CHAPTER

44

COLUMBIFORMES

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Columbiformes are among the most ancient domesticated animals in the world. They were initially used as utility birds (meat, fertilizer and feather products), were later used for sport and as carriers of information, and more recently, as laboratory animals. The history of the domesticated pigeon starts in the early Stone Age, approximately 10,000 to 2,000 years B.C.[17] Pigeons can be termed cosmopolitan birds because, with the exception of the northern and southern polar regions, they occur on all continents and in all the countries of the world. More than half the species are native to Asia and Australia; the second highest number of species is found in the tropics of the Americas.[36]

Of special interest and importance is the Rock Pigeon, from which a whole variety of domestic breeds and color variations have been developed via mutations and recombinations throughout the millennia. Worldwide, millions of pigeon fanciers breed or keep more than 800 varieties of the domesticated pigeon, although the number of breeders of wild-type or nondomesticated pigeons and doves is still rather small.[16] Pigeon breeding is considered a hobby and, as such, provides pleasure and an interesting combination of genetics, behavior, physiology and endocrinology.

Zoologic Taxonomy

The order Columbiformes consists of 8 families, 67 genera and 296 living as well as 11 extinct species (including 3 species of the genus *Dodo*). The Passenger Pigeon, which populated the North American continent, became extinct in the last century. Other dove and pigeon species, particularly populations on small islands, are in danger of extinction.[1,36]

Domesticated Pigeons

Distinctive Pigeon Groups

The species Rock Pigeon is divided into 14 subspecies and is the original genetic stock for domesticated pigeons and for domesticated pigeons that have returned to the wild. These are called city or street pigeons or incorrectly, feral pigeons, and are considered a special variety. The number of these city or street pigeons worldwide is estimated at approximately 500 million. The so-called Field Pigeon, a direct progeny of the Rock Pigeon, became accustomed to humans during the sixth and fifth millennium B.C.[21]

There are at least 800 varieties of the domesticated pigeon globally. These can be systematically differentiated from the Rock Pigeon by body morphology, size and weight; deviations of the skeleton, musculature beak and cere; coloration and design of the plumage (in particular feather structure) and feather morphology; and breed-specific behavior.[33] Nine groups of domesticated pigeons have been distinguished (Table 44.1).[33]

Families of Columbiformes[36]

Caloenadidae	The Nicobar Pigeon is a large 38 to 40 cm bird that develops a mane (long, thin body contour feathers around the neck) and a short white tail. The color of the plumage is mainly a dark, coppery-shimmering green, which shows blue and black at the head and the upper breast. Nicobar Pigeons have a strong beak with small wart-like protuberances at the base. The beak is used to burrow into soil to forage for seeds and fruits. This species needs frost-free shelters for the winter.
Gouridae	The Blue-crowned Pigeon is a large 76 cm bird that may weigh more than 1 kg. A large, light-blue crest is characteristic. There are several subspecies, which show differences in coloration and in size. The beak of the male has a prominent hook, while that of the female is straight.
Otidiphabidae	The Pheasant Pigeon is a 38 to 40 cm pigeon with a relatively large tail. The bird's gait and colorful plumage are similar to those of pheasants. This tropical bird requires a warm environment.
Columbidae	These are true pigeons with 47 genera and 173 species. This is the largest group of pigeons and contains the best flyers. They may consume small seeds or large grains, depending on their body size, which ranges from 12.5 to 40 cm.
Duculidae	"Fruit-eating" pigeons range from 20 to 47 cm in size, live exclusively in trees, and appear awkward when ambulating on the ground.
Treronidae	Green Pigeons are 25 to 40 cm birds that are indigenous to high altitudes (2,500 m) where they inhabit trees in light woods and are occasionally found on the ground.
Didunculidae	Tooth-billed Pigeon

TABLE 44.1 Nine Distinguishing Characteristics of Groups of Domesticated Pigeons

- Colored pigeons, eg, German toys (These birds are selectively bred for coloration and plumage morphology.)
- Medium-sized varieties (with a body mass of up to 500 to 700 g)
- Heavy-sized varieties (with a body length of up to 55 cm, a wing spread of up to 105 cm, and body weight of over 700 g)
- Trumpeters (with their characteristic vocal expressions)
- Frillbacks, Fantails, Jacobins and Monks, Owls, Dewlaps and Swifts (each with a particular feather structure and design)
- Tumblers (These birds are considered flight sports breeds and represent the largest group with several hundred varieties worldwide.)
- Wattled Pigeons (They have a characteristic bulged, distended or wart-like cere, as well as more or less prominently developed naked or wart-like rings around the eyes.)
- Pouters (including the ringbeaters) with a singularly developed round, egg-shaped, pear-shaped or sac-like crop area, which varies according to the breed.
- Hen Pigeons (with their fowl-like body morphology and body posture.)

Pigeon Fanciers

There are several groups of pigeon fanciers whose interests and objectives differ.[33] In decreasing number of enthusiasts, these groups include: 1) the racing pigeon fanciers; 2) breeders of fancy pigeons for exhibition; 3) tumbler pigeons (high flyers, sustained flyers, flying tipplers, purzelers and rollers); 4) producers of meat pigeons (may be raised for individual consumption or as part of a large breeding facility) and breeders of wild pigeon and dove species.

Forty-two countries belong to the International Racing Pigeon Association (Fédration Colombophile International - FCI). There are almost 590,000 members and more than 20 million leg band registrations annually. With average flocks of approximately 50 birds, the FCI members would possess about 30 million pigeons.[33] In Europe alone, there are approximately 205,000 pigeon breeders who raise birds for exhibition and maintain approximately 6.6 million birds.[33]

Unique Characteristics of Columbiformes

Despite the many families, genera and species, which vary in size, weight, plumage and coloring, pigeons have some uniform features.[21,33]

The size of Columbiformes ranges from that of sparrows to that of chickens. They can move effectively on the ground and in the air. The birds have a droplet-shaped rump and an oval front. Their streamlined morphology and their closed plumage, which covers almost the whole body, reduces air resistance during flight and allows the air to pass around the aerodynamic body almost free of turbulence.[1] They have a relatively short neck, small head, small tail and four (in some species, five) short toes.

Columbiformes produce varied vocalizations including cooing, howling, buzzing, tittering or whistling sounds. A chirp-whistling noise is produced mainly by nestlings.[1] Pigeons may live 20 to 30 years.

Selected Anatomy and Physiology

Integument

A particular feature on the beak of the Columbiformes is the cere (ceroma).[16a,21,30]

The plumage of the pigeon does not have the powder down (plumae) found in many other avian groups. The powder found in pigeons is produced by modified semiplumes as well as downs (semiplumae), which can be generally called pulviplumes. Pulviplumes are distinguished from the small body contour feathers by their finer pennaceous barbs, which consist only of the upper part of the vane, while the lower part shows plumulaceous barbs that unfurl more slowly. Semiplumae are found in several genera of pigeons and doves, particularly on the sides of the body.

The powder is derived from cells that surround the differentiating cells of the barbules of a growing feather. They are not a fragment of the sheath or the feather itself. Powder is shed only while the feathers are emerging from their sheaths. Pulviplumes are characterized by a slow exsheathing process, decreased thickness of the rachis and increased reduction of the barbules, resulting in larger quantities of powder. The number of pulviplumes and the amount of powder produced vary significantly with the species.

The feather powder is composed entirely of keratin. The keratin particles inhibit abrasion of the feathers, provide the plumage its silky gray gleam and keep the ends smooth and pliable. The feather powder protects the pigeon from being waterlogged in the rain and from losing body heat in the cold. Powder enables the flight sport breeds to fly more quickly and with greater endurance. There also seems to be a correlation between high powder production and the reduction of the uropygial gland in some species and breeds.[16a]

The most highly modified powder feathers, the fat quills, are found in only some breeds of domesticated pigeons (ie, German toys such as the Nuremberg Swallows and the South German Shield Pigeons). Instead of powder, these feathers contain homogenous, yellow, organic fat. The fat is distributed throughout the plumage during preening, creating the “silky” appearance.[16a]

Frequent exposure to feather powder has been associated with allergic alveolitis (pigeon breeder’s lung) in some susceptible, genetically predisposed humans. The same pathogenesis has been determined for the feather powder coryza.[1a,32] Recent investigators working on a causative relationship between exposure to feather dust and human lung cancer misinterpreted the results, because of the failure to recognize that avian feather dust is not only created by companion birds but also by geese, ducks and chicken feathers in numerous pillows and quilts.

The uropygial gland is absent or poorly developed in many species and in some breeds of the domesticated pigeon.[21] The secretions contain the precursor of vitamin D. Most Columbiformes enjoy getting wet in the rain and bathing in shallow water. Other anatomic characteristics are the absence of a gall bladder and the presence of a highly rudimentary ceca.[1,21,30]

Vascular Plexus

The Columbiformes have an anatomic characteristic called the plexus arteriosus et venosus intracutaneous seu subcutaneous collaris. This plexus of anastomosing vessels extends from the cranium to the crop and base of the neck (Figure 44.1). It is divided dorsally into left and right portions, where it is separated by a 1 mm-wide gap in the median plane. The plexus is thicker (more vessels) in the male than in the female. The venous part of the plexus is composed of manifold twirled and tangled vessels that can be distended or narrowed. In scanning electron microscope pictures, the engorged blood vessels appear to be arranged like roofing tiles.

The plexus is used for sexual and territorial display and regulates circulation and body temperature in both genders.[6] The plexus engorges at high ambient temperatures to prevent hyperthermia through the dissipation of excess body heat through the skin. In flight, the head, underside of the wings, breast, legs and toes radiate heat. At temperatures over 25°C, surplus heat is also dissipated by hyperventilation. Injections in or damage of this plexus, especially during display and in hot weather, can cause fatal hemorrhage.

Gastrointestinal Motility

Gastrointestinal transient times vary with the species and amount and type of food but generally include crop (3 to 17 hours), ventriculus (5 to 19 hours) and intestine (9 to 14 hours).[1] The length of the intestinal tract varies depending on the species, composition of diet and amount and frequency of food consumed. Length ranges from approximately 35 cm in pygmy doves to 70 to 120 cm in domesticated pigeon varieties. Thus, the intestines are 2.5 to 3.5 times longer than the body. Fasted pigeons will defecate between 2.5 and 3.5 hours after consuming food. The majority of excrement (up to 80%) is produced within 24 hours, and the rest is excreted over three to four days.[1]

Physiologic Parameters

The body temperature of the Rock Pigeon and the descendant domesticated pigeon breeds and varieties is not as uniform as in mammals (eg, Wood Pigeon = 41.8°C, African Collared Dove = 41.0°C, Mourning Dove = 42.6°C).[11] The internal temperature varies with the state of excitement, vigor of flight and ambient temperature. The cloacal temperature averages 39.8 to 43.3°C. The diurnal body temperature varies by approximately 2°C.[1,31] During flight, the metabolic rate is increased to 10 to 12 times the basal

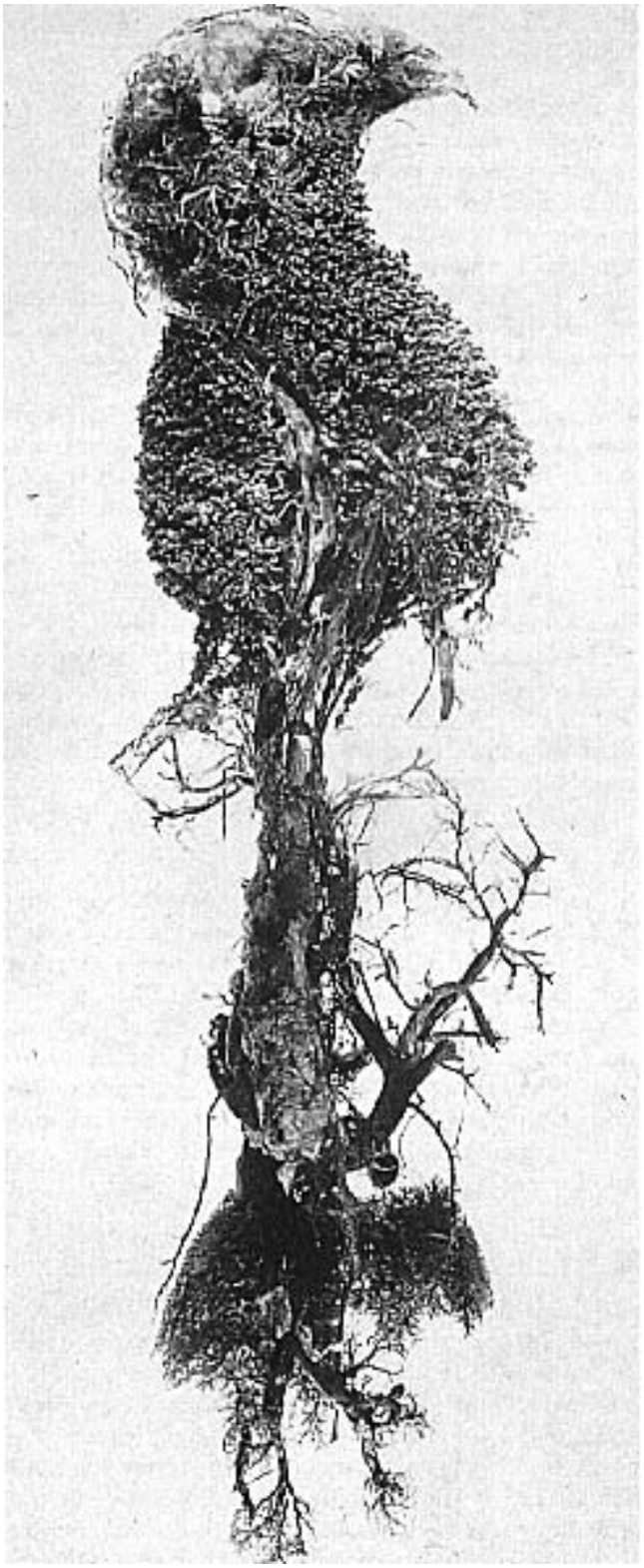


FIG 44.1 Latex cast of the vasculature of a male pigeon demonstrating the plexus arteriosus et venosus intracutaneous seu subcutaneous collaris. Note the extensive network of anastomosing vessels. This plexus is involved in territorial displays and thermoregulation (courtesy of D. Brückner[6]).

level and the body temperature increases by about 1.5 to 3°C.

In Rock Pigeons and domesticated pigeons, there is a thermo-neutral zone between 25 to 30°C where the regulation of the body temperature between 39.8 to 43.3°C is almost independent of changes in the ambient temperature. These pigeons can withstand extremes in ambient temperature of 42°C to minus 40°C. Resting pigeons begin to shiver at an ambient temperature of approximately 20°C, independent of whether or not they have adapted to the cold.

The heart rate of Rock and domesticated pigeons ranges from 180 to 250 beats per minute; the respiratory rate is 20 to 35 breaths per minute.[30] During sustained flight, the heart rate may reach 5.2 to 6.2 beats per second with a high of 9.4 beats per second at the time of take off.[1]

The blood volume of pigeons is approximately 0.1-0.01 ml/g body weight.[30] The prothrombin time, which is a sensitive indicator of hepatopathies, is 15.1 minutes (range of 11.5 to 18.7) for undiluted pigeon plasma. Pigeons generally have a lymphocytic blood differential. Hematologic and clinical chemistry values are listed in the Appendix.[11,17] Electrocardiographic data are provided in Chapter 27.[19,35]

In contrast to most avian species (except hummingbirds and some finches), pigeons and doves drink water by placing the beak up to the nares in water and sucking it up like a vacuum pump. The drinking cycle consists of combined mechanisms of the beak tip, tongue, palate, laryngeal mound and the pressure differences that occur in the anterior and posterior oropharynx while drinking.[37] With each drinking cycle, domesticated pigeons ingest approximately 0.6 ml of water.

Behavior

Although considered the international symbol for peace, pigeons and doves are by no means docile creatures.[1] Columbiformes are rather aggressive, particularly during the reproductive cycle, and have no behavioral inhibitions against killing members of their own species or their offspring. In free-ranging birds, one of the combatants can usually escape, which is not always possible in captivity. This behavioral trait should be considered when designing flight enclosures and constructing lofts. Birds should always have a place that they can use to escape from an aggressive male. Many pigeon and dove species can also be aggressive toward other avian species.

Homing Abilities of Racing Pigeons

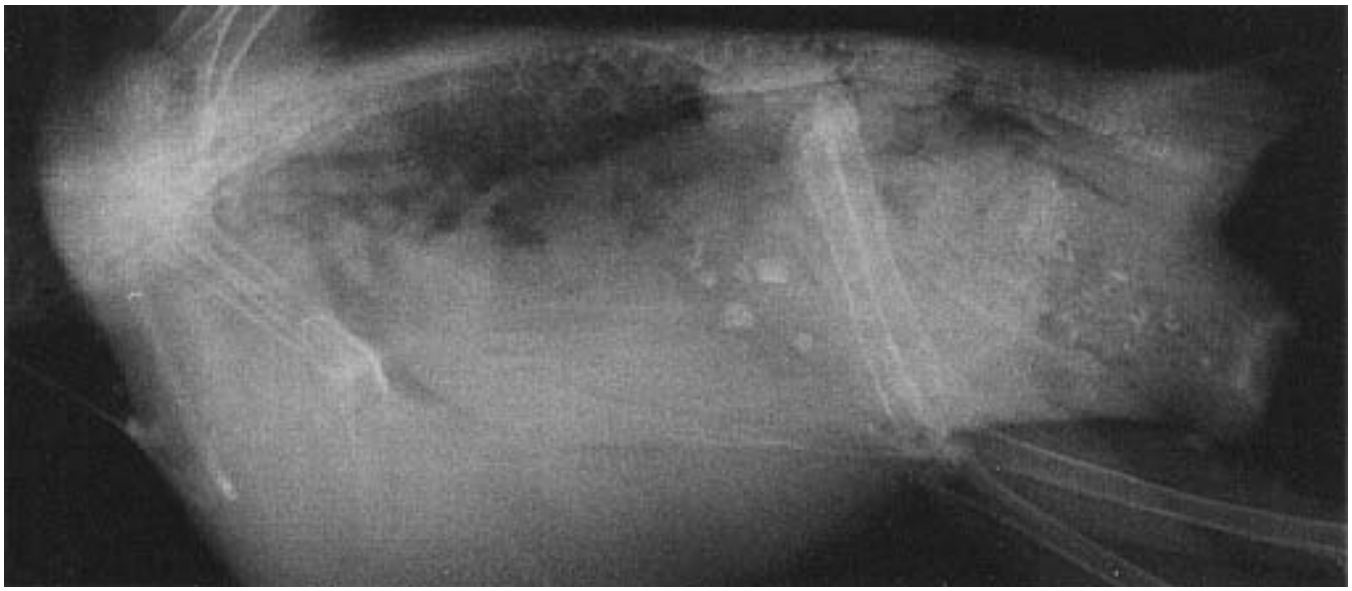
Only racing pigeons have an innate homing ability that has been enhanced through selective breeding and continuous training.[34] Their capacity to return home is based on special senses that enable them to determine the direction of home as soon as they are released. Their methods of navigation detect each divergence from the correct course immediately.[27]

Three distinct parts of the orientation system have been defined in pigeons and migratory birds: the inborn magnetic compass, the acquired sun compass and the star compass (not in homing pigeons).[1,13,15,26,27,28,33,34] The magnetic compass and the sun compass function independently, but they function together to monitor a bird's progress.[13,28] Probably a computer-like mechanism has stored a variety of data, which can be used for reaching the "home loft" target as well as finding the navigational data to get there. Four to five training flights can provide the necessary data.

Other important senses enable a bird to find its way home.[1,15] Homing pigeons can perceive infra-acoustic waves of below 0.06 Hz; they recognize ultraviolet light as well as the plane of polarized light; they sense small changes in air pressure of less than 1 microbar and altitude variations of only 10 m or less; they can detect small variations in the earth's magnetic field; they react to the slightest deviations in the earth's gravitational field.

According to recent findings, racing pigeons obviously do not rely on any one single sense to find their way home, but are assumed to use a combination of orientation factors.[15,33,34] Pigeons can see the sun even when it is invisible to human eyes. Pigeons react to polarized light and probably use this to indirectly determine the sun's position. They are particularly sensitive to the ultraviolet light spectrum and can detect polarized ultraviolet light even through heavy clouds.[15] On the other hand, it is known that homing pigeons are not able to navigate correctly under inverison layer air conditions.

Racing pigeons have iron oxide (magnetic particles) both in the cranium and in the neck musculature that may enable them to gauge the earth's magnetic field by means of special detectors that can recognize the density of the magnetic field.[15] It has been speculated but not proven that olfactory navigation is also of importance for racing pigeons.[1,8,13,15,18,26,28,33,34]



Husbandry

Nutrition

With the exception of fruit-eating pigeons (Duculidae) and green pigeons (Treronidae), the natural feed of other families (including the Columba) consists of the seeds of cultivated plants such as cereals, peas, beans, lentils and oil-fruit.[33] Many doves, free-ranging pigeons and domesticated pigeons feed on other cultivated plants, the seeds of weeds, green parts of many plants, berries and other fruits and animals (insects, snails, earthworms). In addition, they pick up small stones, grit and earth particles, which are necessary for grinding the seeds and other grains (Figure 44.2).[1,33] Domesticated pigeons have been observed to perform as many as 35,000 pick actions a day as a response to visual stimuli.[1]

Diets for pigeons should be rich in concentrated nutrients but should not contain high amounts of water or fiber. Effective formulated diets are readily available for domesticated pigeons[33] (nutritional requirements are listed in Tables 44.2-44.5). Commercially available mixed seeds used for many pigeon and dove species can be enriched by adding brewer's yeast, vegetables and vitamin preparations.[33] Pigeons that are allowed free flight will find additional foodstuffs and are usually well nourished.

FIG 44.2 An adult dove was presented for evaluation of progressive tenesmus of several days' duration. Physical examination indicated a firm mass in the caudal abdomen. Radiographs indicated that the cloaca was impacted with a granular material. A large amount of straw, grit and excrement was removed from the cloaca (courtesy of Marjorie McMillan).

TABLE 44.2 Suggested Mineral Mixture for Pigeons (%)

Components	Breeding Pairs	Squabs
$CaCl_3$	84.79	61.32
Ca_2PO_4	9.21	31.58
NaCl containing iodine	4.80	4.80
$FeSO_4$	0.75	1.50
$MnSO_4$	0.15	0.30
$CuSO_4$	0.10	0.10
$ZnSO_4$	0.20	0.40

TABLE 44.3 Vitamin Requirements for Pigeons

Requirements			
Vitamins (Unit)	Per kg BW*	Per Adult Pigeon**	Per kg Feed
A (IU)	200	100	7,500
D_3 (IU)	20	10	750
E (mg)	2	1	15
K_3 (mg)	0.2	0.1	3
B_1 (mg)	0.3	0.15	3.5
B_2 (mg)	0.3	0.15	3.5
B_6 (mg)	0.3	0.15	3.5
B_{12} (μg)	1	0.5	15
Biotin (μg)	6	3	300
Choline (mg)	70	35	1000
Folic acid (mg)	0.05	0.025	1
Nicotinic acid (niacin) (mg)	3	1.5	35
Pantothenic acid (mg)	0.70	0.35	15

*Body weight
**Body weight approximately 500 g for a racing pigeon

The nutritional requirements and quantity of food consumed vary, based on species, body mass, season, climatic conditions (temperature, relative humidity), type of husbandry (free-flying or restricted to pens), stage of reproduction (egg or sperm production, incubation, raising squabs), stage of growth or molting, amount of exercise, type of feed (seeds, formulated diet) and method of feeding.[33]

The daily feed consumption of pigeons and doves is approximately 1/5 to 1/20 of their body weight. The feed intake of squabs ranges from 10 to 100% of their body weight, depending on their age. The daily amount of drinking water varies between 5 and 8% of the body weight.[1]

The feed quality is of the utmost importance. Grains, seeds or formulated diets should be stored in a dry, clean, pest-free location. Fungi, particular mycotoxins, feed mites and toxic seeds from weeds should be avoided.[33]

TABLE 44.4 Recommended Diet for Pigeons*

Component	Quantity per kg feed
Crude protein	30 - 150 g
Crude fat	20 - 35 g
Crude fiber	50 g
Metabolizable energy	12 ME
Methionine	3.5 g
Methionine and cystine	6.5 g
Lysine	8 g
Calcium	10 g
Phosphorus	6 g
Sodium	1.5 g
Zinc	50 mg
Iodine	1 mg
Copper	2 mg
Manganese	50 mg
Vitamin A	7,500 IU
Vitamin D_3	750 IU
Vitamin E	15 mg
Vitamin K_3	3 mg
Vitamin B_1	3.5 mg
Vitamin B_2	3.5 mg
Vitamin B_6	3.5 mg
Vitamine B_{12}	15 μg
Biotin	300 mg
Choline	1000 mg
Folic acid	1 mg
Niacin	15 mg
Pantothenic acid	15 mg

* Recommendations during breeding, racing and main molting period

TABLE 44.5 Composition of Homemade Pigeon Stones

Components	Percentage
Clay	40
Vitamin/mineral mix (see Table 44.2)	30
$CaCO_3$ granules	20
Grit or gravel (2-3 mm in diameter)	10

Housing

When constructing lofts, it is necessary to consider particular requirements for individual pigeon varieties and the number of birds to be housed.[21-23] Breeds maintained for their flying ability must have the opportunity to fly freely in order to maintain a proper level of health.

Optimal environmental conditions increase the productivity, performance and health of Columbiformes of all species and varieties. The housing (lofts, dove-

cots, aviaries, pens and flypens) criteria for pigeons are listed in Table 44.6. Pigeons must be protected from raptors, cats, dogs, foxes, opossums, raccoons, skunks, martens, weasels and rats.[21]

Pigeon lofts or dovecots should be partitioned so that several pens are provided.[21-23] There should be an entrance room that can be used for storing the necessary equipment, tools and feed, as well as one or more pens for breeding pairs.

For tumblers and other flight sport breeds, room should be provided for the bird's flight training (the exact specifications can be requested from local breeder associations for those breeds). Each loft should have compartments for newly weaned birds. Excrement should be removed on a routine basis or the birds should be placed on gratings (steel bar, metal lattice or rip-wire frames) so that the feces can drop through the grate.

Many countries require that domestic pigeons be kept indoors during certain times of the year. In the northern geographical regions, this period extends from April and May, when the cultural grains are sprouting in the fields.

Preventive Medicine

For pigeons to be at the peak of health and performance, it is necessary to provide them an optimal environment. Practicing sound preventative medicine techniques is far superior to treating disease. Birds involved in racing may be exposed to infectious agents in the race basket and then bring these pathogens back to the flock. This necessitates an ongoing disease surveillance and management program. Pathogens are best recognized and treated before the breeding and racing season.

CLINICAL APPLICATIONS

Pigeon lofts should be equipped with:[16,17,33]

- Appropriate nests (single coops, double coops or batteries). The latter can be equipped for automatic fecal removal by means of a conveyor belt.
- Hoppers, aisle feed troughs or cafeteria feeders and small dishes for feeding mineral.
- Drinking vessels such as bottle fountains or float-valve fountains that work automatically.
- Baths.
- Multipurpose pens.

TABLE 44.6 Design Criteria for Pigeon Lofts

Floor area/kg body weight	0.25-0.5 m^2
Air space/kg body mass	0.25-0.5 m^3
Hourly air exchange/kg body weight	270-320 ml
Maximum content of dust	10 mg/m^3 air
Maximum content of toxic gases:	
CO_2	2000 ppm
NH_3	20 ppm
H_2S	10 ppm
Room temperature	5-28°C

Each bird in the loft should be visually examined daily to determine its overall state of health. Pigeons that appear abnormal should be isolated, observed and evaluated by an experienced avian veterinarian. Birds that cannot be treated are euthanatized immediately and submitted for a complete veterinary and laboratory examination.

Good hygiene demands that excrement and discarded food be removed from the loft and flypens daily. Drinking containers, hoppers, cafeteria troughs and gutters should be thoroughly cleaned at least three times per week or better, daily.

Lofts should be designed with well drained concrete floors to facilitate proper cleaning and disinfection. The concrete floor can be covered with clean litter, sand, gravel or grasses planted in removable flat boxes. If natural soil is used as a floor, excrement should be removed regularly. The upper layer should be removed and replaced with sand or gravel once a year. Flypen floors covered with grass should be cut regularly and the clippngs discarded. The lawn should be chalked with unslaked lime, and holes in the surface should be reseeded.

Recently purchased birds must be placed into quarantine before being added to the flock. This includes birds with veterinary certificates stating that they are free of the most important pathogenic agents. There are many pathogenic organisms, particularly viruses, chlamydia and salmonella, which are not regularly excreted and are not always recognizable by antibodies. Therefore, sentinel birds, preferably very young birds, are placed together with the new ones in the quarantine room. If the sentinel and quarantined birds remain healthy for eight weeks, they can be introduced to the flock.

Any free-ranging pigeons that appear in the loft should be isolated immediately, provided food and water and then released. Birds that do not leave should either be treated according to legal regula-

tions or, if these do not exist, euthanatized or placed into quarantine.

Substandard environmental conditions increase the possibility of microbial enrichment and impair the bird's defense mechanisms.

Factors that may increase a pigeon's susceptibility to disease include:[21,22,33]

- Aviaries, lofts and flypens that are overcrowded, too small, dark, insufficiently ventilated, have accumulated toxic gases and dust, and are not kept clean.
- Equipment and supplies that are not kept clean.
- Feeding birds from impractical hoppers or cafeteria troughs.
- Drinking vessels that are difficult to clean and disinfect and hold stale, dirty water or none at all.
- Litter contaminated with too much feces may be either moist (fungal spores) or dry (dust).
- Squabs weaned too early or fed insufficient quality or quantity of food.
- Failure to separate the weaned squabs from the parents.
- Nutritional deficiencies and food contamination with mycotoxins or feces from insects and rodents.
- Overexertion of birds during the flight and race season and exhibition periods.
- Transport baskets and carriers that are dirty and poorly ventilated.
- Immunosuppression caused by viral, bacterial, fungal, parasitic, toxic or metabolic diseases as well as corticosteroids, some antibiotics, coccidiostats and chemotherapeutic agents (see Chapter 5).
- Corticosteroids should be considered highly immunosuppressive (not only in pigeons).

Special Management Considerations

During the Racing Season

During the racing season (May to September in the northern hemisphere), active racing pigeons should have a veterinary certificate indicating that they are clinically free of salmonella, helminths and other contagious agents. The veterinary certificate should be based on clinical examinations and laboratory testing. Many organizations in Europe request that pigeons be vaccinated against paramyxovirus-1-pigeon.

Young birds should be properly conditioned before they are entered in races. This is accomplished by gradually increasing the flight distance without causing the birds to overexert themselves. Racing pigeons that return from strenuous flights should be provided energy-rich foods and a mixture of electrolytes, glucose and amino acids. Many racing pigeon fanciers feed their own preparations, which are usually kept secret. Racing pigeons that return very late to the loft or appear weak without any obvious reason should be isolated and may be reintroduced to the flock only after successfully passing through quarantine. Birds involved in races should be considered exposed to infectious agents.

The transport baskets and boxes should always be cleaned and disinfected following each transportation. It is imperative that these containers be kept extremely clean to prevent the transmission of infections. Shipping boxes for racing pigeons should offer adequate space for each bird. Only birds that are in excellent condition should be flown. Racing pigeons should be transported to their release destination as quickly as possible. Birds being shipped long distances should be provided food and water and should have at least a three hours' rest before being released.

Prior to the Breeding Season

Fecal samples should be collected from pigeons in all lofts, compartments or flypens and evaluated for bacteria (salmonella) and parasites (coccidia, helminthic eggs) prior to the breeding season (January and February in the northern hemisphere). Groups in which salmonella, protozoa or helminths are identified should be treated. Between treatments, the loft, flypens and all equipment should be cleaned and disinfected as dictated by the respective agent.

Vaccination with avian paramyxovirus-1-pigeon is recommended, and in appropriate regions, vaccination with pigeon poxvirus should also be considered. The latter is usually administered in the late summer but should be available on all appropriate occasions. There is still no efficacious vaccine for *Salmonella typhimurium var. cop*. A vaccine against pigeon herpesvirus is available commercially in Hungary, but the effectiveness of this vaccine remains undetermined.

During the Breeding Season

Approximately two weeks before the first clutch of eggs hatches, all breeding pigeons should be treated with carnidazole, dimetridazole, metridazole or ronidazole to control trichomoniasis. One tablet of carnidazole might be an effective treatment. The tablet should be administered into an empty crop to reduce

the chances of regurgitation. For large flocks, a second prophylactic treatment for trichomonas is recommended from mid-April to the beginning of May. A breeding pair with massive trichomonas should be retreated two weeks before the subsequent clutch hatches. Trichomoniasis should be considered a secondary disease, and the initiating factors that allow an infection to occur should be identified (see Chapter 36).

During the warm season, it is especially important to observe pigeons and their environment for ectoparasites, in particular the red mites, northern feather mites, pigeon ticks, bed bugs, pigeon bugs, pigeon flies and chicken and pigeon fleas. Many of these parasites are found on the birds only at night. If necessary, the animals and their environment should be treated with carbaryl powder or pyrethrin.

Squabs should be placed together in compartments immediately after separation from their parents. If necessary, the weaned squabs should be tested for bacteria (particularly salmonella) and parasites as well as for antibodies against paramyxovirus-1-pigeon. If necessary, the youngsters should be vaccinated.

In the northern hemisphere, all young racing pigeons should be vaccinated for pigeon pox around the end of July. The breeding pairs should be separated from each other at the end of the breeding season.

During the Non-breeding Season

Pigeons that will be involved in exhibition should be removed from the nesting area at the beginning of September to induce an undisturbed molt. During the main molt period, pigeons should be provided food that is high in energy, essential amino acids, minerals, trace elements and vitamins.

Until the middle of October, pigeons for exhibition are separated by gender and are allowed to fly free in segregated groups. Most exhibitors require a veterinary certificate indicating that the birds are free of salmonella and parasites; some also require vaccination again for paramyxovirus-1-pigeon.

A complete physical examination should be performed on each breeding pair and their offspring. Any bird that does not meet breeding target or that is determined to be abnormal should be removed from the flock.

Reproduction

All Columbiformes are monogamous. They differ substantially from gallinaceous birds in reproductive characteristics. In contrast to chickens, female pigeons must at least be able to see a sexual partner for egg production to occur. If a male is not present, another female or a mirror image may stimulate ovulation.

Most of the Columbiformes construct a nest consisting of twigs or similar material in trees, shrubs or other hiding places. Some particular genera are cavity or ground breeders. The Nicobar Pigeon will nest in colonies. The design of enclosures for breeding pigeons should provide a dry, warm, draft-free area.

Pigeons generally are sexually mature by four to six months of age and will select a mate for the breeding season. Pigeons generally breed from spring to late summer when they stop oviposition and enter the main molt that lasts several months. Breeding may start again in late winter. In temperate areas, pigeons may produce offspring year round.

The females of large species lay a single egg; medium-sized species, two and small species occasionally three. Domestic female pigeons lay two eggs, the first at about 5:00 p.m. on one day, and the second approximately 40 hours later (ie, at 2:00 p.m. two days later).[1] Incubation periods and weaning ages are listed in Table 44.7. The hen and cock share incubation duties and two eggs hatch after 17 to 19 days of incubation. The female incubates from the late afternoon until morning, and the male sits on the nest for the rest of the day. The offspring are fed by both parents.[4,5,12,23,24] Information on all stages of embryonal development is still incomplete.[25]

Production of Crop Milk

For two weeks before the squabs hatch, the mucosa of the crop in the hen and the cock proliferates, producing increasingly large amounts of exfoliated crop epithelial cells known as “crop milk.” Columbiformes feed their offspring exclusively “crop milk” for the first days of life and as a supplemental food until they are 16 days of age.

Crop milk is a holocrine secretion of the epithelium of the crop and consists of 75% water, 12.5% protein, 2.5% non-protein, 8.5% lipids and 1.5% minerals. In addition, it contains all essential amino acids, fatty acids, gammaglobulins (IgA), vitamins, minerals and trace minerals. Carbohydrates are present only in small amounts, if at all.[1] Recent research has shown that crop milk is essential for squabs and cannot be replaced by other material, at least not during the first six days of life. Artificial incubation of pigeon eggs is simple; successful hand-feeding remains difficult.

Crop milk is formed in pigeons under the influence of prolactin. The changes in the epithelium of the crop that allow the production of crop milk can be demonstrated microscopically starting on the sixth day of brooding.[1] In the domestic pigeon, the proliferation of the crop epithelium is macroscopically distinguishable by the twelfth day of brooding. The crop wall is thickened ten to twenty times (1.5 to 3 mm) its normal thickness (0.15 mm) and may appear hyperemic.

The offspring of pigeons and doves are considered to be particularly fast-growing vertebrates. Their body mass doubles within 34 hours following hatch, and their growth curve is steep.[31] Both genders of domesticated pigeons reach sexual maturity as early as 120 days of age. The thyroid gland governs molting patterns in the squab, which start around the 50th day of age, and are completed by the sixth or seventh month when the bird is fully grown.[1]

TABLE 44.7 Incubation Period and Fledging Age for Pigeons (in days)

Common name	Incubation Period	Fledging Age
Nicobar Pigeon	28-30	90
Blue-crowned Pigeon	28-30	28
Domestic Pigeon	17-18	21-28
Stock Dove	17	28
Wood Pigeon	16	20-25
Band-tailed Pigeon	15-18	28
Turtle Dove	15-17	14-16
Zebra Dove	12	11-12
Peaceful Dove	13	11-12
Diamond Dove	12-13	11-12
Picui Ground Dove	14	12-14
Plain-breasted Ground Dove	12	14-18
Emerald Dove	12	12-13
Common Bronze-wing	12-14	16-20
Crested Pigeon	14	12
Plumed Pigeon	17	14-17
Squatter Pigeon	17	14-17
Cinnamon Dove	15	12-21
Grey-fronted Dove	17	14-17
Ruddy Quail Dove	10-12	8-11
Luzon Bleeding Heart	15-17	12-14
Pintailed Green Pigeon	16	13-15
Nepal Thick-billed Green Pigeon	14	12
Lilac-capped Fruit Dove	18	9-12
Seychelle Blue Pigeon	28	14-16
Banded Imperial Pigeon	18	14-16

Gender Determination

Only a few of the Columbiformes, eg, the Namaqua Dove, Plain-breasted Ground Dove, Emerald Dove, Luzon Bleeding-heart Dove and the Galapagos Dove, are sexually dimorphic. In these species, the males are noticeably larger than the females.

With most other Columbiformes, including the domesticated pigeons, there are few differences between the secondary sexual signs in the male and female. The sexes cannot always be distinguished with certainty by body size or morphology, the shape of the head, cere or neck, or by differences in specific behavior. Evaluation of differences in the structure of the cloacal lips according to the Japanese method[21] for gender determination has been shown to be ineffective in practice. Endoscopy might be necessary for definitive determination of gender (see Chapter 13).[19]

Gender can be determined in most Columbiformes using a modified nose speculum to examine the inside of the cloaca.[21] The lateral part of the speculum is ground off and smoothed so that the ends are only 17 to 25 mm long and 3 to 5 mm wide. To perform this procedure, the bird is held in a vertical restraint position with the head upside down and the feet toward the examiner. The speculum is inserted carefully about 1 cm into the cloaca (depending on the size of the bird), then opened and slowly advanced dorsally and cranially. The cloacal lips widen and some of the internal cloacal structures become visible. The female is identified by visualization of the orifice of the oviduct on the left side, while the male has bilateral papillae where the vas deferens open into the cloaca. This method of gender determination is reliable for adult birds, but less so for younger pigeons. Injection of either testosterone or follicular hormones has been suggested in juveniles to improve the success of cloacal gender determination. However, considering the accuracy and safety of endoscopy, the use of therapeutic agents that could alter a bird's natural development is not encouraged.

FIG 44.3 A pigeon was presented with conjunctivitis and a mass in the lower eyelid. Cytology of a fine-needle biopsy indicated that the mass was characterized by epithelioid cells packed with acid-fast rods, suggestive of *Mycobacterium* spp. (courtesy of Helga Gerlach).

Artificial Insemination

Managing the Male

The best males to use for semen donors are mature birds that are with hens eight days before, or up to four days after, egg laying. Two people are required for collecting the semen. One person restrains the bird upside down with the tail toward the examiner. The other person holds a Pasteur pipette in one hand, and the tail is lifted up and held between the thumb and index finger of the same hand. The opening of the cloaca is literally pressed together to push the spermatozoa out of the papilla of the ductus deferens.

This pressure also causes blood plasma to pass from the capillaries under the cloacal epithelium. This blood plasma collects in the median part of the cloaca and combines with the spermatozoa to produce 0.1 to 0.2 ml of semen.

Managing the Female

The most suitable females for artificial insemination are those that have been sexually stimulated by a sterile male.[2,33] Males are sterilized by transecting the ductus deferens, which are visible as meandering whitish cords between connective tissue folds of the peritoneum (cave ureters) (see Color 13). The cranial end of the transected vas deferens should be permanently closed with an ethicon clip to prevent the spermatozoa from being released into the abdominal cavity. Spermatozoa are still produced following sterilization and may initially occlude the seminal duct and vas deferens. The accumulated spermatozoa will eventually be phagocytized by leukocytes.

The collected semen is used to directly inseminate the female. The oviductal mucosa contains glands that store sperm and keep it viable for several days. Insemination is best performed around 8:00 p.m. four days before the first egg of a clutch would be laid. This method maximizes the chance that any eggs produced will be fertilized. Insemination is achieved by restraining the hen in the same manner as described for semen collection. An assistant opens the proctodeum with a short vaginal speculum. The orifice of the oviduct is identified on the left side of the urodeum, and should not be confused with the opening of the cloacal bursa or the entrance to the coprodeum.

The salpingeal orifice is relatively large in older hens but is difficult to visualize in young hens before the first egg has been laid. Two small papillae that represent the vestiges of the Wolffian duct can also be identified. These structures disappear shortly before the first egg is laid. Insemination is most successful if performed with undiluted ejaculate immediately or shortly after collection. The pipette is positioned relatively deep into the distal section of the salpinx and the semen is released, while simultaneously and slowly withdrawing the pipette. If properly performed, semen should not reflux into the cloaca.

Clinical Examination

The clinical examination might involve a single pigeon or the entire flock. The physical appearance of a healthy pigeon, examination procedures for the loft and examination procedures for the individual pigeon are similar to those described for Psittaciformes (see Chapters 2, 8). A bird's feathers should be carefully protected during the examination procedure. Damage to the feathers of a racing or exhibition bird can substantially affect their performance.

It is necessary to determine the breeds and color varieties, because some groups of pigeons are more susceptible to certain diseases. For example, the German toy pigeons, many pouters, trumpeters, frillbacks, fantails, jacobins, owls, tumblers, certain homers, strassers, kings and runts are very suscepti-

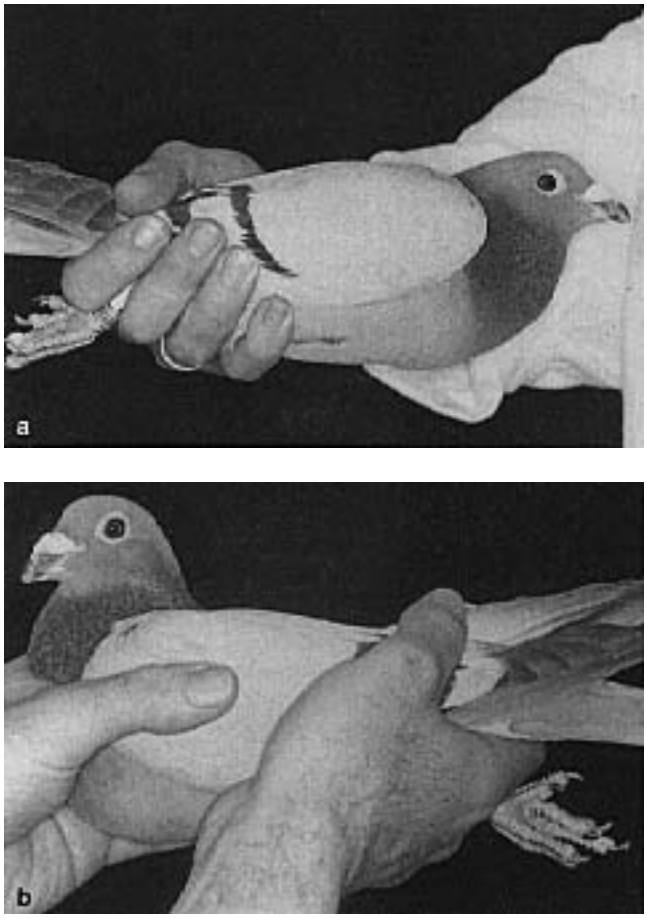


FIG 44.4 The basic method of restraint in Columbiformes is the horizontal hold. **a)** The bird's feet are stretched caudally and are held between the index and middle fingers. At the same time, the thumb and the other fingers fix the end of the wings and the base of the tail. The restrained pigeon lies flat in the inside of one hand. The other hand is free for examining the bird. **b)** Large pigeons may require both hands for proper restraint, and in this instance a second person is needed to facilitate the physical examination (courtesy of R. Korbel).

FIG 44.5 With a vertical restraint technique, the bird is held upright with the thumb, index and middle fingers placed at the end of the wings and the remaining fingers restraining the feet and base of the tail (courtesy of R. Korbel).

ble to salmonella and viral infections. Restraint techniques for Columbiformes are described in Figures 44.4 to 44.7.

Therapeutic Methods

The subcutaneous connective tissue of the caudal third of the neck is most suitable for subcutaneous injections. The skin near the base of the neck should be gently lifted to create a fold, and the needle should be directed strictly dorsomedian with a relatively flat cranial orientation.[39] The animal is restrained in the horizontal hold. The exact location of the needle is checked by injecting a small fraction of the drug and watching for a bubble of fluid in the tissue. The plexus arteriosus et venosus intracutaneous collaris must be avoided. Injection into this area can cause fatal hemorrhage. Infusing large volumes of fluid or injecting caudally can damage the clavicular air sac, the jugular vein and the vagus nerve. Large volumes of fluid can be administered into the subcutaneous connective tissue on the side of the thoracic wall and behind the wings.[39]

Pigeon poxvirus vaccines can be administered by feather follicle or wing web method. A feather follicle vaccine is applied by removing approximately ten feathers on the lateral thigh and rubbing the vaccine into the follicles using a brush provided by the manufacturer (Figure 44.8).[31,32,39] This method should not be used for emergency vaccination because field virus can infect the traumatized skin. The wing web method employs a puncture through the propatagium with a special needle provided by the manufacturer. Both methods should be used only as recommended by the manufacturer.[10,39]

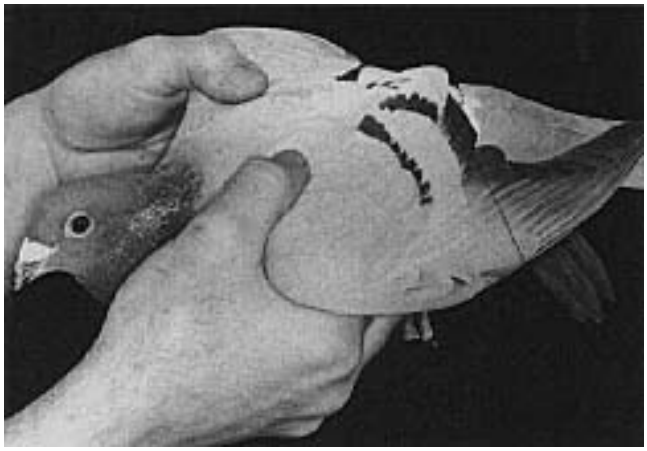


FIG 44.6 The wings are best examined using horizontal restraint. Another method for restraint when examining the wings is to hold both wings with the head facing the examiner. The thumb is on the upper surface of the wings, the other fingers on the lower side, and both wings can be palpated simultaneously. For examining the legs, the pigeon is held against the body of the person who is restraining it, and the hands press gently down on the body while the hind limbs are examined and compared between the thumb and index finger (courtesy of R. Korbel).

FIG 44.7 To examine the crop and neck region, the animal is restrained in one hand using the horizontal hold. The other hand is used to palpate the regions in question and to open the beak. This can be done by fixing the upper beak between the thumb and middle finger while carefully pressing down the lower beak with the index finger. It is easier, particularly with larger pigeons, if an assistant restrains the bird while it is being examined (courtesy of R. Korbel).

The iliotibialis muscle of the thigh is a good site for intramuscular injections in some pigeons or doves. The bird is restrained inside the palm of one hand, the head and the leg to be injected are fixed between the middle and index fingers, and the other leg is held between the ring and little fingers. The injection is administered at the middle of the femur, and the needle runs distally. The pectoralis muscle is used for IM injections in larger Columbiformes that require a higher injection volume.[39] The injection site is approximately parallel to the cranial third of the mediana sterni, close to the carina with a cranio-dorsal needle angle of approximately 70°. The needle must be advanced approximately 5 to 7 mm into the muscle, not too flat or too far laterally. Although the injection volume depends on the body size, it should generally be restricted to less than 0.5 ml. The smallest possible needle gauges that are compatible with the viscosity of the therapeutic agent should be used to prevent hemorrhage.

For intravenous injections, the ulnar vein or medial metatarsal veins can be used (Figure 44.9). Postvenipuncture hemorrhage can be reduced by using the thumb to tighten the propatagium at its insertion, directing the needle as far proximally as possible and releasing the propatagium before withdrawing the needle. This reliably prevents bleeding without the need to apply continuous compression.[39]

Anesthesia

General Anesthesia

Isoflurane is the anesthetic of choice for use in pigeons (see Chapter 39).[11,14]

Several protocols for injectable anesthetics have been suggested including the IM administration of ketamine hydrochloride (20 to 40 mg/kg body weight) in combination with diazepam (0.5 to 1.5 mg/kg body weight) or xylazine (2 to 5 mg/kg body weight).[14,11] The use of methomidate (10 to 20 mg/kg body weight intramuscularly) has also been reported in pigeons. However, the use of injectable anesthetics in pigeons is fraught with problems that include widely variable responses and levels of safety among patients.[9]

If injectable anesthesia must be used, it is best to use 25 mg/kg body weight ketamine hydrochloride together with 12.5 mg/kg body weight clamazolam IM.[9] Combined ketamine/clamazolam injection anesthesia has been shown to have minimal adverse effects on the physiologic regulation systems of the pigeon. An excitation phase will occur during the induction

FIG 44.8 Application of a feather follicle pox vaccine in a pigeon. The feathers from the medial area of the thigh have been removed, and the vaccine is applied to the follicles with a brush according to the manufacturer's recommendations (courtesy of Curt Vogel).

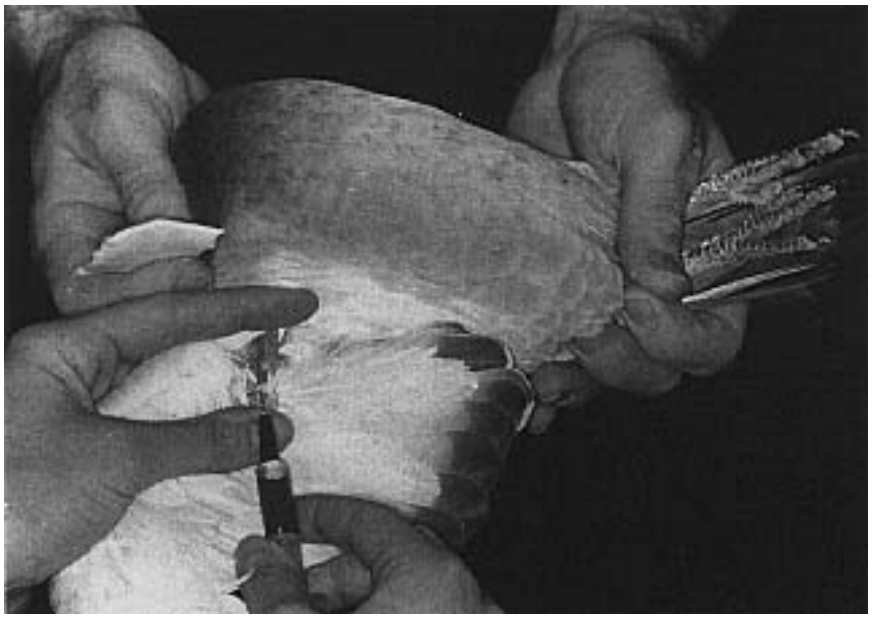


FIG 44.9 The ulnar vein can be used for blood collection or IV injections, but tends to hemorrhage more than the medial metatarsal vein. Using the thumb to tighten the propatagium before inserting a needle may help reduce post-cannulation bleeding (courtesy of Curt Vogel).

and recovery phases with this combination, but in general it appears to provide satisfactory restraint for about 25 minutes. There are no known anesthetic recovery problems. The recovery phase can be shortened to 10 to 20 minutes by administering benzodiazepine antagonists IV.

Local Anesthesia

Columbiformes are sensitive to many local anesthetic agents and may develop adverse drug reactions or die following the administration of 0.5 ml/kg of 2% procaine or lidocaine hydrochloride. Local anesthesia can be achieved with 1% procaine or 2% lidocaine hydrochloride with the addition of adrenalin 1:20,000. The addition of adrenalin increases safety, decreases absorption and prolongs anesthetic duration.[29] Local anesthesia is achieved within two to ten minutes of application.

Diseases

The primary disease problems are due to infectious agents. The corresponding clinical and pathologic features, as well as some suggestions for control and therapy, are mentioned in the pertinent chapters. Table 44.8 provides a checklist of infectious diseases. Noninfectious ailments are also discussed in other chapters.

Two special problems with pigeons should be mentioned here.

Pigeons frequently have trichomoniasis (canker) of the oropharynx and the crop as well as occasional systemic infections, which cause lesions in the liver, base of the heart and lungs. Native preparations (swab from the crop) for demonstrating trichomonas are taken for direct microscopic examination. One-half to one hour after collection of the sample, the agent will no longer be recognizable. With cooling down of samples or cadavers, the agent becomes invisible. Therefore, sending samples to a diagnostic laboratory is of no benefit.

In pouters, so-called sour crop (ingluveitis) is a common problem. Sour crops have to be emptied and

TABLE 44.8 Check List of Infectious Agents in Pigeons

VIRUS
Pigeonpox
Herpesvirus
– Inclusion body hepatitis in pigeons (syn. Infectious esophagitis)
– Contagious paralysis (syn. pigeon herpes encephalomyelitis)
Avian adenovirus
Avian parvovirus
Avian reovirus
Eastern and western equine encephalomyelitis
Venezuelan equine encephalomyelitis
Rubivirus
St. Louis encephalitis
West-Nil-Virus
Avian paramyxovirus, serotype 1 Newcastle disease, serotype 1 pigeon, serotype 7
Avian influenzavirus A
Avian retrovirus
– Type C retrovirus group (Avian leukosis-related viruses) including avian sarcoma and leukemia viruses
– Avian reticuloendotheliosis virus

CHLAMYDIA
Chlamydia psittaci

MOLLECUTES
Mycoplasma spp.
Acholoplasma spp.

RICKETTSIA
Coxiella burnetii
Aegyptianella pullorum

BACTERIA
Staphylococcus spp.
Streptococcus spp.
Mycobacterium avium-intracellulare
Erysipelothrix rhusiopathiae
Listeria spp.
Clostridium spp.
Enterobacteriaceae
Pseudomonas aeruginosa
Aeromonas hydrophila
Alcaligenes faecalis
Bordetella spp.
Campylobacter spp.
Vibrio spp.
Borrelia anserina
Pasteurella spp.
Actinobacillus spp.
Haemophilus spp.
Cytophaga anatipestifer (*syn. Pfeifferella, Moraxella, Pasteurella*)
Acinetobacter calcoaceticus

FUNGI
Microsporum spp.
Candida albicans
Cryptococcus neoformans
Histoplasma capsulatum
Aspergillus spp.

ECTOPARASITES
Argas spp.
– (*A. reflexus* = Pigeon tick)
Ixodes spp.
Dermanyssus gallinae
– Roost mite syn. chicken mite
Ornithonyssus
– Northern fowl mite
Syringophilus columbae
– Quill mite
Sarcopterinus nidulans
Cytodytes nudus
– Air sac mite
Laminosioptes cysticola
– Forms nodules within the subcutis
Neonyssus spp.
– In nasal and sinus cavities
Speleognathus striatus
– As above
Cheyletiella heteropalpa
– Feather mite
Falculifer spp.
– Feather mite
Megninia spp.
– Feather mite
Analges bifidus
– Feather mite
Hemialges anacentros
– Feather mite
Knemidocoptes mutans
– Scaly-leg mite
Neoknemidocoptes laevis
– Depluming scabies

FLUKES (Trematodes)
Echinoparyphium spp.
Echinostoma spp.
Hypoderaeum conoideum
Cotylurus cornutus
Ribeiroia ondatrae
Apatemon gracilis
Brachylaema spp.
Harmostomum spp.
Postharmostomum spp.
Cryptocotyle concavum
Amphimerus elongatus
Tanaisia bragai

ROUNDWORMS (Nematodes)
Ascaridia columbae and other *A.* spp.
– Common or large roundworm
Ornithostrongylus quadriradiatus
Trichostrongylus tenuis
Tetrameres spp.
Dispharynx nasuta
– Spiral stomach worm
Pelucitus spp.
– Filaria in the subcutis of the neck
Capillaria spp.
– Thread worms
Syngamus trachea
– Red worm syn. forked worm

INSECTS
Columbicola columbae
– Slender pigeon louse
Campanyulotes bidentatus
– Golden feather louse
Colocera spp.
– Little feather louse
Hohorstiella spp.
– Large body louse
Neocolpocephalum spp.
– Narrow body louse
Bonomiella columbae
Physconelloides spp.
Cimex spp.
– Bedbugs
Haematosiphon inodora
– Adobe bug
Oeciacus vicarius
Triatoma spp.
– Assassin bug
Ceratophyllus spp.
– Fleas
Echidnophaga gallinacea
– Stick-tight flea
Tenebrio molitor
– Yellow mealworm
Dermestes lardarius
–Larder beetle
Neocrophorus vestigator
Silpha spp.
– Carrion or Sexton beetle
Pseudolynchia canariensis
– Pigeon louse fly
Ornithomyia spp.
– Louse fly
Ortholfersia spp.
– Louse fly
Stribometapa podostyla
– Louse fly
Lynchia spp.
– Louse fly
Microlynchia pusilla
– Louse fly

TAPEWORMS (Cestodes)
Aporina delafondi
Choanotaenia infundibulum
Hymenolepis spp.
Raillietina spp.
Cotugnia spp.
Diphyllobothrium mansoni (only larvae)

PROTOZOA
Eimeria spp.
Toxoplasma gondii
Sarcosporidia spp.
Haemoproteus spp.
Plasmodium spp.
Leucocytozoon spp.
Trypanosoma hannai
Spironucleus columbae
Trichomonas gallinae

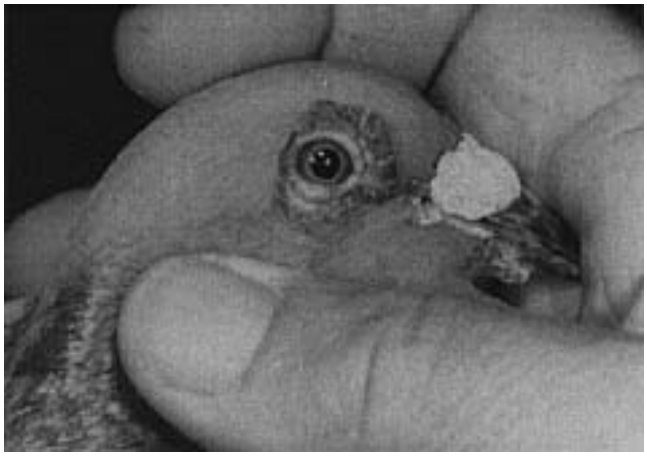


FIG 44.10 Mild conjunctivitis is characteristic of chlamydiosis in adult Columbiformes.

rinsed with saline at body temperature, possibly with some added antibiotic. Pouters must be fed in small portions to avoid overloading the crop. This is particularly important after transport, when the animals start eating again.

FIG 44.11 Poxvirus infections can cause high morbidity in some flocks. Squabs are particularly susceptible to the virus and may develop the cutaneous or diphtheroid forms of the disease. This squab had characteristic papules on the beak and oral mucosa.

FIG 44.12 Torticollis caused by paramyxovirus-1-pigeon in a fancy (helmet) pigeon (courtesy of Louise Bauck).

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