Ovine Meat Inspection

2nd Edition

Anatomy, physiology and disease conditions

A Grist

CONTEXT

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DIAGRAM LIST

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ANATOMY/ PHYSIOLOGY

SKELETAL SYSTEM

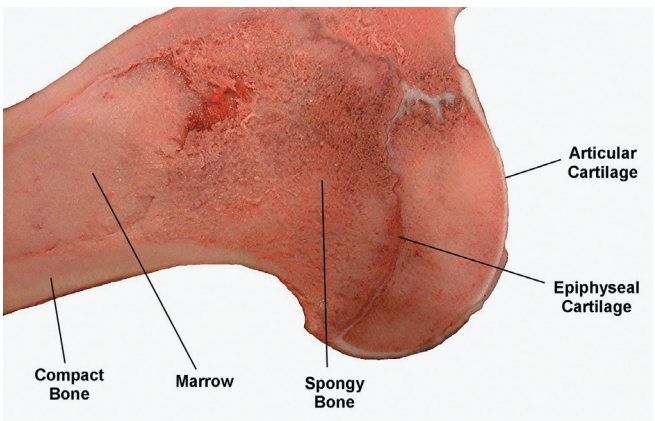
INTRODUCTION

The skeletal system provides structure, protection and a means of locomotion. Muscles are attached to the bones by ligaments or tendons and move the animal by contracting around a pivot or joint. In this section the basic structure, position and function of the bones is described. For this purpose the bones of the skeleton are divided into the skull, the axial skeleton and the appendicular skeleton (forelegs and hindlegs).

THE STRUCTURE OF BONES

Bone is a collagen matrix containing mineral salts, chiefly calcium phosphate, and various cells including osteoclasts and osteoblasts. The deposition of mineral salts within the matrix is controlled by osteoblasts. Mineral reabsorbtion and release of the minerals into the blood is attributed to the large, mononucleated osteoclasts. These cells work in balance, their activity being controlled by parathyroid hormone (PTH) secreted by the parathyroid gland in response to fluctuation in the serum- calcium level of the blood. If this level decreases, more hormone is released which has the effect of increasing the activity of the osteoclasts whilst decreasing the osteoblast activity and hence subsequently increasing the calcium in the blood. This deposition and reabsorbtion of mineral salts of the bone is a continual process.

Bones have a connective tissue membranous covering, the periosteum, which has bone-forming properties and, through fusion with muscular connective tissue, anchors the muscle to the bone. Under the periosteum is the dense, or compact bone, which in the long bones forms a hollow shaft containing marrow and spongy bone. Marrow occurs in two forms, red and yellow, and is a combination of blood vessels and connective tissue containing fat and blood producing cells. Red marrow produces blood cells such as erythrocytes and leukocytes; yellow marrow is formed mainly from fatty tissue. Spongy or cancellous bone is usually found at the extremities of long bones and is composed of thin intersecting layers of bone. The



Section through a humerus

articular cartilage has a bluish white colour and is also known as hyaline cartilage due to its glassy appearance. The epiphyseal cartilage represents the site at which bone growth increases the length of the long bones.

BONE TYPES

There are several classification systems used to describe bone types, the most common being the subdivision of bones into shapes, therefore the types encountered can be considered to be:

- Long bones, such as those of the humerus and femur.
- Short bones, such as the carpus and tarsus, roughly cuboid in shape.
- Flat bones, consisting of two layers of compact bone separated by a thin layer of spongy bone, as occurs in cranial bones and the scapula.
- Irregular bones, for example the vertebrae.

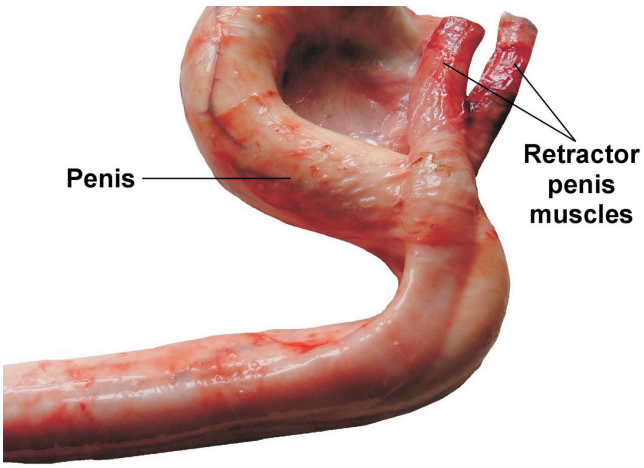
THE STRUCTURE OF JOINTS

The separate bones of the skeletal system are jointed together by systems that either fix the bone in relation to its neighbour or allow partial or free movement (articulation). Fibrous and cartilaginous joints between bones form fused or limited mobility joints, and synovial joints allow free movement between articulating bones.

Cartilaginous joints are found in areas such as between the vertebrae, at the pelvic symphysis and between the two halves of the mandible. Their structures vary and allow a small range of movement between the bones.

Fibrous joints immobily connect bones forming joints such as those fusing the flat bones of the skull at joints known as sutures.

The cartilaginous joints between the vertebrae



The penis proper is composed of three columns of tissue, with a rich arterial blood supply, that surround the hollow urethra. Contained within a fibrous tunic and roughly circular in section, the dorsal aspect of the penis is formed by the two fused *corpus cavernosae* with the urethra surrounded by the *corpus spongiosum* carried in a ventral groove. The columns of *corpus cavernosae* terminate at the glans of the penis which is formed by the *corpus spongiosum*. In addition to the columns of erectile tissue the penis also contains a large proportion of connective tissue, and is characterised by the presence of a sigmoid flexure (an 'S' shaped portion) that straightens out when the penis becomes erect and is retracted, post copulation, by the retractor penis muscles following disgorgement of blood from the erectile tissue.

MAMMARY GLANDS

The mammary glands are modified sweat glands containing connective tissue, blood vessels, lymphatic vessels and glandular tissue. Alveoli within the gland tissue secrete and store milk which is then collected in ducts and delivered to the teats. Sheep possess two mammary glands; each with a teat, combined to form the udder. The udder is visibly separated into two halves along the median plane by the presence of suspensory sheets; the division between the two glands on each side of the separation is indistinct as the glandular tissue of one gland tends to fuse with that of the other. The milk produced collects in interconnecting ducts before entering the teat cistern. The teat contains a single duct, usually held closed by a combination of the naturally elasticity of the connective tissue of the teat, and an encircling layer of smooth muscle.

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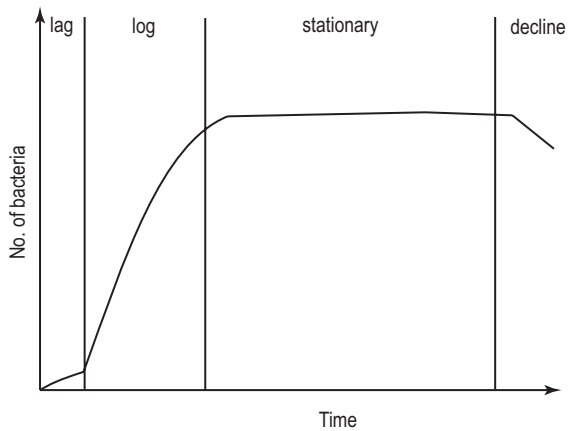
DISEASES OF SHEEP

Bacterial growth is by binary fission, where the internal contents of the bacterium halve, split and then reform into two matching bacterium, the doubling time varying from 20 minutes (*E.coli*) to 24 hours (tubercle bacilli). The process of binary fission means that one bacterium becomes two, two become four, four become eight, and eight become sixteen, and so on. Given balanced growth, where all required nutrients are available, the growth curve of bacteria follows distinct phases. After an initial lag phase, high-virulence exponential growth occurs during the log phase, followed by a stationary phase where the number of bacteria produced is equal to the number dying, which is in turn followed by the decline phase where the number dying is greater than the number produced as the available nutrients are used up.

Each bacterial species has varying requirements for optimum growth, including available nutrients, temperature, available moisture in the form of water activity (Aw), and the pH or hydrogen ion concentration of their growth medium.

Taking these factors in order, bacterial growth requires water-soluble nutrients, and high protein foods are favoured such as eggs, fish and meat. Food was historically salted to preserve it, which reduces moisture as well as preventing the osmotic diffusion of nutrients into bacterial cells.



Bacterial growth curve

In terms of temperature, the lower the temperature, the slower bacteria grow. Most disease causing bacteria (pathogens) cannot grow below 4ºC and none can grow below 0ºC, spoilage bacteria can grow at temperatures down to -5ºC. As these are the only two groups of bacteria present on meat, at temperatures below -5ºC all bacterial growth ceases.

Each bacterial species has an optimum temperature for growth, as well as a temperature range in which they grow, it is generally accepted that there are four groups:

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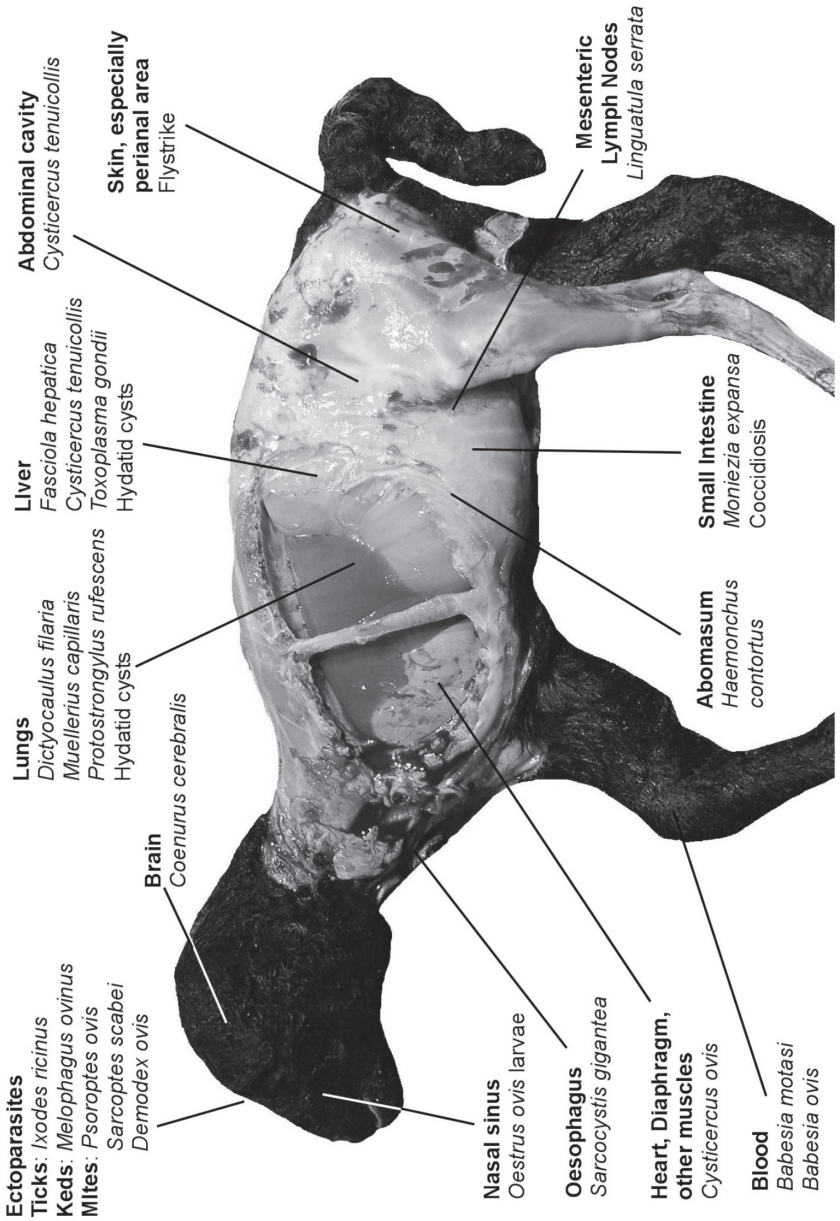
PARASITES

MAIN PARASITES OF SHEEP



PARASITISM

Parasites can be defined as plants or animals that live on or within another living organism at whose expense it gains some advantage whilst giving nothing in return. The host/parasite association can be complicated. The type of parasite encountered ranges from viruses (intracellular parasites) that can only reproduce in a living cell, to protozoa (single celled organisms) to intestinal worms and insects. Although they are parasitic, viruses are generally treated as a separate group, and we will only be considering parasites that are internal (endoparasites) and external (ectoparasites) that affect sheep.

During post mortem inspection of the ovine species, the presence of parasites and their affects on the host tends to be the most common condition encountered.

Parasites may have a direct or indirect lifecycle. A direct lifecycle means that the parasite can only complete the lifecycle by parasitizing the host. An indirect lifestyle involves at least one secondary (or intermediate) host. In the case of sheep, the ancestral association with canines both as control and predator has led to a number of parasites relying on the ingestion of parts of infected ovine carcases by canines to complete their lifecycle. To this end the infective parasite stage in sheep forms infective hibernation stages, usually in the form of cysts, awaiting digestion by canids and their subsequent activation to evolve to their adult form.

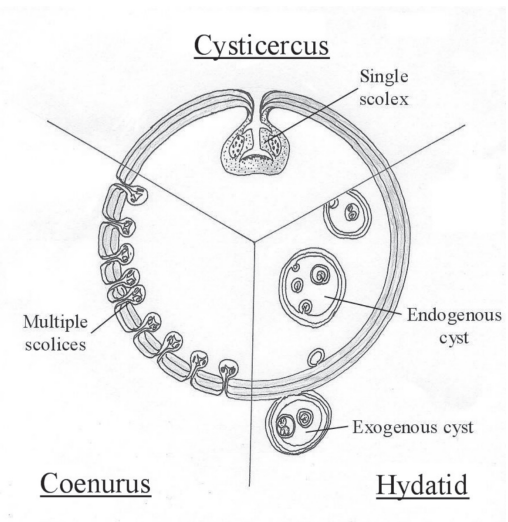
These cysts, or metacestodes, present in differing forms in preferred parts of the body known as predilection sites, some larvae having an affinity for musculature with a good blood supply such as the heart, diaphragm, others only maturing within the central nervous system. Once the larvae have reached this predilection site it develops into one of three metacestodes in sheep, a *cysticercus*, a *coenurus* or a hydatid.

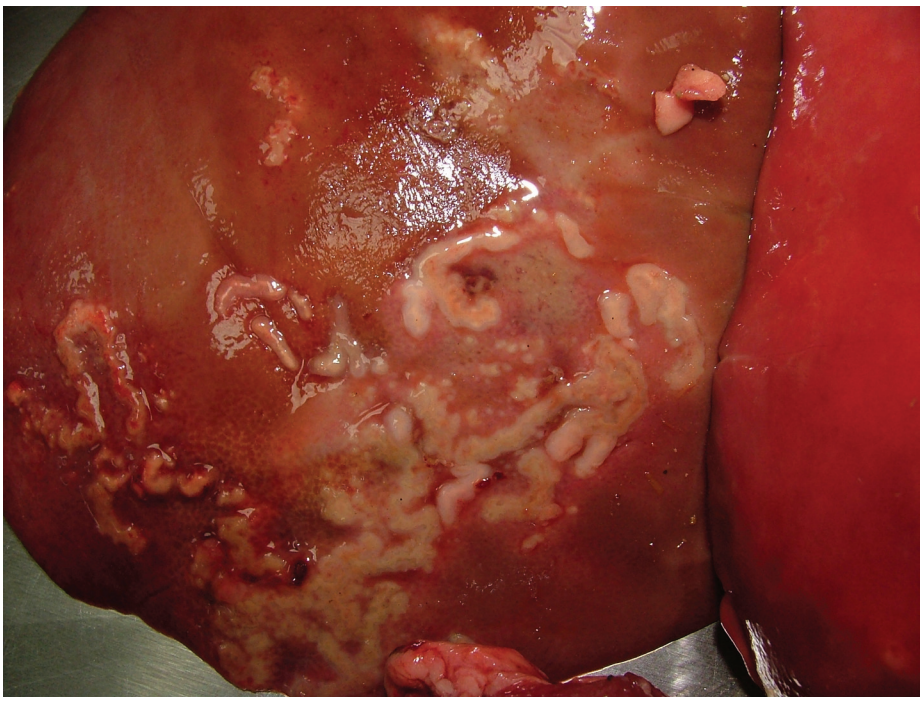
CYSTICERCUS

A cysticercus is a fluid-filled cyst containing a single protoscolex (the scolex is the attachment organ of the tapeworm, in this case infolded within the structure of the cysticercus).

COENURUS

A fluid filled cyst containing numerous protoscolices.





Scarred tracking in a liver

The single scolex is clearly visible in this cyst.

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NEOPLASIA

TUMOURS

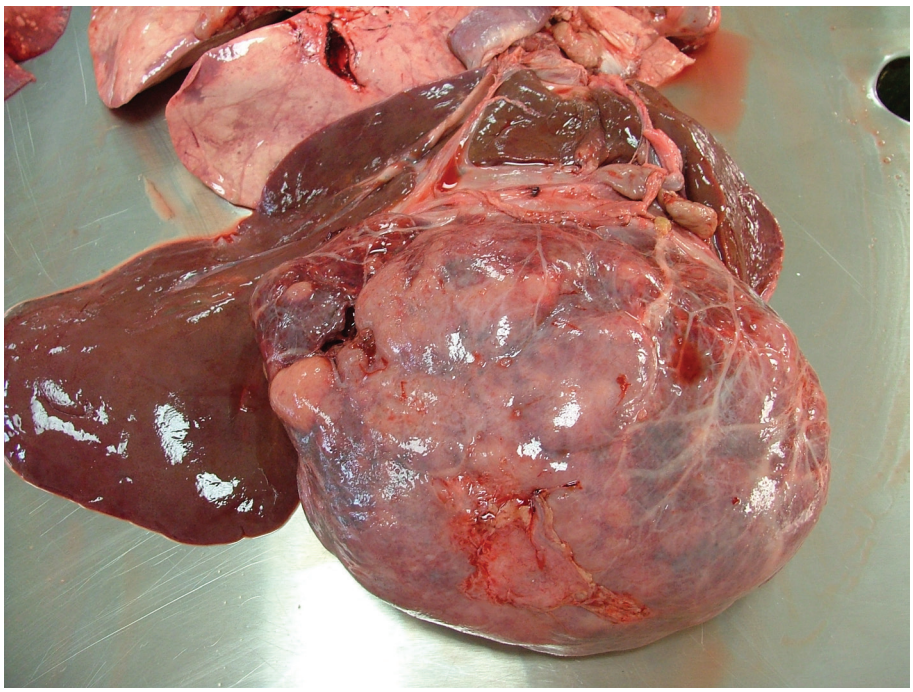
INTRODUCTION

The term tumour literally applies to any abnormal swelling, but nowadays it tends to refer exclusively to neoplasms, which are abnormal new growth of tissue, in which cell multiplication is uncontrolled and progressive in addition to serving no purpose and growing faster than normal tissue. These neoplastic formations are classified as being either benign or malignant, the gross appearance of neoplasia is variable being dependant on their origin and type. Both malignant and benign tumours are served by increased blood vascularisation, any tumour requiring nutrients to continue growth. In the case of the rapidly growing malignant tumours the blood vessels tend to be thin, poorly formed and prone to rupture creating the appearance of haemorrhagic areas within the tumour. Masses require histological examination for a definitive diagnosis, however there are characteristics of benign and malignant tumours.

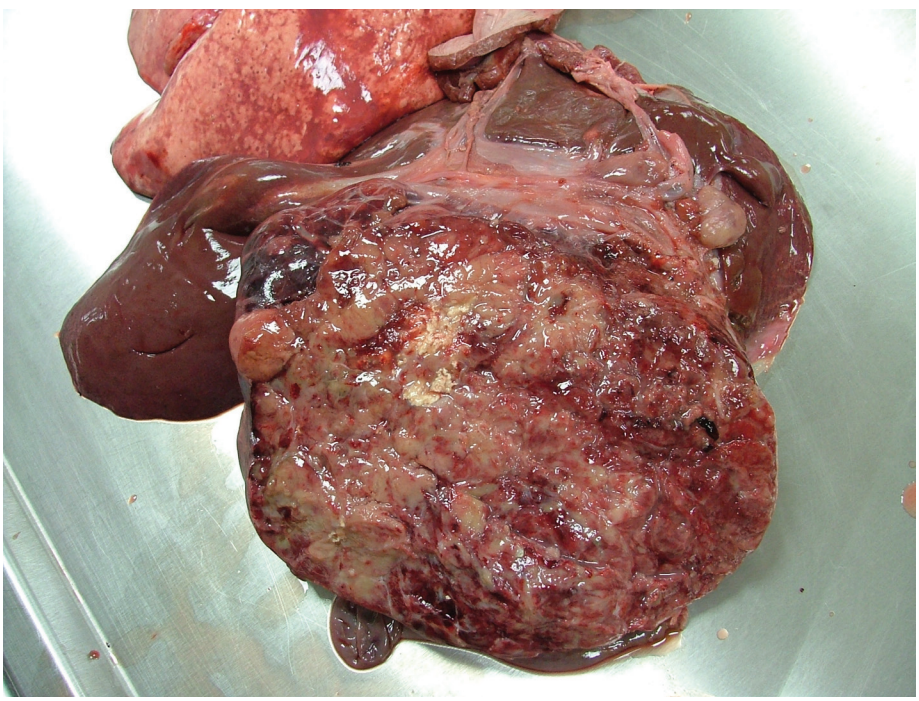
BENIGN TUMOURS

These grow slowly, pushing aside normal tissue without invading it. They are usually encapsulated and do not produce secondary tumours within the body. Although some benign tumours are caused by viruses, on the whole they do not appear to be infectious. The effect of their presence tends to be physical, blockage of systems in the body and pressure applied to organs being obvious examples.

A large tumour (hepatic tumour) attached to a liver



Large hepatic malignant tumour



Variegated cut surface with areas of necrosis

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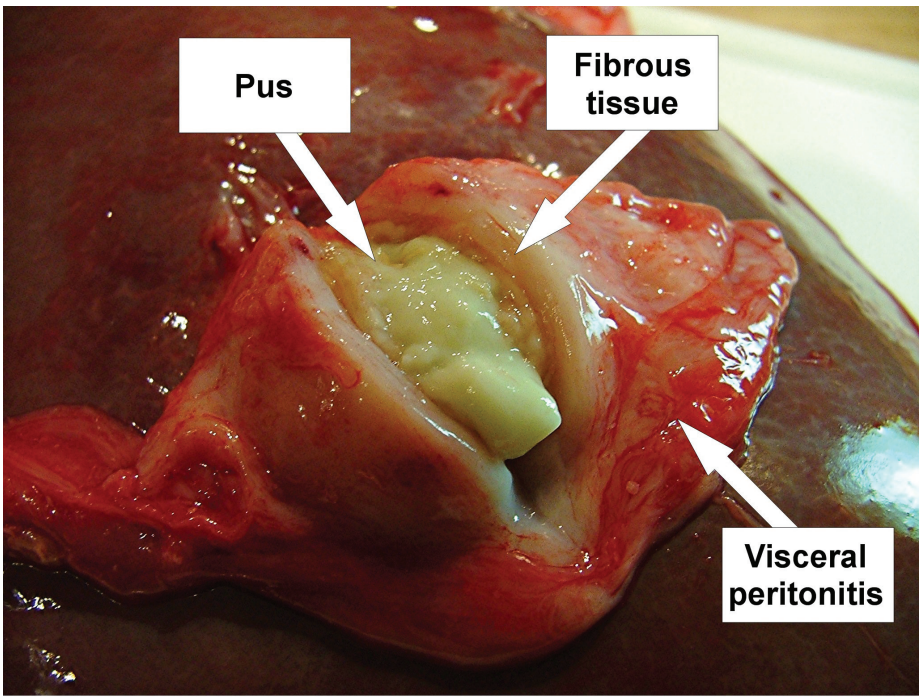
CONDITIONS ENCOUNTERED AT OVINE POST MORTEM INSPECTION

ABSCESSES

An abscess is a collection of pus surrounded by fibrous tissue; it is part of the bodies' defence mechanism normally triggered by the presence of pus forming bacteria. This fibrous tissue is a normal healthy reaction and consists of newly formed connective tissue and blood vessels. Pus may consist of dead or dying bacteria, dead tissue cells that formerly occupied the area, dead or dying white blood cells, debris and a certain amount of fluid exuded from the blood vessels in the vicinity.



Anatomy of a hepatic abscess

If the organisms multiply, the abscess will continue to increase in size until the pus escapes. If the abscess is near the surface of the tissue part of the wall becomes necrotic and is removed allowing the pus to discharge.

When the abscess is deeper within tissue and the pus is under tension it can burrow through less resistant tissue and reach the surface through a canal known as a sinus. If the bodies' immune response is sufficient to destroy the organisms contained in the pus the abscess may remain localised and be eventually absorbed, caseated or calcified.

The synovial joints, for example knees, knuckles and shoulders, provide a nutrient rich fluid surrounded by a good blood supply that offers ideal conditions for bacterial growth. Microorganisms can enter the joint through a penetrative wound, via the blood stream or from a nearby area of infection, foot rot for example. The most common method of acquired infection is through the umbilicus, however studies have also demonstrated that *Streptococcus dysgalactiae* infection of joints can be achieved via the digestive route from the mother during feeding.

When infected the joint swells as fluid increases, the synovial membrane becomes hyperaemic and thicker (fibrinous). If the infection entered via, or gains access to, the blood stream it can lead to polyarthritis, where most joints are infected, especially the large joints of the limbs.

Arthritic joint (arrowed)

One of the most commonly isolated pathogens in cases of lamb arthritis is *Streptococcus dysgalactiae*; other implicated bacteria include *E.coli*, *Erysipelothrix rhusiopathiae*, *Actinomyces pyogenes*, *Pasteurella haemolytica* and *Streptococcus spp.*

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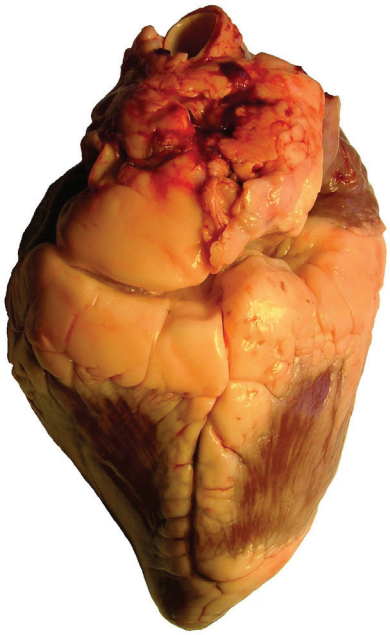
AIDE MEMOIRE - ANATOMY

Heart

- Fat is crispy due to stearin
- 2 bones present at aortic origin in older animals
- 3 ventricular furrows
- 4 chambers, left atrium and ventricle, right atrium and ventricle.
- Average heartbeat 70-120 bpm at rest.
- Weight 100-150g



Spleen

- Flat and oval in outline
- Bluish/red in colour
- White Malphigian corpuscles visible in red pulp when incised
- Attached to rumen
- Weight 50-100g

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CONDITION AND CAUSE

Disease	*Aetiology*	*Type*
Actinobacillosis (Leather lips, 'Cruels')	*Actinobacillus ligniersi*	Bacterial
Actinomycosis (Lumpy Jaw, Ray Fungus)	*Actinomyces bovis*	Bacterial
Anthrax (Wool sorters disease, Splenic fever, Charbon, Malignant pustule)	*Bacillus anthracis*	Bacterial
Babesiosis (Haemosporidiosis, Piroplasmosis, Red Water Fever)	*Babesia motasi* *Babesia ovis*	Parasitic
Bacillary Haemoglobulinuria (Red Water Disease)	*Clostridium haemolyticum*	Bacterial
Black Disease (Infectious necrotic hepatitis)	*Clostridium novyi*	Bacterial
Blackleg (Black quarter)	*Clostridium chauvoei*	Bacterial
Bloat	Miscellaneous	
Bluetongue (Ovine catarrhal fever, 'sore muzzle' disease)	Orbivirus	Viral
Braxy	*Clostridium septicum*	Bacterial
Brucellosis (Ovine brucellosis, OB)	*Brucella melitensis*	Bacterial
Campylobacteriosis (Ovine Genital Campylobacteriosis)	*Campylobacter fetus* *Campylobacter jejuni*	Bacterial
Caseous Lymphadenitis (CLA. CL. Cheesy Gland. Pseudotuberculosis)	*Corynebacterium pseudotuberculosis*	Bacterial
Contagious Epididymitis (Ram Epididymitis)	*Brucella ovis*	Bacterial
Coccidiosis	*Eimeria arloingi* *Eimeria crandallis* *Eimeria ovinoidalis*	Parasitic

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AFFECTIONS OF SPECIFIC PARTS

ANTE MORTEM INSPECTION OF SHEEP

Many things can hamper ante mortem inspection of sheep but one factor predominates: sheep are almost the ultimate prey species and as such will attempt to appear fit and healthy in the presence of a predator (humans), disguising clinical signs of disease or weakness due to injury.

Given the time constraints of ante mortem inspection, the reaction of the animals to the preceding transportation, strange lairage environment, and the factors above, the clinical signs of disease, trauma or other animal health and welfare issues can be barely noticeable; a fact that leads to sheep being the forgotten species in terms of welfare. The greatest tool available to those conducting ante mortem inspection of sheep is experience, especially of normality in the species and as such this section gives a guide to ante mortem conditions based on deviation from the norm for sheep in the setting of the lairage environment under the following headings: Abnormality of behaviour, Abnormality of breathing, Abnormal discharges, Abnormality of movement/posture, Abnormality of shape / condition and Abnormality of skin/eyes/mucous membranes.

The process of ante mortem inspection should ideally be performed with the animals in movement and at rest, and preferably with the opportunity to view the animal from both sides in cases of conditions that may be unilateral. Movement obviously allows for checking gait, locomotion and central nervous system lesions; monitoring resting behaviour can demonstrate signs of conditions such as pruritus and laboured breathing.

PHYSIOLOGICAL DATA

Rectal temperature	39.5°C ± 0.5°C
Heart rate	60-120 beats per minute, average 75 bpm
Respiratory rate	19 breaths per minute

DEAD ON ARRIVAL/IN LAIRAGE

Anthrax, Black Disease, Bluetongue, Braxy, Enterotoxaemia, Haemorrhagic enteritis, Salmonellosis, Tetanus

ELEVATED TEMPERATURE

Bacillary Haemoglobulinuria, Black Disease, Blackleg, Bluetongue, Braxy, Foot and mouth disease, Leptospiridiosis, Louping Ill, Malignant oedema, Pasteurellosis, Peste Des Petits Ruminants, Salmonellosis, Tetanus, Tick borne fever, Sarcocysts, Toxoplasmosis

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