Veterinary aspects of training
Thoroughbred racehorses

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Introduction

Providing optimal veterinary services to Thoroughbred racehorses requires an understanding of both the veterinary aspects of their care, and the dynamics and economics of the racing industry. The following chapter provides a demographic overview of Thoroughbred racing and in particular wastage. Commonly encountered diseases are discussed with an emphasis on the veterinary management and disease prophylaxis during both training and racing.

Demographics and wastage

Thoroughbred racing evolved in England over 200 years ago and now exists in over 50 countries. A comparison of the size of Thoroughbred flat racing industries between some of the major racing countries based on foal crop, number of races and starters, prize money and betting turnover is illustrated in Table 48.1.

All facets of the Thoroughbred racing industry rely heavily on veterinary input, which extends from pre-conception to the end of a horses’ athletic career. Termination of a racing career may result from veterinary advice pertaining to injury or disease, or be based on economic grounds and an assessment of athletic ability. Horses are typically retired to stud if they have accomplished a superior racing career that they are unlikely to better, or have genetic potential that would offset their future potential race earnings. Alternatively, other horses are routed to other athletic endeavors if they are functionally sound.

Horses have their first opportunity to race as 2 year olds and their competitive longevity is the result of a multitude of veterinary and specific industry-based factors. Generally the majority of the racing population is made up of horses aged 2 through 5 years of age. Sex distribution of the racing population commences with relatively equal proportions of males and females as yearlings and 2 year olds. In subsequent racing years there is an attrition of females to breeding so that horses older than 4 years of age, are typically gelded males (Fig. 48.1 and Fig. 48.2).

Age of first race start depends on athletic conformation, degree of maturity, genetics, aspirations and expectations of the owner and trainer, as well as race programming and prize money structure of the specific country. Attempts to judge musculoskeletal maturity and suitability for racing based on objective means such as physeal closure have been generally unsuccessful.

The actual time of first race start is then dependent on the response to training, health, and soundness. Interestingly, in a study examining factors affecting early career wastage there was no correlation between sex and foaling date with time of first race start.

While concerns over racing 2-year-old horses exist, two studies...
found that horses who raced first as 2 year olds had greater numbers of career starts and raced longer than did horses that commenced racing at an older age. This may in part be due to injury or disease that prevented these older horses from competing as 2 year olds and which may have persisted further into their career.

Wastage refers to all losses occurring at any stage in the breeding, growth, training and racing of a racehorse. Wastage includes all losses in breeding, deaths at any stage, lost training days, un-raced horses and retirement. Considerable wastage occurs in the Thoroughbred racing industry as a whole from the time that the mare is covered to the commencement of racing by the progeny. A UK-based wastage study calculated 72.8% of mares each year fail to have progeny that will go on to race between 2 and 4 years of age. In this study, the 1975 foal crop was followed and of those named and eligible for training only 50.6% raced as 2, 3, or 4 year olds; this result is confounded by horses reserved for National Hunt racing that did not race on the flat. A more recent UK study following 1022 foals found 52% entered training at 2 years of age. Similar prospective studies of 353 and 553 yearlings sold at auctions in Australia revealed that approximately 50% of these horses raced as 2 year olds and that 75 to 80% of horses had raced by their 6-year-old seasons.

Lameness, followed by respiratory disease, is the major cause of wastage for Thoroughbreds in race training, manifesting as lost or affected training days. A UK wastage study found that 53% of horses showed lameness at some stage during a season and in 20% of cases the lameness was sufficient to prevent racing after injury. A subsequent study identified lameness (67.6%) and respiratory disorders (20.5%) as the most common cause of lost training days. Sore shins and inflammatory airway disease (IAD) were the most commonly encountered ailments in a UK study looking at failure to train and race. Similarly a US-based study looking at 95 horses

### Table 48.1

<table>
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<tr>
<th>COUNTRY</th>
<th>RACES</th>
<th>PURSES‡</th>
<th>AVERAGE PRIZE MONEY PER RACE</th>
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Betting handle figures are for the year 2011 in USD$ millions

Notes: US $ conversions of the Euro at 1.00 Euro = US $1.32

*Estimated figures
**No breeding industry
***Not reported
†No wagering
‡US Dollars in millions

over an 81-day period reported musculoskeletal injuries altering training or racing schedules in 35–55% of horses and preventing training or racing for a period of time in 26–46% of horses. A recent Australian wastage study of 2- and 3-year-old horses found that of lost or modified training days, 56% were due to lameness and 16% due to respiratory disease. Similar findings have recently been reported out of New Zealand, identifying musculoskeletal (82%) and respiratory diseases (11%) as the major cause of involuntary time out of training. A further reason horses may not race or race less than the average number of times is a ‘lack of athletic ability’.

Breakdowns, fatal musculoskeletal injuries and sudden death during racing and training have been a focus of many recent studies, most aimed at identifying risk factors in an attempt to minimize these injuries. Regional differences exist with regard risk factors, prevalence and types of injuries between countries, states, regions and even individual tracks. The rate of breakdown injuries during racing differs between countries, with rates of 2.2/1000, 2.9/1000 and 21/1000 starters in the USA, Australia and Japan, respectively. These differences are difficult to interpret since they may in part be due to potential errors inherent with epidemiologic studies and different definitions of a breakdown. Approximate risk of fatal or catastrophic musculoskeletal injury are 0.6/1000 starters in Australia and 1.4–1.7/1000 starters in the USA, while in the United Kingdom there are 0.8 deaths/1000 starters. The reasons for differences in rates between countries are multifactorial, but dirt tracks, the presence of medications and longer races have all been implicated as possible factors contributing to a higher incidence of injury. An Equine Injury Database was launched in 2008 with reported rates of fatality rates for 2008–2010 of 2.04–2.00/1000 starters. Catastrophic life-threatening injuries appear more likely to occur when racing, whereas non-fatal injuries are more common in training, which may be a function of speed. Breakdown injuries more commonly involve a forelimb than hindlimb, common sites of injury include fetlock and suspensory ligament, carpus, humerus, pelvis, tibia and superficial flexor tendon. There is evidence that pre-existing lesions predispose to catastrophic injuries, highlighting the value of early identification of such lesions in preventing injury.

A multitude of risk factors contributing to breakdown injuries have been identified, including track characteristics, weather and season, race distance, starting position and race quality. Individual horse characteristics identified include racing frequency, training intensity, age at first start, duration of career, number of lifetime starts and the hoof or shoeing characteristics. Causes of sudden death other than fatal musculoskeletal injuries that have been described include ruptured aorta, myocarditis, valvular insufficiency, sclerosis of the coronary arteries, severe pulmonary hemorrhage and disseminated massive hemorrhage.

**Provision of services**

A working relationship between the veterinarian and trainer is paramount to providing optimal services to a stable. Excellent communication is essential as is an appreciation of the trainer’s perspective and recognition of the non-veterinary factors such as owner expectations and aims, economics and the trainer’s previous personal

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**Fig 48.1** Age of racing Thoroughbreds. Source of data VRC racing services.

**Fig 48.2** Age and sex of Thoroughbred race horses in Australia depicting the lower proportion of females at all ages. Source of data VRC racing services.
experience. The veterinarian should also have knowledge of normal training techniques and schedules, which often differ between trainers. Veterinary services should be preventive as well as problem oriented and applied at both the individual-horse and whole-stable level. The level and extent of services provided on an ambulatory basis will be dictated by the ability to access a hospital or referral clinic.

The veterinarian–farrier relationship is important because of the prevalence and significance of hoof-related problems. Ideally management and prevention of hoof-related lameness should be a joint approach as opposed to demarcating and allocating 'foot' and 'non-foot' cases. Adequate diagnostics and an understanding of the principles involved in the application of physical and alternative therapies allow the veterinarian to appropriately prescribe and substantiate or refute their use.

Establishment of a complete and reliable recording system of disease, lameness and treatment is essential. Accurate recording of administered medications is important where withdrawal times prior to racing must be considered. The system must be easily accessible, efficient and permanent. Ensuring accurate identification of horses prior to treatment or procedures is paramount in a stable environment, particularly where there are large numbers of horses and staff involved. Similarly, clear instructions and great care should be taken when dispensing and administering medications that may be regulated by racing authorities.

The importance of a thorough clinical examination cannot be overstated. It is often easy to neglect the basics in the busy stable environment. A thorough relevant history and systematic clinical examination are the foundation of any accurate and efficient diagnosis, treatment and prognosis. Horses are often presented for a particular complaint but on closer inspection reveal multiple related and unrelated problems. It is also important to judge what can and cannot be done efficiently, adequately and practically at the racetrack/stable and what is better performed in the clinic setting.

Acquisition of racehorses involves selection of yearlings, 2 year olds and tried (older) horses. Economics and method of purchase by public auction or private treaty will determine the extent of veterinary pre-purchase examination. Limiting comments to lesions and conformational faults only, and their likely effects on future athletic soundness appears the most appropriate advice from a veterinary perspective.

**General disease and injury management concepts**

**Prophylactic measures**

Ligament, tendon and joint injuries may occur during breaking and pre-training and reports of swelling or lameness during this period warrants investigation. Subclinical conditions such as osteochondrosis may manifest during preliminary training and early identification may allow treatment with minimal impact on a horse’s racing career.

Prophylactic measures to prevent and minimize problems are implemented as part of good stable management. Such measures include routine selection of horses for lameness and clinical examinations, vaccination and parasite prophylaxis programs. Feeding and training regimes are typically established by the trainers. Sound reasoning coupled with subtle diplomacy is required to obtain trainer compliance with regard to feed and work schedule related changes.

The veterinarian has an important role in advising trainers on the value of instructing stable hands and setting up reliable recording systems that ensure staff observe and report on their horses as they go about caring for and riding them. Feedback from stable staff is important at all levels including observations such as fecal amount and consistency, feed consumption, water intake, signs of colic, coughing or evidence of stable vices, all of which can be detected by educated grooms maintaining stalls. Regular assessment of body weights can be used as a monitor of fitness, disease or ‘training off’.

Recording rectal temperatures of horses with reduced feed intake, subdued demeanor or any other clinical signs of disease should be ingrained as an automatic process.

Daily tacking up can identify a variety of subtle changes including changes in gait as horses are walked out of stall, acquired swellings, skin conditions, nasal discharge and change in response to saddling or bitting. Riders, trainers and clockers can monitor for lameness and more subtle gait changes such as ‘hanging on a rein’, ‘feeling rough’ or repeatedly changing strides. Likewise other observations such as respiratory noise, altered breathing pattern or performance and poor recovery after exercise may all facilitate early identification of problems. The use of heart rate meters combined with global positioning system (GPS) data allows tracking of typical speed and heart rate curves and deviations from normal for individuals indicating need for closer veterinary investigation of musculoskeletal, respiratory or cardiovascular systems.

Routine ‘trot-up’ examinations are an efficient management tool for early detection of musculoskeletal disease and may consist of regular daily, weekly, pre-race or post-race evaluations. Ideally an environment is created where if there is any question as to what effect continued exercise will have on a horse, the trainer will be prompted to have the horse examined. Continuity and regular assessment of individual horses facilitates more specific treatment decisions and detection of subtle changes in gait or lameness. Such monitoring creates a rewarding environment for assessment of therapy, since race performance alone is not always an accurate determinant of therapeutic success.

**General management of disease**

Early detection and accurate diagnosis of disease coupled with appropriate therapy, rest periods and rehabilitation are all essential to maximize racing longevity. The goal of treatment should be a rapid return to soundness and functionality, without compromising long-term soundness and earning potential. The economic cost of unnecessary or incorrect therapy may be significant. Training alterations require additional considerations, including the impact on the animal’s other body systems, particularly the musculoskeletal and cardiorespiratory systems. Furthermore, veterinarians should habitually establish appropriate ‘informed consent’ of trainers and owners since every treatment has a complication rate that may range from a mild injection site reaction to life-threatening colitis, sepsis or anaphylaxis. In this light, the veterinarian must also consider the risk of musculoskeletal injury with continued racing and training and, importantly, the associated risk to riders.

Medication of horses in training should include considerations of potential side effects as well as optimizing administration times in conjunction with training programs. There is often a compromise required between appropriate medication, required optimal rest and lost fitness. The final decision should be that of the trainer/owner, while the role of the veterinarian is to provide information regarding a disease and then provide a range of options for management, allowing the trainer to weigh up the cost benefits of therapy and modification of their training. Regulatory concerns and drug withdrawal times warrant careful consideration, particularly the use of oral preparations or ‘in feed’ drugs where stall contamination represents a particular concern.
Specific disease and injury management

The purpose of the following sections is to provide some general approaches to managing commonly encountered injuries and diseases of Thoroughbreds in race training. While different strategies are employed to address different pathology, some conceptual similarities exist with regard to the management of injured or diseased racehorses, particularly with respect to the effect of alterations in training.

Musculoskeletal diseases

Dorsal third metacarpal disease, carpal and fetlock joint disease and tendon or ligamentous injuries are the most common musculoskeletal problems leading to wastage. Routine, diligent observation of subtle changes in symmetry and meticulous palpation combined with use of hoof testers and flexion tests aids early identification of the most likely site of lameness. Where possible, targeted diagnostic anesthesia and imaging is used which is both economical and time saving. Quality imaging modalities including radiography, ultrasoundography and scintigraphy, are essential for accurate diagnosis, treatment and prognostication.

The presence of a secondary lameness is common and may go undetected without appropriate diagnostic anesthesia. Bilateral disease is commonly identified, particularly with carpal and fetlock injuries, tibial stress fractures and sites of osteochondrosis. Lameness examinations can be aided in the fractious patient with a small dose of sedation. Jogging in a circle or figure eight can also be useful for assessment of mild lameness and may help differentiate among sites of lesions causing lameness.

Exercise modification

Musculoskeletal diseases often require modifications to the training program, dictated by the disease or injury and the horse’s level of fitness. Changing the typical training formula is achieved by alteration of distance and/or speed. Terminology differs geographically in describing the approximate speeds horses train and race and understanding local terminology allows assessment of the current work load and appropriate suggestions with regard to modifications. Speed and distance may be expressed in furlongs (220 yards or approximately 201 meters) (Table 48.2).

Trainees may have a variety of track surfaces available for training horses and advice with respect to training surface should be formulated based on knowledge of the local track characteristics, current track conditions and their contributions to injury risk. Traditionally turf has been associated with a lower risk of musculoskeletal injury than dirt, although confounding factors, primarily geographic, may contribute to this apparent lower risk. Some specific injuries appear to have an association with particular track surfaces. There is an apparent increase in the incidence of proximal suspensory desmitis in horses working on deeper surfaces with wood chip, dirt and synthetic tracks having an increased incidence over turf. The incidence of dorsal third metacarpal disease is higher in horses training on dirt compared to wood fiber tracks.

Track condition or rating, has been implicated to influence the risk of injury; however, several large epidemiologic studies have found no association between track condition and injury rate. The mechanical characteristics of dirt and turf tracks are determined in part by their structure, with moisture content being the major variable influenced by weather and track maintenance. Injury risk is higher on turf tracks when the surface moisture content is low, resulting in a harder track and faster race times. Dirt tracks, on the other hand, have been associated with injuries under a variety of conditions, typically when moisture content is either too low or high or surface is of inadequate depth or composition. The mechanical characteristics of synthetic tracks, the majority of which have a wax component, are temperature dependent as well. Synthetic tracks appear to potentially decrease the risks of fatal musculoskeletal injuries; however, they may contribute to an increased risk of other non-fatal injuries. The major contributor to track performance and safety is likely to be associated with good track maintenance regardless of the surface. Unleveled track surfaces and areas where track is compacted such as ‘crossings’ for horse and vehicular access and areas around starting chutes have been associated with increased risk of injury. An inadequate banking or camber on turns may also contribute to injuries and alteration to track camber and surfaces have shown benefits in reducing injury rates in Thoroughbred and Standardbred racing. Therefore considerations to track characteristics should be given, especially with advice regarding horses working at high speed or rehabilitating from injury.

Hill or incline work, either under saddle or on an inclined treadmill, allows work rate to increase while limiting speed. Inclines modify the activity and loads on various muscles, likely increasing the overall load on the hindlimbs that may be beneficial if attempting to strengthen the hind quarters, or being contraindicated in
horses with hindlimb injuries. Walking in waist deep water in a pool or on a submerged treadmill provides greater work to the advancing limb and may benefit attempts to improve extensor and particularly quadriceps strength.

Direction around turns (clockwise vs counterclockwise) influences limb-loading patterns with the lead limb subject to a greater load than the contralateral limb and this additional loading may predispose the lead limb to injury. Typically in a counterclockwise racing direction the horse preferentially leads with the left forelimb on the turn, and for clockwise racing the right forelimb with most horses changing to the opposite lead at some stage during the straight. Many injuries appear to have ‘lead’ or inside limb predilections dependent on the direction of racing such as dorsal third metacarpal disease, superficial digital flexor tendonitis, and antebrachiocarpal joint injuries, particularly the distal radius and proximal intermediate carpal bone. ‘Outside’ limb injuries are commonly associated with the medial middle carpal joint.

Common musculoskeletal injuries associated with limb predilections may be minimized or prevented by training in both directions on turns. If introduced early in a training program it allows development of balance in both directions and minimizes repetitive loading of specified predilection sites.

Walking exercise can be provided by either hand walking, mechanical walkers, or treadmills. Often overlooked, walking is useful in horses that are temporarily out of work and beneficial in horses susceptible to ‘tying-up’ or with chronic joint complaints. Walking after high-intensity exercise improves recovery. Ponying is useful for horses that do not settle at slow speeds or horses with back complaints, particularly wither or girth rubs. Some musculoskeletal back problems may be exacerbated, if the horse has tendency to track sideways.

Swimming is a primarily aerobic exercise medium useful in reducing the effects of weight-bearing work and has been suggested to decrease the rate of musculoskeletal disease (Fig. 48.3). While allowing non-weight-bearing joint motion, swimming does not stimulate appropriate bone responses or maintain joint ligament tone. Potential complications of pools include infection of pre-existing wounds, interference injuries (higher risk in circular pools), exercise-induced pulmonary hemorrhage, colic and rarely drowning. Swimming increases muscle activity in some selected muscle groups and therefore may be contraindicated in the presence of primary muscle injuries.

The effect of complete cessation of exercise on a horse’s level of cardiovascular fitness often depends on the horse’s stage of training. Horses early in their training phase appear to lose significant amounts of aerobic fitness within 2 weeks, whereas horses more advanced in training are slower to detrain, losing fitness over 4–6 weeks.

Bandages and bandaging
Support bandaging can be useful to minimize swelling and edema associated with acute pathology or intermittent limb edema. The effectiveness of lower limb athletic support bandages or boots in preventing injury and their effect on performance is unknown; studies in healthy human athletes indicate they can be performance impairing. Studies of lower limb bandaging and athletic taping have had variable results in different studies: some have demonstrated a beneficial role through either reduced hyperflexion of the fetlock or reduced peak vertical forces, while other studies have failed to demonstrate benefits of taping or bandages. Support boots have been shown to reduce maximal extension of the fetlock at the walk and trot and may be beneficial reducing strain in the SDFT and suspensory ligament during rehabilitation. Improperly applied bandages may contribute to pathology and any bandaging may be contraindicated at high speed due to effects on heat dissipation. Work boots or padded bandages can be used to limit and reduce the severity of interference injuries.

Cold therapy
Cold therapy provides anti-inflammatory, analgesic effects and reduces cellular metabolic demands and should be considered in any acute or chronic injury. Rapid icing of acute injuries is followed by intermittent icing for approximately 48–72 hours until inflammation is resolved; chronic injuries benefit from icing after every bout of high-intensity exercise. Ice water slurries in large rubber boots are easy to apply, have the ability to include the carpus, and cool the limb more efficiently compared with commercial cold packs, reaching stable tissue temperatures in 10–15 minutes (Fig. 48.4). Excessive icing can cause dermatitis and ice burns. Limiting ‘icing’ times to less than 30 minutes, applying multiple applications with durations of at least 20 minutes out of the ice and application of a barrier layer (Cling Wrap, UK; Saran Wrap, USA; Glad Wrap, Australia) seems to minimize this complication.

Joint diseases and injuries
Medical management of joint injuries and disease
Early and aggressive anti-inflammatory therapy is indicated with all joint injuries provided the diagnostic process is not compromised. Once the level of joint compromise is determined, appropriate specific treatment can be pursued. Joint inflammation can be controlled with systemic non-steroidal anti-inflammatory drugs (NSAIDs) at recommended doses for 24–48 hours, combined with cold therapy and bandaging. Cessation of high-intensity exercise and the substitution of walking is indicated while the joint is acutely inflamed. Trotting and swimming can be used to maintain activity until the horse is able to return to its previous level of work intensity. Rapid resolution of synovitis and capsulitis is beneficial in avoiding capsular edema and capsular fibrosis that may lead to reduced range of joint motion. Passive joint flexion may aid in maintaining range of joint motion.

Intra-articular medications (as discussed in chapter 23) are likely to be most efficacious if used in a planned manner with
Veterinary aspects of training Thoroughbred racehorses

Surgery is occasionally indicated in order to salvage an animal for breeding or retirement. Before deciding if surgery is indicated, careful consideration must be given to the prognosis, expected rehabilitation time and economics. In many cases surgery assists the diagnostic process and may more accurately determine the prognosis and post-surgical management. Horses occasionally perform successfully with intra-articular lesions that may be addressed surgically, and weighing up the long-term benefits of surgery against the potential short-term economic losses can be difficult, particularly during the high earning stages of horse’s careers. A good working relationship with a surgeon experienced in treating joint disease in Thoroughbred racehorses will facilitate the decision-making process. Importantly only horses not considered at risk of breakdown should continue to train and should be monitored for evidence of progression.

Osteoarthritis

Early osteoarthritis can be managed with medical therapy and rest when indicated. The progression of osteoarthritis is often difficult to accurately predict. Despite this, initial and subsequent joint radiography provides valuable assessment of disease progression, in conjunction with regular lameness examinations and assessment of response to therapy. Complete rest for long periods in older horses with osteoarthritis can often be contraindicated with regard to racing longevity, since retraining often places demands on the arthritic joints that they cannot accommodate. Alternatively, maintaining such horses in lower-intensity modified training regimens
which include swimming, longer intervals between high-speed work combined with intermittent anti-inflammatory therapy, physical therapy and continual use of disease-modifying osteoarthritis agents may assist in prolonging their racing longevity. Advancing osteoarthritis requires continual monitoring, particularly for evidence of subchondral bone injury that may propagate to complete fracture. Eventually a stage is reached where the level of osteoarthritis becomes incompatible with safe and economic training and racing, and in these cases clinical findings combined with appropriate diagnostics support advice for retirement.

**Bone-related injuries and diseases**

Stress-related cortical bone injuries ‘incomplete stress fractures’ have been reported in a variety of bones including the third metacarpal bone, tibia, humerus, pelvis, sacrum, lumbar vertebrae and scapula. These manifestations of bone fatigue have been postulated in some instances as precursors to complete spontaneous fractures.28,36,64,85–90

Similarly, exercise-induced subchondral bone injuries have been well documented in the third carpal bone and distal third metacarpal and metatarsal bones as well as other sites of osteochondral fractures, and have been proposed to be associated with cyclic loading and bone adaptation responses.93

**Training modifications**

Training protocols appear to directly influence bone-related injuries and disease.

Changes in training intensity induce bone adaptation via altered forces and fatigue damage, with initial bone weakening due to increased bone porosity.90 The decreased mineral content is thought to significantly impact bone strength around 3 weeks after an alteration in training.94,95 and may take up to 3–4 months or longer to replace the lost bone, during which time the bone is weaker.94–96 It is the bone adaptation process itself that appears the more important component of bone weakening, rather than the fatigue damage.97 Two-year-old horses appear to be at greatest risk of adaptive bone pathology as their skeleton models and remodels in response to race training. The lowest bone mineral density in these horses occurs at 2–3 months after entering race training.96,98 Significant decreases in bone mineral content detrimental to bone strength occur during periods of inactivity,98 and are likely a result of a decrease in bone strains leading to extensive bone remodeling and increased porosity.93 A greater risk of bone fatigue-related injuries has been associated with return to work after periods of inactivity or lay-up.90,100

Since horses training at a slow speeds adapt their bones to that particular speed, the introduction of higher-speed pace work (‘breezing’) results in altered loads and bending forces requiring a further bone adaptation response, making bone susceptible to fatigue injury during this adaptation period.95,101 A study examining gait and speed as risk factors for fatigue injury of the third metacarpal bone in 2-year-old Thoroughbred racehorses recommended training modifications to reduce the incidence of ‘bucked shins’ consisting of reducing the extent of the low-speed long-distance work and increasing the frequency of the short-interval high-speed work.102 Therefore, allocating less training time to long-distance slow exercise and the introduction of earlier more frequent short distance fast exercise affords bone more time to adapt to race speeds.90 Problems that may be encountered include the inability to control young poorly educated horses, and the uninvestigated effects of this training protocol on other structures, particularly tendons and ligaments. The most appropriate training regimens to obtain optimal remodeling and modeling responses of bone that will best accommodate forces associated with racing and training are yet to be determined.103

**Dorsal metacarpal disease**

Dorsal metacarpal disease manifesting as ‘bucked or sore shins’ is one of the most common causes of lost training days in 2-year-old Thoroughbreds; one survey reported it to affect 70% of Thoroughbreds, with increased risk of third metacarpal stress fracture within 6–12 months.93,104,105 Deciding if affected horses can continue training will depend on severity of the condition as determined by regular palpation of shins, lameness examination and radiographic evaluation. Early identification of disease through palpation and detection of subtle lameness allows early treatment and the majority of horses to remain in training. Treatment should include immediate modifications to the training program and aggressive anti-inflammatory therapy. Monitoring the horse’s gait during exercise and the level of pain on palpation of shins are useful in assessing the response to therapy. Swimming can be used to augment fitness, with the track regimen consisting of trotting and shorter distances of pace work regularly (for example, 1–2 furlongs every other day). Horses with more advanced dorsal metacarpal disease have marked pain, evidence of swelling or cortical lucency identified radiographically and should be removed from training on economic grounds for at least 6 weeks. They should be returned to training with suitable modifications to the training regimen as discussed above for horses with adaptive bone pathology. Recommended training schedules to avoid bucked shins and to manage horses with early evidence of bucked shins have been documented.106

**Third metacarpal dorsal cortical stress fractures**

Conservative management typically requires a minimum of 7 months rest with a variable degree of success in achieving healing.107,108 Surgery offers an advantage with both lag screw fixation or the combination of osteostixis and positional screw fixation are reported to be more reliable than osteostixis alone, with healing and screw removal at 2 months after surgery, followed by resumption of training within 1 month of screw removal.59,60,109

**Stress fractures at other sites**

Stress fractures may be seen at a variety of sites (third metacarpal bone, tibia, humerus, pelvis, sacrum, lumbar vertebrae and scapula) and periods of reported rest for these fractures vary, so there is no clear consensus on an appropriate duration of stress fracture rehabilitation.105 Provided the stress fracture is not at risk of propagation to a complete fracture, general recommendations include stall rest with hand walking (the horse should be offered about 10 minutes hand walking twice daily, doubling weekly) until the horse is sound at the trot in a straight line. The horse should be evaluated for lameness after 2–4 weeks, first at the walk and if appropriate at the trot. Once sound at the trot, access to a small yard (20 feet square) for a further month is followed by a month of pasture release prior to return to training. A more rapid rehabilitation plan can be instituted under direct veterinary supervision with gradual introduction to low-level trot work after the month of stall rest and walking; however, such a program requires regular lameness and radiographic evaluation to monitor healing and possibly follow-up scintigraphic evaluation. This protocol can minimize time of maximal exercise restriction, but return to high-speed training should be delayed for at least 3 months from time of stress fracture diagnosis. Stress reactions and non-adaptive exercise-induced bone remodeling can also be managed with a similar approach.
Subchondral bone injuries

Subchondral bone injury and associated osteoarthritis occurs primarily in the carpus associated with the third carpal bone and the fetlock joint in the palmar/plantar metacarpal/metatarsal condyles and proximal sesamoid bones. The pathogenesis of these injuries is poorly understood but involves disease of both the articular cartilage and subchondral bone. Subchondral epiphysial bone changes have been identified as potential precursor to some fracutres of third carpal bone and condylar fractures of the cannon bone.

The diagnosis and management of subchondral bone diseases is problematic and both joint and bone disease issues should be addressed. Often radiographic findings are equivocal and in these cases scintigraphy can be a useful aid in diagnosis. Determining the degree of subchondral bone injury and collapse on radiographs alone can be difficult; computed tomography and MRI are superior to radiographs in detecting subchondral bone pathology. Typically if subchondral bone damage is evident, prolonged periods of rest are usually required and surgery may be indicated particularly if disease is involving the carpus. Many advanced subchondral bone injuries carry a guarded prognosis for future athletic performance, due to chronic lameness.

Breakdown Injury

Major breakdown injuries in racing Thoroughbreds include severe bone and ligament injuries involving the fetlock (traumatic disruption of suspensory apparatus, condylar fractures and P1 fractures) and carpus (distal or proximal row slab fractures with unstable or collapsed carpus) as well as major fractures of the humerus, tibia and pelvis. Appropriat assessment and use of corticosteroids is important for a racecar, veterinary. Appropriate first-aid measures prevent further osseous and cartilage injury; maintain skin cover and prevent further damage to blood supply that may ultimately determine the ability to salvage the animal. Removal of these patients from the racetrack environment allows appropriate diagnostics, communications and decision making to take place.

Tendon- and ligament-related injuries and diseases

The combination of training and aging may have a progressive detrimental effect on tendon strength. Micro-trauma due to accumulated submaximal strains results in alterations in tendon structure that decrease its ability to cope with cyclic strains and may ultimately result in injury. There may be an ‘optimal window’ during growth and training for the development of tendon extracellular matrix that would best prepare the tendon for cyclic damage associated with race training; this timing and activity level is yet to be determined and excessive exercise at a young age may result in damage. Prevention and early detection of lesions may become reality with further research into marker molecules that could allow identification of subclinical tendinitis.

Tendon injuries

Superficial digital flexor tendon (SDFT) injuries are a substantial cause of wastage, with a reported incidence in racing Thoroughbreds of 8–43%, and are more prevalent in horses older than 2-years of age. Astute observations of changes in flexor tendon profile, careful palpation and ultrasonography are the essential tools for the identification, assessment of severity, prognostication and monitoring of healing in tendon injuries.

Clinically apparent swelling, heat and pain on palpation indicate the need for careful ultrasonographic evaluation. Re-evaluation of a tendon at 1–3 weeks after injury may provide a more accurate indication of lesion severity and is particularly important when a lesion is suspected but not well defined on the initial examination. Peritendinous inflammation (‘bandage bow’) is typified by apparent tendon swelling with less intense pain on palpation when compared with tendinitis. Ultrasound confirmation of the diagnosis is required and treatment consists of aggressive anti-inflammatory therapy and cessation of pace work until all inflammation has resolved. Slow resolution of inflammation or residual thickening should prompt follow-up ultrasonographic examination.

Ultrasonographic monitoring of healing allows alterations to be made in the rehabilitation program and examinations are advised prior to any major increase in the level of exercise intensity. Clinical reassessment during rehabilitation is also important and changes should prompt ultrasonography. Blisters are not advised since they affect both the clinical and ultrasonographic assessment of a tendon and have no documented benefits. The prognosis for SDFT injuries in the Thoroughbred is reported to range from 20–60% of horses returning to successful racing and up to 80% sustaining a re-injury. Continuing to train with a mild lesion in a Thoroughbred racehorse results in progression to a more severe lesion. This is seldom economically or clinically successful and carries the risk of a catastrophic breakdown.

Controlled exercise rehabilitation programs may improve results with 71% of horses treated with a graded exercise program racing at least once compared with 25% of horses subjected to pasture rest alone. The decision to embark on a rehabilitation program should take economics into consideration, particularly the costs and benefits. Regardless of the level of rehabilitation undertaken, initial management involves cessation of training and aggressive anti-inflammatory therapy. The value of additional medical management procedures including intralesional or peritendinous sodium hyaluronate, polysulfated glycosaminoglycans and β-aminopropionitrile fumarate has not been well defined. Similarly, regenerative medicine techniques including the use of stem cells, platelet-rich plasma and other growth factor based biologies have been widely used recently and have shown some promise; however, at this stage in flat racing Thoroughbreds, none have shown dramatic improvements over rest and rehabilitation alone.

Surgical intervention has been suggested to improve prognosis with tendon splitting in the acute phase often combined with superior check ligament desmotomy. Superior check ligament desmotomy has a reported prognosis of 68–88% for returning horses to racing, with 52–56% racing at least 5 times after surgery. These results are similar to reports of conservative therapy alone. Furthermore, superior check desmotomy may increase the risk of suspensory ligament injury. Regardless of additional therapies, the total time required prior to reintroduction to race training is 8–12 months; a worse prognosis is documented for horses rested for less than 6 months.

Injuries of the suspensory ligament and its insertions

Training appears to have a strengthening effect on the suspensory apparatus with untrained horses more likely to experience ligament failure at smaller loads, whereas trained horses fail at greater loads.
Sesamoiditis, on the other hand, is often identified prior to training and a range of severity exists and may progress with training. Management of sesamoiditis is difficult and can be frustrating as recurrence with resumption of higher-intensity exercise is common. Initial therapy consists of local application of cold therapy, pressure bandaging and administration of systemic anti-inflammatory agents. Long-term rest up to 6 months is important to allow bone maturity and prevent fracture. Despite the benefits of long-term rest, the radiographic appearance of the lesions seldom makes an appreciable improvement. The long-term effect on the horse’s career is not clear; however, it appears that the severity and presence of additional pathology such as enthesisophytes impact on both racing longevity and earning potential.

**Suspensory branch desmitis and sesamoiditis**

Suspensory branch desmitis appears most prevalent in younger horses and particularly 2 year olds early in their career. Desmitis of the suspensory branches may manifest with concurrent sesamoiditis, sesamoid fractures or splint bone lesions. Sesamoiditis, on the other hand, is often identified prior to training and a range of severity exists and may progress with training. Management of sesamoiditis is difficult and can be frustrating as recurrence with resumption of higher-intensity exercise is common. Initial therapy consists of local application of cold therapy, pressure bandaging and administration of systemic anti-inflammatory agents. Long-term rest up to 6 months is important to allow bone maturity and prevent fracture. Despite the benefits of long-term rest, the radiographic appearance of the lesions seldom makes an appreciable improvement. The long-term effect on the horse’s career is not clear; however, it appears that the severity and presence of additional pathology such as enthesisophytes impact on both racing longevity and earning potential.

**Foot-related injuries and shoeing**

The foot is a common site of lameness and poor foot conformation is a common Thoroughbred trait, particularly under run heels and long toes that may predispose to injury. Foot balance in the dorsopalmar or plantar plane appears important. Excessive heel length or wedging and the resultant high hoof angles preferentially loads the suspensory ligament and SDFT, predisposing these structures to injury. Suspensory apparatus failure has been associated with under run heels (difference in toe and heel angles) and low toe angles have been associated with an increased risk of catastrophic injury. Decreasing the difference between toe and heel angle and increasing the toe angle alone may reduce injury risk.

Overreach injuries are typically high impact, with deep tissue damage usually greater than is initially apparent. Rarely do they initially cause a significant lameness unless there is major tissue trauma. These injuries can become a site of lamina detachment and if overlooked result in pocketing of dirt and subsequent infection, manifesting as lameness 3–7 days after the initial injury. Prevention of this sequelae requires excision of the separated tissue back to lamina attachment combined with bandaging while avoiding sand and dirt from gaining entry to the laminae–wall interface. Repetitively injured horses can be managed with ‘bell boots’ and shoeing changes.

Corns are a common cause of lameness and appear to be more commonly associated with flat sole, low heel and long toe conformations increasing weight-bearing in the caudal aspect of the foot. Addressing foot balance combined with light paring of sole over the bruising and application of a seated out heart-bar shoe combined with 2–3 days low-intensity exercise is generally adequate to resolve lameness. In some cases it may be necessary to ‘float’ the affected heel off the shoe. Hoof treatments are initially aimed at reducing inflammation and softening the sole overlying the bruised area through localized poulticing coupled with anti-inflammatory agents. These modifications combined with low-impact work including walk, trot, swimming are undertaken until there is resolution of inflammation and lameness. Use of heart-bar or egg-bar shoes and correction of foot balance by removal of excess toe provides more support for the caudal third of the foot. Time is necessary for dissipation of interstitial fluid and re-cornification of the bruised solar tissue. Once the pain is resolved, hardening of the

with fracture of the proximal sesamoid bones. The diagnostic approach is similar to that for tendon lesions although prognostication based on a lesion’s ultrasonographic appearance is more difficult. Inferior ultrasonographic image quality compared to that obtained when imaging superficial digital flexor tendons and the presence of muscle fibers complicates both diagnosis and assessment of healing, particularly in the high suspensory area. The prognosis for return to racing after suspensory desmitis has been reported to be relatively poor.

**Suspensory branch and body**

Horses developing small lesions of the suspensory branch early in training often only require 4–6 months and have a fair to good prognosis. In contrast, lesions in older horses, more advanced lesions, or those slow to resolve ultrasonographically, have only a poor to fair prognosis and require prolonged periods of rest up to 12 months. A higher incidence of reoccurrence is seen in these horses, the desmitis behaving similar to that described in show and dressage horses. Rehabilitation is similar as for tendons, with a graded exercise program and ultrasonographic monitoring of healing combined with attention to foot balance, particularly avoiding excessive heel length. There are anecdotal reports of horses with mild lesions remaining in training and racing, particularly if speed work is limited to race starts only; however, there is a risk of progressive damage or complete failure.

Lesions of the suspensory body are dealt with using similar methods as discussed for tendon injuries. The presence of concurrent splint bone lesions should be ruled out. Typically, management and the prognosis for return to racing is determined by the lesion severity and assessment of the healing response. At least 8–12 months is usually necessary prior to returning to training.

**Proximal suspensory and its attachment**

Lameness associated with the proximal suspensory ligament and its attachment is relatively common in Thoroughbred racehorses. Diagnosis can be difficult because of the variety of ligament or bone lesions seen separately or together, with a wide range of clinical severity. In addition, the intimate association of the carpometacarpal joint and proximal suspensory ligament limits the specificity of diagnostic anesthesia to identify lameness arising from the proximal suspensory area and the carpometacarpal and middle carpal joints. Clinical differentiation of high suspensory pain and third carpal bone disease can be difficult.
new sole can be achieved by applying diluted iodine solution (2%) or formalin (10%).

Quarter cracks are manifestations of shear forces within the hoof wall and laminae. Some cases may be associated with hoof imbalance and excessive wall length in the affected quarter. They may be identified prior to lameness, providing an opportunity to prevent crack propagation and lameness by corrective trimming/shoeing and modified exercise regimes. Depending on size, stability and the extent of propagation many smaller stable cracks can be debrided and patched. This combined with rasping of the quarter, attention to foot balance and application of a bar shoe all assist in stabilizing the crack. Unfortunately many cracks in Thoroughbreds involve the heel or caudal aspect of the quarter and are not readily amenable to repair. These caudal cracks, and cracks with coronary band involvement often require stripping of the hoof wall to allow regrowth of stable horn tissue.

Pedal osteitis, pedal bone ‘rim’ fractures, sole bruises and other injuries secondary to solar concussion are often accentuated by exercise on sand tracks. Management includes sole pads, wide web seated out shoes and egg-bar shoes. Discrete sole lesions can be covered temporarily with a small welded plate to protect the area, while still allowing access of topical treatment. High nails or ‘nail presses’ can be overlooked during lameness examinations. Nail and/or hematoma pressure may result in persistent lameness without evidence of infection. Evaluation of clinch heights and sequential application of hoof testers to each nail will facilitate their identification. If identified before the onset of infection the nail can be removed and iodine solution flushed down the nail hole to disinfect and facilitate drying. If infected, soaking the foot in Epsom salts, poulticing and debridement are indicated.

Interference injuries can result from one or a combination of factors including conformation, shoeing, soundness and immaturity (Fig. 48.7). Identifying the cause of the interference is necessary in order to develop a plan aimed at resolving the problem. The presence of neurologic disease should be ruled out. If necessary, identification of the source of interference can be determined by applying chalk to the affected area to identify the limb and area causing the interference. Resolution requires ideal foot balance and in younger horses time is needed to learn and achieve balance on the straight before high-speed work around turns is introduced. Protective bandaging and bell boots minimize trauma while attempts are made to resolve a problem. Lighter shoes, partial shoes (‘tips’) and ‘safing’(rounding) of edges resolves many problems.

‘Going down on bumpers’ or ‘running down behind’ describes excoriation typically of the plantar fetlock in the hindlimbs and occasionally in the forelimbs (Fig. 48.8). This can be multifactorial and may be associated with fatigue, shoeing, or compensation for lameness. At times this may be severe and result in the removal of full-thickness skin cover. If no lameness problems are identified and if the problem continues with a temporary decreased intensity of training the application of wedged heels, extended heel or egg-bar shoes and correction of dorsoplantar foot balance can assist resolution. Recurrently injured horses often require taping of the fetlocks with protective padding such as orthopedic felt or other padding. All interference injuries should be treated as contaminated wounds with potential for infection.
Muscle-related injuries and disease

Recurrent exertional rhabdomyolysis (RER)

Most commonly seen in 2-year-old fillies, RER is reported to affect approximately 5% of racing Thoroughbreds. The quantitative correlation between muscle enzymes and severity of clinical signs is poor and elevation of muscle enzymes after exercise does not always indicate clinical rhabdomyolysis; conversely, clinically affected horses may have delayed peaks and more prolonged elevations of enzyme activity in serum. Horses exhibiting elevated muscle enzymes and minimal clinical signs warrant further investigation and management changes, since the effect on ultimate performance is unknown. Serial monitoring of muscle enzymes is a reasonable tool to determine responses to management changes and therapy. Cases responding poorly warrant further diagnostic evaluation.

Management issues that can be manipulated include diet, exercise schedules and potential stressors. Minimizing stressors by maintaining a regular daily work schedule and quieter stall location remote from major traffic areas in stable are recommended. Benefit can be gained from different exercise prior to track work, including extensive walking, swimming or 'ponying'. Tranquilization can also assist, with low doses of acepromazine (5–10 mg intramuscularly 60 minutes prior to work) effective in some cases. Reduction of the amounts of digestible carbohydrate in diet can be achieved by reduction of the quantity of grain or substitution of a less digestible carbohydrate source replacing oats with corn, while adding fat to maintain dietary calories. Dietary change may be more important in modulating the degree of nervousness and excitability rather than playing a direct role in the pathogenesis of the disease. The use of prostaglandins is often advocated, no association in elevation of muscle enzymes was seen in fillies associated with their estrous cycle; controlling estrus behavior may still act to minimize stress levels in some individuals. Electrolyte, and vitamin E and selenium supplementation may also be of benefit.

Working twice daily with one session only being light work avoiding ‘days off’ and substituting different forms of exercise on days that horses are not worked can be all effective managing difficult cases combined with reduction or complete removal of grain from diet on these rest days is indicated. A slow introduction of high-intensity work coupled with a gradual increase in carbohydrates which follows increased workloads limits subclinical elevations in muscle enzymes. Cases responding poorly to other management changes may respond to administration of muscle relaxants such as methocarbamol, dantrolene and phenytoin. Use of oral branched-chain amino acid preparations prior to exercise has been reported anecdotally to reduce the magnitude of muscle enzyme elevations.

Treatment of acute cases includes immediate cessation of exercise and administration of polyionic fluids (either intravenous or oral, depending on severity) to achieve rehydration and promote diuresis, combined with administration of NSAIDs (flunixin meglumine or phenylbutazone). Acepromazine appears efficacious in calming these horses and may facilitate resolution of RER. Occasionally extremely uncomfortable horses may require α2-agonists and opiates for analgesia.

Muscle strains and tears

Primary muscle injuries are difficult to verify as a source of lameness and usually require exclusion of skeletal lesions. Swelling, asymmetry and pain on deep palpation may be apparent in some cases. Measurement of muscle enzymes is of limited value as elevated enzyme levels are generally not a consistent finding with isolated muscle tears. Lameness is typically the most obvious at the walk and swing phase of the trot. Muscles commonly identified include semimembranosus, semitendinosus and brachiocephalicus. Accompanying bone lesions may be present and are seen most commonly at the tuber ischii with tears of the semimembranosus and semitendinosus. Muscle tears generally require a rest period of 2–3 weeks to resolve if no bony involvement is present; more significant time appears required for tears of the brachiocephalicus, requiring 3–6 weeks of rest.

Back and wither injuries

Withers are a common site of injury due to saddle rubs or falls. These are susceptible to rubbing, hematomata formation and infection. They are best managed by avoiding saddle contact until completely healed and exercise may continue with use of military saddles or swimming and ‘ponying’. Padding in most cases is inadequate due to the propensity to rub.

Diagnosis of back injuries and related pain is often difficult. Typically pain is muscular in origin and may be associated with an underlying lameness. The presence of bony pathology such as vertebral stress fractures and overriding spinous processes may be demonstrated with radiology or nuclear scintigraphy. Treatment is directed at identifying the underlying cause coupled with temporary cessation of pace work, anti-inflammatory and local therapy.

Infections of the musculoskeletal system

High-intensity exercise, close horse-to-horse and horse-to-handler interaction, confined surroundings and veterinary intervention contribute to Thoroughbred racehorses commonly experiencing a variety of musculoskeletal infections. Cellulitis is common and generally seen in the lower limb. Occasionally idiopathic peri-articular tarsal infections are seen. Traumatic injury leading to osseous infection is common. Although rare, clinicians should be observant for signs of septic arthritis given the frequency of intra-articular therapy and the repercussions of this complication. There are rare reports of idiopathic synovial infections of horses in training.

Successful treatment is facilitated by rapid identification and institution of appropriate antimicrobial therapy, adequate wound therapy, clean bandaging and avoiding areas of contamination, such as sand rolls, water activities, and the hands of the stable staff. Antibiotic selection should take into consideration the high concentrations of horses interacting in a common environ coupled

Fig 48.8 An example of ‘running down behind’ or ‘going down on the bumpers’ chronic excoriation seen here on the plantar aspect of the right hind fetlock in this Thoroughbred racehorse. Note also the slightly wedge-heeled shoe that has been applied in an attempt to reduce the ongoing trauma to the area.
with intense human contact and frequent use of antimicrobials. It is likely that individual racetrack environments will establish predominate pathogens with specific sensitivities akin to a hospital environment.

**Respiratory diseases**

**Lower respiratory diseases**

Respiratory disease is a major cause of wastage for horses in race training, and lower respiratory diseases in particular appear to contribute most significantly. An appropriate diagnostic work-up consisting of a clinical examination and use of clinical pathology (hematology, transtracheal aspirate [TTA] and bronchoalveolar lavage [BAL]), endoscopy, ultrasonography and radiography, when indicated to allow appropriate management and prognostication. In addition, assessment of the environment, stall or yard conditions including design, horse movements, bedding and feeding are important in the diagnosis and management of lower airway disease in the horse in training.

**Coughing horses and inflammatory airway disease (IAD)**

Horses suffering from IAD typically present as otherwise apparently healthy young horses usually 2–3 years old that have been in the stable environment for a couple of weeks or longer and present primarily for 'coughing'. The presence of a nasal discharge may be variable. Endoscopic evaluation typically reveals a mucopurulent tracheal exudate containing elevated numbers of neutrophils. Although the severity of tracheal exudate has been correlated with lower airway inflammation, observing upper airway mucus may occur independently of lower airway inflammation; therefore its presence is not an indication for testing for lower airway inflammation. Furthermore, neutrophil proportion of tracheal wash samples has been shown not to be as useful as visual assessment of tracheal mucus in identifying horses in training which require treatment and management for IAD. Excessive coughing is stimulated by laryngotracheal palpation, auscultation with the aid of a rebreathing bag or passing an endoscope into the trachea.

Historically, viral respiratory infections have been implicated as the major cause of lower respiratory disease in young racehorses. Recent studies suggest a variety of pathogens, including bacteria, mycoplasma, endotoxin and non-infectious agents may contribute to IAD. The role that bacteria isolated from transtracheal aspirates play in this syndrome is unclear. Their quantity, whether extra- or intracellularly located and species (Streptococcus, Pasteurella and Bordetella spp.) have all been considered as characteristic of IAD. The role of antibiotics in treating IAD has yet to be established.

The environment appears to be an important component of IAD, triggering allergic or non-allergic airway inflammation. Air quality improvements can be made by minimizing feed dust with low dust or wet feeds, soaking hay and feeding on the ground. Housing changes include improving ventilation by use of yards or pens and reviewing choice of bedding by avoiding straw and dusty beddings in favor of wood shavings or clean sand. Minimizing noxious gases by regular stall cleaning and minimizing dust production by avoiding sweeping and mechanical 'blowers' in favor of hosing also improve air quality. Quarantine of cases may reduce risks if an infectious cause is suspected because of the sudden onset of multiple cases.

Pharmacologic therapy for IAD includes systemic or inhaled mucolytics, bronchodilators and corticosteroids. The presence of mast cells in BAL fluid may indicate the presence of immune-mediated airway disease. In such cases use of a short course of systemic corticosteroids and an inhaled mast cell stabilizer (sodium cromoglycate) may be indicated.

**Exercise-induced pulmonary haemorrhage (EIPH)**

Exercise-induced pulmonary hemorrhage (EIPH) is thought to occur due to high transmural alveolar capillary pressures, and numerous factors may contribute to the severity of hemorrhage including exercise intensity, distance, age, upper respiratory obstruction, heterogeneous ventilation, hemorheological factors, small airway disease and lower airway inflammation. Despite this, a recent study showed that age, sex, weight carried, track hardness, speed of racing or air quality did not have a strong association with development of EIPH. The reported prevalence of EIPH depends on the criteria used, with epistaxis occurring in approximately 1–2% of race starters. After high-intensity exercise (30–90 minutes) there is endoscopic evidence of EIPH in approximately 75% of horses. Bronchoalveolar lavage (BAL) is a more sensitive means of documenting EIPH and has demonstrated its presence in nearly all racing Thoroughbreds. Furthermore, BAL may better correlate with severity and chronicity.

Identification and appropriate treatment of IAD combined with the use of bronchodilators and furosemide prior to exercise are still the popular mainstays of EIPH therapy. Although efficacy in reducing EIPH has not been definitively demonstrated, pre-race administration of furosemide has been shown to decrease the incidence and severity of EIPH under race conditions. Even in jurisdictions where furosemide is not allowed on race day it can be incorporated in the training program and used prior to high-intensity training. The furosemide dosage is typically (150–250 mg) given intravenously or intramuscularly 2–4 hours prior to work. One study suggested administration 30 minutes prior to exercise was superior to administration at an earlier time of 240 minutes.

The association with the high work intensity makes training modifications difficult; slower longer duration work may decrease severity of EIPH, since the disease has been documented with greater incidence in racing distances less than a mile. Blood in the airway incites an inflammatory response and complete erythrophagocytosis takes up to 2 weeks. Management should be aimed at minimizing high-intensity exercise during the inflammatory period, and treating airway inflammation. Response to therapy can be assessed with a follow-up BAL. Investigation of the FLAIR™ nasal strip has shown potential benefits in upper airway mechanics and a reduction of EIPH; however, controversy (prohibited by some racing jurisdictions) and conflicting results exist with its use.

**Upper respiratory diseases**

Upper respiratory diseases commonly manifest as poor performance, and in most cases are associated with abnormal upper respiratory noise. Upper airway abnormalities have a prevalence of approximately 6–10% in racing populations.

Detailed investigation of an upper respiratory abnormality should include a thorough accurate history aimed at characterizing the noise and determining if there is an effect on performance. Historical information should also include detail of any previous upper airway surgical procedures or use of gear or tack to improve the observed problem. Track visits or the use of ‘sound spectrum analysis’ assist noise characterization. Diligent and systematic clinical examination is indicated particularly with respect to
doubt that an established protocol, appropriate equipment preparation, maintenance, trained technical staff and experience are essential to achieve reliable quality recordings. These factors could be no more relevant than on the Thoroughbred racetrack where the environment and nature of the breed predisposes to an excitable patient and the need for efficiency. The over-ground examination requires clear communication with the trainer to coincide with the horses’ fast work. This individualized scheduling is essential to maximize the value of the examination and minimize the disruption to training schedules. Furthermore, the upper airway recording period of most interest is typically a brief period (30–60 sec) of high-intensity exercise nearing the end of the exercise. If the recording does not produce diagnostic quality images, repeat examinations require scheduling to coincide with the horses’ ongoing training/racing regime. Application of heart rate monitors and GPS systems are also easily adapted to the protocol and provide valuable information when assessing the exercise regime.

Over-ground dynamic respiratory endoscopy

The ability to image the upper airway of the racehorse during ridden exercise in the horse’s normal working environment has greatly advanced veterinarians’ ability to more readily and accurately replicate exercise-related dynamic upper airway obstructions. The ease of application, safety and tolerance by the horse in training of this instrumentation has allowed assessment of the influence of rider, tack, surface, head position and environment on upper airway conditions. Since the introduction of the first commercially available dynamic respiratory endoscope in 2008 providing diagnostic quality reproducible images, there are now several systems of varying quality, features and cost. The prevalence of upper airway performance limiting conditions, ease of application, reproducibility of diagnostic images and affordability has made this an invaluable tool to the Thoroughbred racetrack practitioner. The semi-rigid malleable insertion tube in conjunction with wireless telemetric video-endoscopic recording creates quality video recordings comparable to and in many cases superior to that obtained by treadmill video-endoscopy (Fig. 48.9 and Fig. 48.10). Essential to the clinical value of this diagnostic technique is reliable production of quality recordings, frame by frame (25 frames per second) analysis and control and documentation of the exercise protocol. There is little
noise and poor performance is a race-related assessment; therefore, the goal of the exercise protocol is to replicate these conditions. The chances of obtaining a definitive diagnosis from the examination are improved by emphasizing the need for trainers to replicate racing conditions as much as possible; this is often assisted by working the horse in company with another horse. The variability and tendency for training exercise regimes to not replicate the level of exertion reached during competitive racing has been associated with a lower sensitivity of over-ground endoscopy in diagnosing intermittent dorsal displacement of the soft palate versus endoscopy during high-speed treadmill strenuous exercise. Accurately documenting sectional exercise times (200 m/furlong intervals) over the final 1000–1200 m is important to correlate frame-by-frame video findings with the stage of exercise and observations of the rider.

**Left recurrent laryngeal neuropathy (RLN)**

Once diagnosed, the prognosis and suitability for surgery should be carefully determined. Potential diagnostic oversights include previous surgery, arytenoid chondritis, fourth branchial arch defects, and other upper airway or lower airway conditions such as IAD and EIPH in conjunction with RLN. Presence of these abnormalities will negatively impact on the surgical prognosis. Prior to considering surgical treatment there should be careful assessment of the horse’s ability to return to racing within 2 months. Despite the above-reported range, from 40 to 85% for a successful outcome with horses able to return to racing, a similar prognosis for successful return to racing compared to horses undergoing laryngoplasty; with 63% of unraced horses and 60% of horses which had raced prior to neuromuscular pedicle grafting winning at least one race after surgery. Despite this, of the horses that had raced prior to surgery ~40% had improved race performance after surgery. Clinical and experimental evidence to date suggests this surgical procedure is best applied to horses identified with hemiparesis (grade III or less laryngeal function) and that are 2 years of age or younger due to the prolonged time required for re-innervation and the associated rehabilitation time (6–12 months). Laryngoplasty can be performed after neuromuscular pedicle grafting if re-innervation is unsuccessful, though horses that have had unsuccessful laryngoplasty are not candidates for re-innervation because of the associated disruption to the first cervical nerve and CAD fibrosis with laryngoplasty. Other management options include racing in less competitive company and over shorter distances (5–6 furlongs; 1000–1200 m). Furthermore, permanent tracheostomy or temporary tracheotomy are both alternatives if sanctioned by racing authorities.

**Intermittent dorsal displacement of the soft palate (IDDSP)**

In the resting horse, diagnosis is tentatively based on a combination of appropriate history and endoscopic examination, subjective judgment of laryngopalatal instability and/or presence of soft palate or sub-epiglottic ulceration. Careful questioning of riders provides valuable information; reports of ‘gulping type’ noise particularly at the end of races or immediately after the winning post and poor performance in the final furlong is often reported. That said, ensuring historical suggestive of IDDSP is a repeatable phenomenon is essential before embarking on exhaustive diagnostics and management changes. Evidence of epiglottic flaccidity, dysfunction or hypoplasia may further support the diagnosis of IDDSP, and warrants further investigation with radiography. Endoscopic examination of the guttural pouches is indicated to assess for the presence of inflammation or infection which may affect the pharyngeal branch of the vagal nerve coursing the ventral floor of the mediastinal cavity.
guttural pouch compartment. Although characteristic history and resting endoscopic findings may be useful, when used alone, these parameters have been shown to result in an inaccurate diagnosis in 35% of horses examined. Dynamic exercising video-endoscopy of the upper airway either over ground or associated with high-speed treadmill exercise is essential for a definitive diagnosis of IDDSP. It is important to ensure that exercise protocols during over-ground dynamic endoscopic examinations replicate racing conditions as closely as possible to minimize the possibility of false-negative results. As important as definitively diagnosing IDDSP is the ability to document whether additional upper airway abnormalities are occurring concurrently.

Medical management may include continued training as the condition may resolve with increased fitness and weight loss, or rider and gear changes. Inexperienced riders can often encourage the likelihood of displacement by taking too heavy a ‘hold’ on the reins. Immature horses should be given time to mature, as many resolve their tendency for IDDSP. Gear changes including tongue ties, figure eight nosebands and a bit that secures the tongue (W bit, spoon bit or a ‘Serena song’ bit) used individually or combined can be effective. Analysis of racing records of a large number of Thoroughbred racehorses, with or without a definitive diagnosis of IDDSP, has revealed that use of a tongue tie has a beneficial effect on racing performance. Medical management of upper airway inflammation (pharyngitis) may be beneficial when neutritis of the pharyngeal branch of the vagus nerve accompanies upper airway inflammation. Anti-inflammatory therapy, both systemic and local pharyngeal spray, may benefit these horses. The laryngeal support device ‘Cornell Collar’ or ‘Throat Support Device’ is advocated as a non-surgical option to prevent IDDSP, by positioning the larynx in a more dorsal and rostral position. Despite promising experimental results the efficacy in resolving naturally occurring IDDSP is yet to be determined. The use of this device is associated with regulatory conditions in some countries and is not able to be used at all in others. When medical management fails, surgery is indicated and a variety of procedures have been described, including staphylectomy, sternohyoidomycectomy, partial ster-nothyroidomyectomy, palatoplasty techniques and laryngeal tie-forward and epiglottic augmentation in the presence of epiglottic hypoplasia. The surgical technique of choice remains controversial and is often individually surgeon preference driven. The laryngeal tie-forward procedure combining sternothyroidomycectomy and ten-ectomy appears to have gained most support recently for horses initially unsuccessfully managed conservatively, with only a short time out of training, approximately 2–3 weeks, required before resuming exercise. Horses undergoing laryngeal tie-forward procedure are reported to be as likely to race postoperatively as matched controls and success rates as high as 83% have been reported in a small group of horses. The prognosis for horses improving their race performance regardless of the other types of surgery therapy pursued is reported to be approximately 60%.

Arytenoid chondritis

Small mucosal lesions noted on the axial surface of arytenoids in the absence of arytenoid thickening are encountered infrequently and generally heal without complication, and without having effect on future racing performance. They are typically seen in young Thoroughbreds in training or in yearlings around sale time. However, occasionally, they may progress or appear as localized granulomatous lesions which may occasionally be refractory to antibiotic and anti-inflammatory therapy, and require local excision. Rarely these mucosal lesions have been seen to progress to arytenoid chondropathy in yearlings, necessitating protracted antibiotic therapy or arytenoidectomy. For this reason endoscopic monitoring of arytenoid mucosal lesions appears appropriate, and if indicated medical management consisting of cessation of high-intensity training, parenteral and topical antibiotics and anti-inflammatory agents.

Arytenoid chondropathy identified in the acute stages with only mild cartilage thickening may be managed with cessation of training and medical therapy, with a favorable prognosis for returning to racing in the short to medium term. Peri-arytenoid inflammation with minimal cartilage involvement may be arrested medically and may allow continued training if mucosa is intact and abductor function and airway are judged as adequate. Cases with minimal cartilaginous distortion, granulation tissue on the axial surface and complete arytenoid cartilage abduction capability may be managed with a combination of medical therapy, surgical debridement of granulation tissue and draining tract and short-term rest.

Horses failing to respond to the above approaches or those with moderate to severe cartilage thickening are candidates for partial arytenoidectomy. Partial arytenoidectomy is also indicated for horses with failed prosthetic laryngoplasty, particularly when failure is associated with postoperative infection. This procedure is associated with a convalescence period of 3–4 months. The reported success rate for horses returning to racing and attaining comparable preoperative earnings/start following partial arytenoidectomy is approximately 60%. Compared to prosthetic laryngoplasty, a similar rate of return to racing is expected though postoperative earnings are likely to be lower. Despite this, the likelihood of improved postoperative outcome can be managed by racing over shorter distances. Compared to horses having undergone prosthetic laryngoplasty, clinical indications are there is a lower incidence of horses requiring management for persistent coughing and aspiration following partial arytenoidectomy.

Other upper respiratory problems

Other regularly recognized upper respiratory problems that can be managed with minimal lost training time and while the horse remains in the stable include uncomplicated epiglottic entrapment and sub-epiglottic cysts. Problems that often require between 2 and 4 weeks out of training requiring surgery include alar fold flutter, axial deviation of aryepiglottic folds and atheromas. Pharyngeal collapse, fourth branchial arch defects, collapse of the apex of the corniculate process, septal abnormalities and advanced sinus cysts limiting airflow carry a poor prognosis for return to successful racing, even with appropriate surgery if indicated.

Gastrointestinal diseases

Parasite prophylaxis programs are best coordinated with the spelling facilities. Mouth cuts in the commissures are often encountered and may be overlooked in a horse ‘hanging’ on a rein. Management involves ruling out a musculoskeletal problem and minimization of the trauma by changing bits using topical medical therapies and changing to a thicker or rubber bit, using cheekers or ponying without bit until healed.

Gastric ulceration

Gastric ulceration in Thoroughbred racehorses is reported to affect 66–93% of the population, increasing to 80–100% for horses in advanced training or racing. The disease most commonly manifests in racing Thoroughbreds as a decrease in feed intake, and confirmation of ulceration is achieved via endoscopy, however a poor correlation exists between clinical signs and the severity
of ulceration. Risk factors include the stable environment, periods of no feed intake and administration of NSAIDs and corticosteroids.

Feed management in horses with gastric ulceration should focus on regular feeding with multiple daily meals and constant access to hay in order to avoid any prolonged periods that horses are not eating. Pharmacologic antiulcer therapy (H2 blockers or proton pump inhibitors) in most cases improves appetite within 1–2 weeks of commencing therapy. Failure to improve may indicate need for further investigation and management changes. Since the prevalence of ulceration is high in the racing Thoroughbred population, and the severity of ulcers in our experience does not seem well correlated with clinical signs, a therapeutic trial may be indicated if gastric endoscopy is not available. Horses that respond to therapy should be maintained on therapy while in training, with omeprazole the preferred therapeutic.

**Cardiovascular diseases**

Cardiovascular diseases, with the exception of atrial fibrillation, are relatively rare in racehorses. However, functional and anatomic cardiac abnormalities should not be overlooked as potential causes of poor performance.

**Veins (septic and non-septic thrombophlebitis)**

Typically associated with intravenous injections, thrombophlebitis can be very debilitating to a Thoroughbred racehorse. Once a vein is inflamed it should be avoided as a site of venipuncture, until inflammation is completely resolved. Cessation of high-intensity activity combined with hot packing and antimicrobials may hasten resolution. Progressive sepsis or thrombosis of both veins can become career threatening. The risks of thrombophlebitis may be decreased by use of a disposable 1.5-inch 18G catheter instead of a needle for administration of all agents that may incite an inflammatory response if delivered perivascularly.

**Diarrhea**

Severe enterocolitis needs to be recognized and treated immediately with aggressive medical therapy. Prophylaxis involves avoiding unnecessary use of antimicrobials. Use of specific antimicrobial agents appears to be associated with an increased frequency of enterocolitis. Inclusion of metronidazole in therapy may be indicated if diarrhea is associated with antimicrobial use. Concerns of potential salmonellosis warrants some form of isolation of these cases.

**Colic**

Typically the incidence of colic is low in racing populations. Swimming activity is noted occasionally to cause colic in some individual horses; in this capacity it is typically seen within 2 hours of a swimming episode. The etiology of swimming-associated colic is undetermined but is typically associated with gaseous distension of the large bowel; usually, the majority respond to medical therapy, but a small number require surgical intervention. Individuals that seem predisposed to recurrent bouts require swimming to be removed from their training schedule.

**Cardiac abnormalities**

The most common indication for investigation of cardiac function in racing Thoroughbreds is poor or decreased performance. The most commonly identified pathologic arrhythmia is atrial fibrillation. Atrial fibrillation is typically associated with a marked reduction in high-speed performance and may occur associated with a race or strenuous exercise. Atrial fibrillation may be paroxysmal, resolving within 24–48 hours of its identification after exercise and diagnosis may be difficult if the arrhythmia resolves before it is documented. Cases with persistent atrial fibrillation require treatment to achieve conversion to a normal rhythm; the presence of pre-existing cardiac lesion as a contributing factor should be ruled out as this will negatively impact long-term athletic prognosis.

Heart murmurs have been documented in a large portion of the population of racing Thoroughbreds; one study identified murmurs in 81% of 846 Thoroughbred racehorses and no association was found between racing performance and murmurs. Investigation of cardiovascular function using Doppler echocardiography may be indicated if a murmur not typical of a functional systolic murmur is identified or in horses with poor performance not attributable to the respiratory or musculoskeletal systems. Documentation of apparently pathologic murmurs in young untrained horses warrants documentation and monitoring over time, since mitral and tricuspid regurgitant murmurs have been demonstrated to progress with training.

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