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PAIN ARISING IN THE SHOULDER REGION ■ ■THORACIC OUTLET SYNDROMES The thoracic outlet contains the first rib, the subclavian artery and vein, the brachial plexus, the clavicle, and the lung apex. Injury to these structures may result in postural or movement-induced pain around the shoulder and supraclavicular region, classified as follows. True neurogenic thoracic outlet syndrome (TOS) is an uncommon disorder resulting from compression of the lower trunk of the brachial plexus or ventral rami of the C8 or T1 nerve roots, caused most often by an anomalous band of cartilaginous tissue connecting an elongate transverse process at C7 with the first rib. Pain is mild or may be absent. Signs include weakness and wasting of intrinsic muscles of the hand and diminished sensation on the palmar aspect of the fifth digit. An anteroposterior cervical spine x-ray will show an elongate C7 trans verse process (an anatomic marker for the anomalous cartilaginous band), and EMG and NCSs confirm the diagnosis. Treatment consists of surgical resection of the anomalous band. The weakness and wasting of intrinsic hand muscles typically do not improve, but surgery halts the insidious progression of weakness. Arterial TOS results from compression of the subclavian artery by a cervical rib, resulting in poststenotic dilatation of the artery and in some cases secondary thrombus formation. Blood pressure is reduced in the affected limb, and signs of emboli may be present in the hand. Neurologic signs are absent. Ultrasound can confirm the diagnosis noninvasively. Treatment is with thrombolysis or anticoagulation (with or without embolectomy) and surgical excision of the cervical rib com pressing the subclavian artery. Venous TOS is due to subclavian vein thrombosis resulting in swell ing of the arm and pain. The vein may be compressed by a cervical rib or anomalous scalene muscle. Venography is the diagnostic test of choice. Disputed TOS accounts for 95% of patients diagnosed with TOS; chronic arm and shoulder pain are prominent and of unclear cause. The lack of sensitive and specific findings on physical examination or specific markers for this condition results in diagnostic uncertainty. The role of surgery in disputed TOS is controversial. Multidisciplinary pain management is a conservative approach, although treatment is often unsuccessful. ■ ■BRACHIAL PLEXUS AND NERVES Pain from injury to the brachial plexus or peripheral nerves of the arm can occasionally mimic referred pain of cervical spine origin, includ ing cervical radiculopathy, but the pain typically begins distal to the posterior neck region in the shoulder girdle or upper arm. Neoplastic infiltration of the lower trunk of the brachial plexus may produce shoulder or supraclavicular pain radiating down the arm,

numbness of the fourth and fifth fingers or medial forearm, and weakness of intrinsic hand muscles innervated by the lower trunk and medial cord of the brachial plexus. Delayed radiation injury may produce weak ness in the upper arm or numbness of the lateral forearm or arm due to involvement of the upper trunk and lateral cord of the plexus. Pain is less common and less severe than with neoplastic infiltration. A Pancoast tumor of the lung (Chap. 83) is another cause of injury to the brachial plexus and should be considered especially when a concurrent Horner's syndrome is present. Acute brachial neuritis is often confused with radiculopathy; the acute onset of severe shoulder or scapular pain is followed typically over days by weakness of the proximal arm and shoulder girdle muscles innervated by the upper brachial plexus. The onset may be preceded by an infection, vaccination, or minor surgi cal procedure. The long thoracic nerve may be affected, resulting in a winged scapula. Brachial neuritis may also present as an isolated paralysis of the diaphragm with or without involvement of other nerves of the upper limb. Recovery may take up to several years, and full func tional recovery can be expected in the majority of patients. Occasional cases of carpal tunnel syndrome produce pain and paresthesias extending into the forearm, arm, and shoulder resem bling a C5 or C6 root lesion. Lesions of the radial or ulnar nerve can also mimic radiculopathy at C7 or C8, respectively. EMG and NCSs

can accurately localize lesions to the nerve roots, brachial plexus, or peripheral nerves.

For further discussion of peripheral nerve disorders, see Chap. 457. SHOULDER Pain arising from the shoulder can also on occasion mimic pain from the spine. If symptoms and signs of radiculopathy are absent, then the differential diagnosis includes mechanical shoulder pain (bicipital tendonitis, frozen shoulder, bursitis, rotator cuff tear, dislocation, adhe sive capsulitis, or rotator cuff impingement under the acromion) and referred pain (subdiaphragmatic irritation, angina, or Pancoast tumor). Mechanical pain is often worse at night, associated with local shoulder tenderness, and aggravated by passive abduction, internal rotation, or extension of the arm. Demonstrating normal passive full range of motion of the arm at the shoulder without worsening of the pain can help exclude mechanical shoulder pathology as a cause of neck region pain. Pain from shoulder disease may radiate into the arm or hand, but focal neurologic signs (sensory, motor, or reflex changes) are absent. Fever CHAPTER 20 Acknowledgment The authors acknowledge the contributions of John W. Engstrom to ear lier editions of this chapter. ■ ■FURTHER READING Cohen SP, Hooten WM: Advances in the diagnosis and management of neck pain. BMJ 358:j3221, 2017. Popescu A, Lee H: Neck pain and lower back pain. Med Clin North Am 104:279, 2020. Rupp R et al: International standards for neurological classification of spinal cord injury: Revised 2019. Top Spinal Cord Inj Rehabil 27:1, 2021. Shin DW et al: Global, regional, and national neck pain burden in the general population, 1990-2019: An analysis of the global burden of disease study 2019. Front Neurol 13:955367, 2022. Vazirizadeh-Mahabadi M, Yarahmadi M: Canadian C-spine Rule versus NEXUS in screening of clinically important traumatic cervi cal spine injuries: A systematic review and meta-analysis. Arch Acad Emerg Med 11:e5, 2023. Section 2 Alterations in Body Temperature Charles A. Dinarello, Neeraj K. Surana

Fever Body temperature is controlled by the hypothalamus. Neurons in both the preoptic anterior hypothalamus and the posterior hypothalamus receive two kinds of signals: one from peripheral nerves that transmit information from warmth/cold receptors in the skin and the other from the temperature of the blood bathing the region. These two types of signals are integrated by the thermoregulatory center of the hypo thalamus to maintain normal temperature. In a neutral temperature environment, the human metabolic rate produces more heat than is necessary to

maintain the core body temperature in the range of 36.5–37.5°C (97.7–99.5°F). NORMAL BODY TEMPERATURES A normal body temperature is ordinarily maintained despite environ mental variations because the hypothalamic thermoregulatory center balances the excess heat production derived from metabolic activity

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