerebrovascular accident (CVA) – sudden death of some brain cells due to lack of oxygen when the blood flow to the brain is impaired by blockage or rupture of an artery to the brain; also referred to as a stroke

cutaneous – of, relating to or affecting the skin

decompression illness (DCI) – dysbaric injuries related to scuba diving; DCI includes both decompression sickness and arterial gas embolism

decompression sickness (DCS) – a syndrome caused by bubbles of inert gas forming in the tissues and bloodstream that can evolve from too rapid an ascent from compressed-gas diving

distal – situated away from the point of origin or attachment, as of a limb or bone; terminal

dorsal – relating to the back (posterior) part of the body

dura mater – the outermost of the three layers of the meninges surrounding the brain and spinal cord

dysaesthesia – distortion of any sense, especially the sense of touch

embolism – a detached intravascular mass clogging capillary beds at a site far from its origin

EMS – emergency medical services

epidural – a form of regional analgesia involving injection of drugs through a catheter placed into the epidural space

equilibrium – the condition of a system in which competing influences are balanced

facet – a small, smooth, flat surface, as on a bone or tooth

flexor – a muscle that when contracted acts to bend a joint or limb in the body

ganglion – a biological tissue mass, most commonly a mass of nerve cell bodies

haemorrhagic – pertaining to bleeding or the abnormal flow of blood

interneurons – neurons that process signals from one or more sensory neurons and relay signals to motor neurons, also called connector neurons

intervertebral – situated between two contiguous vertebrae

ischemic – a decrease in the blood supply to a bodily organ, tissue or part caused by constriction or obstruction of the blood vessels

lymphatic – pertaining to, containing or conveying lymph

meninges – the system of membranes that envelopes the central nervous system

motor nuclei – collection of cells in the central nervous system giving origin to a motor nerve

neurological – having to do with the nerves or the nervous system

paraesthesia – a sensation of numbness or tingling on the skin

pia mater – the delicate innermost layer of the meninges, the membranes surrounding the brain and spinal cord

pneumomediastinum – the presence of air in the mediastinal soft tissues

pneumothorax – a collapsed lung

postural – position of the body or body parts

proprioceptors – sensors that provide information about joint angle, muscle length and muscle tension

pulmonary – having to do with the lungs

quadriceps – a large muscle in front of the thigh, the action of which extends the leg or bends the hip joint

subcutaneous emphysema – the presence of air or gas in subcutaneous tissues

thrombotic – having to do with intravascular coagulation of the blood in any part of the circulatory system, as in the heart, arteries, veins or capillaries

transverse – crossing from side to side

trauma – a serious injury or shock to the body, as from violence or an accident

vasoconstriction – narrowing of a blood vessel

venous – of, relating to or contained in the veins

ventral – relating to the front (anterior) part of the body

ventral horns – the two roots of a spinal nerve that pass ventrally from the spinal cord and that consist of motor fibers

vertebra – the bones forming the spinal column

vertigo – a sensation of whirling motion, either of oneself or of external objects

vestibular – relating to the sense of equilibrium

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REVIEW ANSWERS

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NOTES:

Divers Alert Network Southern Africa

Divers Alert Network Southern Africa (DAN-SA) is an international, nonprofit organisation dedicated to improving dive safety through research, education, medical information, evacuation support, products and services.

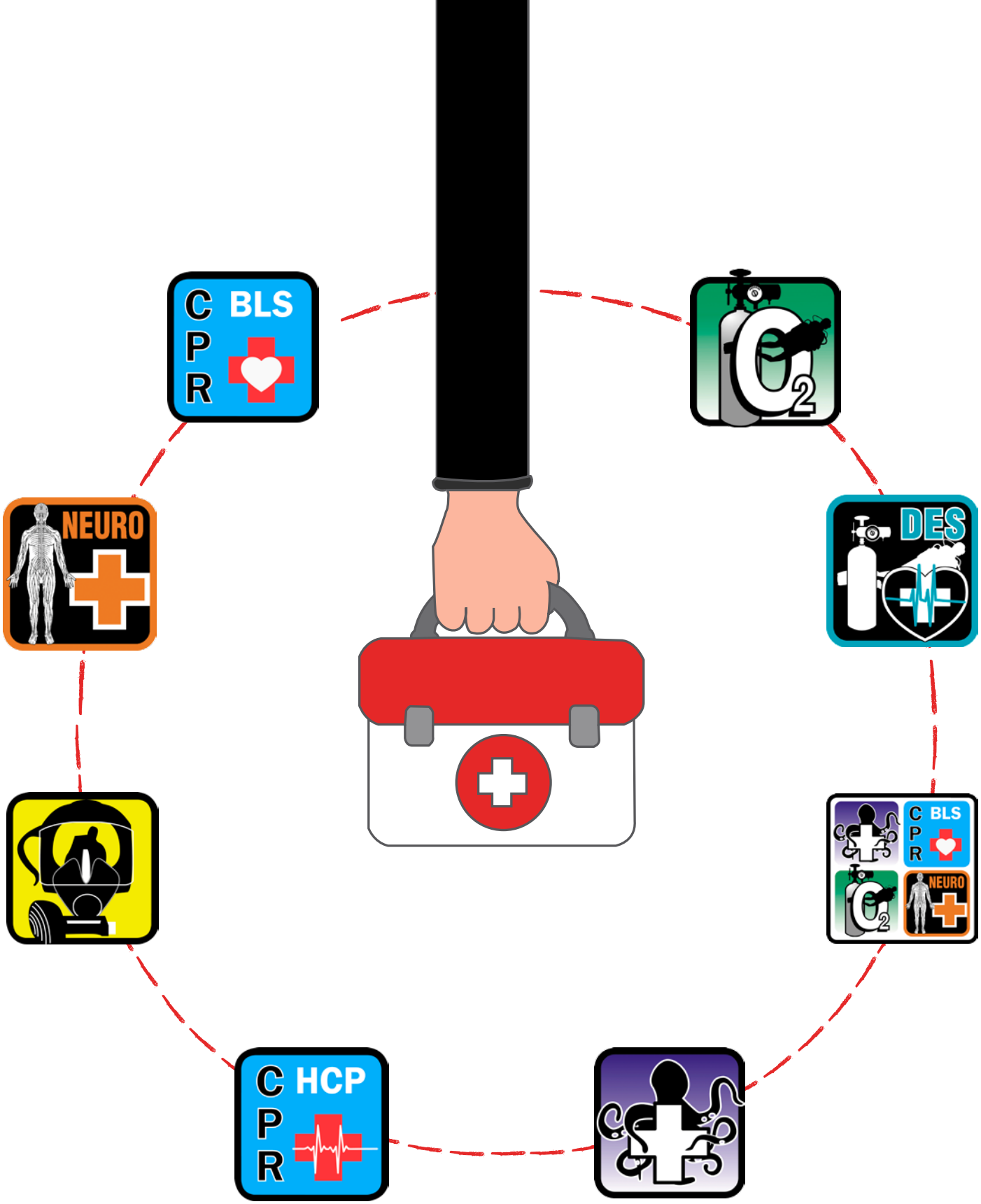
Among the services DAN-SA provides to the diving public is the DAN Emergency Hotline (0800 020 111 (local) or +27 828 10 60 10 (int.)). This hotline is available 24 hours a day, seven days a week for anyone who suspects a diving injury, requires assistance or needs to activate ***your DAN evacuation benefits*** (an exclusive benefit of DAN membership). Callers are connected directly with a member of DAN's Medical Services department, who can facilitate medical consultation with dive medicine specialists and co-ordinate evacuation to ensure appropriate care.

DAN-SA's non-emergency safety resources include the DAN Medical Information Line DAN-SA (0800 020 111 (local) or +27 828 10 60 10 (int.)), the online Health & Diving libary (http://dansa.org/dan-resources.htm) and ***Alert Diver*** magazine, the DAN Shop, the DAN-SA Podcast, a blog and more.

Membership dues and dive cover support DAN's nonprofit efforts. DAN members enjoy benefits such as access to the DAN Dive Accident Cover, medical evacuation support, access to the electronic *Alert Diver* magazine, safety guides and more.

Your participation in this DAN training course demonstrates your commitment to dive safety. Continue your education and your commitment by supporting **the industry's only organisation dedicated solely to improving dive safety**. Join DAN today.

To learn more about DAN and the multitude of resources it provides, or to become a member, please visit dansa.org.



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