IV. PIGEONS AND DOVES

A. INTRODUCTION

1. Origin

The terms "pigeon" and "dove," especially in languages other than English, are often used interchangeably, with "dove" generally having connotations of grace, gentleness, and religious significance, rather than of speciation. In fact, pigeons and doves are representatives of several distinct genera of the subfamily Columbidae.

Wild pigeons and doves are more or less worldwide in their distribution, with a number of species of each being native to North America. A few species such as the band tailed pigeon (*Columba sasciata*<) and the mourning dove (*Sonaida macroura*) are seen in parts of Canada (Goodwin, 1967).

Domesticated pigeons (*Columba livia domestica*) and the common "street pigeons," which are feral derivatives of domestic pigeons, are not indigenous to the Americas, but were first brought to this continent by the French and the English, to Quebec and Nova Scotia respectively, circa 1607.

All today's many varieties of domestic pigeons derive from the rock pigeon (rock dove) of Europe, Asia, and North Africa (Levi, 1969). The domesticated doves (*Streptopelia risoria*) Ringneck, Laughing, Barbary, etc., originated from a wild type North African ancestor (*Streptopelia roseogrisea*) and are not found in the feral state in the Americas (Goodwin, 1967). The number of dove breeders has increased considerably in recent years, particularly in the USA (Burger, 1974). Numerous research and zoological exhibit colonies are also maintained in both the USA and Canada (Kendall and Scanlon, 1981; Mulder, 1978).

2. Domestication

Archaeological records suggest that both pigeons and doves trace their domestication back to around 5000 BC. Greek and Roman writings refer to the selective breeding and housing of pigeons in dove cotes (Levi, 1969), which must represent one of man's first recorded attempts at intensive animal production.

The hardy and prolific *Columba livia* has, through the centuries, given rise to hundreds of breeds and varieties at the hands of pigeon fanciers. These exhibit a very wide range of sizes, shapes, forms, and behavioral characteristics. By far the most numerous single group is that of the racing homers, which express the characteristic homing and survival instincts common to all pigeons, but not to doves. It is probable that this almost complete lack of homing instinct, and its vulnerability to predation accounts for the captive dove never having been as widely propagated and never becoming established as a feral bird like the street pigeon. As a consequence, doves have remained relatively unchanged by selection, with only the fawn and white coloured varieties being commonly propagated, despite their grace and the ease with which they can be maintained (Hollander, 1954).

In addition to the keeping of pigeons for racing and for fancy, their young (squabs) have long been raised for food. In the USA, a squab industry had been established by the middle of the 19th century and still flourishes, particularly in the southern states (Levi, 1969). To date, a large and viable squab industry has not become established in Canada, although one seems now to be developing on the west coast.

B. BIOLOGY AND BEHAVIOR

1. Distinctive Features

Two characteristics differentiate pigeons and doves from all other avian families:

a. "Crop Milk"

This protein rich substance is produced in the crop of both the male and female pigeon and dove, from the desquamation of the outer epithelial cells of the lateral walls of that organ. The crop lining cells hypertrophy and become lipid rich, under the influence of the hormone prolactin, secreted in the adenohypophysis. Both of the parents feed their young by regurgitating "milk," which will constitute essentially the sole food of the squab for its first few days. Subsequently, the crop milk will be mixed with increasing amounts of regurgitated grains and other nutrients ingested by the parents. Some other avian species feed their offspring on regurgitated crop content; however, none but the Columbidae produces a cellular "crop milk" (Vandeputte-Poma, 1980; Silver and Cooper, 1983).

b. Method of Drinking

Pigeons and doves are unique amongst birds in not imbibing by repeatedly scooping water up into their beaks and elevating their heads to help them in the act of swallowing. All Columbidae drink by submerging their beaks to the nostrils and sucking in in continuous drafts.

2. Biological Characteristics

a. Breed Differences

About 100 different breeds and varieties are described in more or less detail by Levi in his comprehensive reference work on the pigeon (Levi, 1969). The intensive and divergent selection that has gone into the establishment of these innumerable breeds and varieties has resulted in a great variance in conformation, feathering, colour and behavior.

Much less diversity exists among domestic doves, although an increased interest in these animals, both by fanciers and for research, has resulted in a large number of colour and feather pattern mutants being identified since mid-century (Burger, 1974).

Pigeon breeds may, for convenience, be grouped on the basis of body weight and size into: light breeds, averaging 250-300 g adult weight; medium birds of between 450-500 g and heavy breeds up to 1000 g.

b. **Physiological Parameters**

Differences in breed size are reflected in the ranges seen in many of the physiological parameters of pigeons.

Body temperature is 41.8°C (106.6°F) and blood volume is variable and rather small, at about 8 ml/100 g (Schrag, 1974). In common with other birds, their erythrocytes are oval and nucleated. Platelets do not exist as in mammals, but are replaced by nucleated thrombocytes: cells with a scanty cytoplasm, which are somewhat smaller and more round than erythrocytes.

Rather surprisingly, doves and pigeons, particularly of the small breeds, will hybridize and breed naturally if isolated together. Male pigeons and female doves produce fertile eggs in about 50% of their matings; only about 3% of the offspring hatched are female. Fertility from the reciprocal cross is very low. All hybrids are apparently sterile, although the males have viable sperm (Cole and Hollander, 1950).

3. **Behavior**

Wild pigeons and the feral, so-called "street pigeon," have adapted to and thrive in a wide variety of habitats and environments. In nature, these birds tend to select a relatively small, confined roosting and nesting space. They are, however, gregarious and, by choice operate in groups within which they form monogamous fairs. Numerous genetically influenced, often bizarre, behavioral characteristics, such as homing, tumbling, and pouting, have been selected by fanciers and are described by Levi (1969).

C. **RESEARCH USES**

1. **Sources**

In Canada, pigeons for research are most often acquired either directly or indirectly from commercial squab farms in USA, among which one or two major breeding facilities supply either investigators or laboratory animal supply houses (ILAR, 1979). The breeds used are most often the large Kings and the White Carneaux. A second, often used source is the local pigeon fancier and breeder. A majority of birds from this source are homing pigeons, though this is also the means by which breeds showing special inherited physiological and behavioral characteristics may be acquired. Breeding at research institutions is rarely undertaken in this country except as regards to ring doves. Research breeding colonies and colonies at zoological parks constitute essentially the only sources of the last named species.

Birds from any of the above sources will usually prove satisfactory and the choice will depend on availability and on the requirements of the research. In

any case, newly acquired animals should be of known age, parentage, from a premises with a known health status and be permanently banded for identification (usually done on squabs before they leave the nest). "Street pigeons," which are feral birds, about which little will be known, do not generally make suitable research animals.

2. Utilization as Models

Pigeons in research are most often thought of as providing models for behavioral studies, although they are widely used for other purposes as well. Their attributes of good memory, sharp vision, and stable behavior have particularly suited them for investigations into various aspects of learning behavior and cognizance (Skinner, 1951; Epstein, Lanza and Skinner, 1981). Similarly, they have found considerable use in neurophysiological research, although they do not withstand surgical interference as well as do a number of the laboratory mammals, especially not during their fall molt period (Desmedt and Delwaide, 1966).

The pigeon's relative freedom from enzootic diseases and other disorders associated with prolonged confinement, as well as ease of husbandry, enhance its value as an experimental animal for biomedical studies (Clarkson, Prichard, Lofland *et al.* 1963), although it has not been widely used in these investigations in Canada. Pigeons have provided valuable models in studies on atherosclerosis, carbohydrate and lipid metabolism (Wagner and Clarkson, 1974), endocrinology, toxicology and problems in genetics, reproduction, and population control (Elder, 1974; Sturtevant, 1970). Ring doves have been studied mostly for reproductive physiology (Cheng, 1979; Silver, 1978) and immunogenetic investigations (Miller, 1967).

Despite the above outlined extensive use of pigeons and doves as laboratory animals in biomedical as well as behavioral research since early in the 20th century, surprisingly little information on their care and maintenance has been published in the animal care literature Indeed, this species is "conspicuous by its absence" from most manuals and guides on laboratory animals and was even dropped from the third (1967) and subsequent editions of the otherwise fairly comprehensive reference work on laboratory animals compiled by the Universities Federation for Animal Welfare (UFAW, 1967).

D. HUSBANDRY

1. Housing

Pigeons are highly adaptable, hardy birds of a generally tractable disposition. As a consequence, they have, through the years, been successfully raised by hobbyists and commercial breeders under a vast variety of husbandry conditions. Generally, pigeon housing has consisted of more or less closed lofts and holding nests opening into a wire enclosed flypen or aviary of varying but usually quite limited area. Such a facility should be proof against the entry of predators, particularly cats and dogs.

The large loft, nest boxes and flypen system has been successfully adapted to research breeding requirements of production with large numbers of pairs

(Nohlgren and Wagner, 1977). However, when a communal loft/flypen system is used, up to 10% of the progeny may be sired by extra-pair copulation.

Pigeons do not need heating or enclosed housing as long as their water supply is kept from freezing and they are provided with space for limited exercise in the form of a flypen. Doves are also able to adapt to extremely cold weather, but are adversely affected by cold drafts and rapid chilling (Hollander, 1959).

2. **Caging**

a. **Breeding Cages**

Pair breeding cages have been the usual way of raising the defined pedigree pigeon required for certain types of research. It has been stated that these cages must be at least 0.7 m^3 (3 $ft.^3$) if fighting or other disruptions to reliable breeding are to be avoided; however, the space requirement for doves is less critical (Hollander, 1959). More recent reports show that much less space is needed to successfully cage-breed pigeons and that a 46 cm (18 in.) cube-shaped, wire enclosure with an open, 15 cm square (6.2 in.), 5 cm (2 in. deep) burlap lined pine nest box is adequate. This type of cage may be made of welded wire in batteries of four (Sturtevant and Hollander, 1978). Chopped straw or hay may be provided for bedding. Short, 5-8 cm (2-3 in.) lengths of string make an excellent source of clean nesting material for small numbers of breeding pairs of laboratory pigeons and doves.

Breeding pairs must be provided with two nests, as they will often start a new clutch before the previous pair of squabs has left the nest (Clarkson, Prichard, Lofland *et al.* 1963).

b. **Standard Laboratory Cages**

The majority of pigeons for research are housed singly, often for long periods (several years), in commercially obtained, standard pigeon cages. These average about 24 cm (9 1/2 in.) wide, provide approximately 775 cm^2 (120 sq. in.) of floor space, with up to 33 cm (13 in.) head room. Commercial cages have a more or less solid back and sides, a wire mesh top and door, with outside water and feed containers. While pigeons have been maintained in even smaller cages, for several months in "apparent good health," they lose muscle tone and strength in their wings, are unable to fly properly on release and, in attempting to do so, may sustain injury (sprains) to their wing joints (Clarkson, Prichard, Lofland *et al.* 1963).

There are significant advantages to the use of flight cages for both pigeons and doves in many behavioral studies in that they permit natural movements and interactions, as well as ensuring a more nearly normal physiological status in the test animals.

Flypens should be either located indoors or be roofed in such a way as to minimize the risk from the introduction of disease and parasites from wild bird carriers.

The obvious spatial inadequacy of the standard pigeon cage, at least for long-term holding, has led several Canadian user groups to seek practical ways to enrich the cage environment; two of these are briefly described here:

c. **Modified Poultry Cages***

Wire poultry cages 30 x 46 x 41 cm (12 x 18 x 16 in.) high, in three batteries of 10 cages each, may be suspended on a custom made rack over standard, slightly forward sloping, rat-rack dropping trays. The fronts of the cage batteries are modified to suspend feed and water troughs or individual cups. Temporary dividers can easily be inserted between the individual cages if desired, although signs of insecurity, or of fighting between birds in adjacent cages, has not been a problem. Birds have thrived in these cages over a period of 12 years with no indication of maladjustment, and have been used consistently in behavioral studies. On release, at any time, they are able to fly immediately.

In addition to being far less expensive, routine cleaning is much quicker and easier than with standard, individual cages. Dust control, as in all pigeon rooms, presents a problem, the control of which in this cage system, may be aided by a gentle spraying of the racks and pigeons with water. (Pigeons, it should be noted, like to bath and splash if given the opportunity.)

d. **Flypen Holding****

Pigeons held in small standard pigeon cages to control body weight and other parameters during experimentation are, under this system, released between periods of experimental use into an indoor flypen, until needed again. The wired off end of a pigeon holding room, 2 x 3 m (7 x 10 ft.) in area, has been used. Perches (nest boxes optional) should be provided and the floor covered with sawdust or paper. Pigeons prefer to roost on a perch or ledge against a wall. Birds subject to this regimen do not lose flying ability, do not fight newcomers introduced into the flypen, maintain a normal body weight, are less labour intensive to look after, and remain healthy.

e. **Comments on Caging Standards**

The standard, small individual cage is said to provide the incumbent with a sense of security by simulating the natural habitat. This rationale seems somewhat specious, in that the King and Carneaux pigeons, which have been captive bred for innumerable generations, have shown no aversion to permanent residence in wire sided chicken cages. The pigeon is a flying bird and surely should be provided with sufficient cage space to stretch its wings, if access to a flypen cannot be provided.

For certain experimental purposes, small groups of pigeons have been housed five to a chicken finishing battery compartment. Under such conditions, normal pairing and breeding cannot take place and fighting and feather picking will usually occur (Clarkson, Prichard, Lofland *et al.* 1963). Even though these problems have been circumvented to some extent by partial debeaking, this practice should be discouraged and this system of caging should not be used.

3. **Environment**

Pigeons may be raised under wide seasonal ranges of temperature, humidity, light, and barometric pressure, if kept in flypens. For cage housed birds, temperature should be held between 10-24^{o}C (50-57^{o}F) with RH of 30%. A 12-hour light, 12 hour dark diurnal cycle is commonly provided, although 14 hours light will enhance breeding activity (Sturtevant and Hollander, 1978).

A problem peculiar to pigeon rooms in the laboratory is the one of excessive dust from feathers and skin. This dust is a potentially potent allergen and management steps should be taken for its control. It is responsible for the so-called pigeon breeders' lung disease, and may cause a severe reaction in susceptible persons (Fink, Moore and Barboriak, 1975). The dust is light and should theoretically be removable by exhaust hoods over the cage racks. In practice, this usually creates excessive turbulance and tends to scatter the dust. A system of supply diffusers near the ceiling above the cages and exhaust diffusers at floor level, if coupled with regular damp mopping, has proven a more satisfactory method of pigeon dust control.

As indicated above, pigeons enjoy splashing in water and will frequently bath, if water is available. Access to water for this purpose does not seem to be necessary or particularly beneficial, merely pleasurable.

Sudden noise or surprise movement will startle pigeons and doves and should be avoided. Lighting that can be reduced by rheostat when bright light is not needed, will help to keep the birds quiet and is a useful feature in pigeon rooms.

E. **NUTRITION**

1. **Requirements**

Members of the family Columbidae are all seed eaters, though most species will also eat insects. Domestic pigeons and doves are almost entirely granivorous. Non-breeding birds may be maintained on a fairly low protein diet consisting of peas, wheat, corn, and similar cereal grains. Under large group housing conditions, it has proven advantageous to offer these grains "cafeteria style," along with oyster shell, a granite grit mix and mineral supplement containing iodized salt. Pigeons, if they are to breed optimally, need a supplement of Vitamin D and probably Vitamin A and B. The diet for breeders should contain at least 15% protein, and it is good practice to use a commercial, combined vitamin-mineral premix added to either the feed or water (Hollander, 1954; Clarkson, Prichard, Lofland *et al.* 1963; Sturtevant and Hollander, 1978).

Adult pigeons will consume large amounts of food and, if caged without exercise, should be kept on a restricted diet to maintain about 80% of their normal body weight on *ad libitum* feeding. In practice, this is about what they will consume in 20 minutes, fed twice daily.

2. **Feeding**

Food consumption is about one-tenth of the pigeon's body weight and will range from 20-100 g daily, depending on the strain.

Under laboratory conditions, particularly for small numbers of caged birds, the feeding of a pelleted pigeon feed (readily available commercially) is by far the most satisfactory procedure to follow. A vitamin-mineral supplement is usually also fed, but granite grit is not essential with pelleted rations, although oyster shell must be provided for breeders. The periodic feeding of some mixed whole grain is said to be good practice, in order to exercise the gizzard (Sturtevant and Hollander, 1978).

Powdered rations should not be offered to pigeons as, although they will usually eventually eat them, they have difficulty swallowing fine particles and will sometimes refuse to do so for a long enough time to cause death (Clarkson, Prichard, Lofland *et al.* 1963). Pigeons can handle wet mashes better and may be trained to accept these when young (Hollander, 1954).

Semi-synthetic diets are quite often required in research on pigeons, particularly for the feeding of high protein and high fat diets, on which these birds survive quite well. The "crop milk" on which the squabs are raised is extremely high in these nutrients, having a protein level approaching 50%, and fat about 20% (Vandeputte-Poma, 1980). Synthetic diets should be pelleted unless the birds have been pretrained to accept powdered feed.

3. **Water**

A continuous supply of fresh water is important. This should be provided either in a cup located outside the cage or so covered that it cannot be fouled. The pigeon consumes from 36-60 ml of water daily. Water depth must be maintained at approximately 5 cm (2 in.) so as to accommodate the pigeon's manner of drinking. It is important that pigeons be given ample opportunity to drink after feeding, which they will normally do within two hours of eating, to help move grain from the crop. The inability to drink at these times, for any reason, may result in retention and swelling of food in the crop, causing discomfort. Light should be maintained in the room for a two hour period after feeding to facilitate drinking, as the birds will attempt this even in the dark, despite having very little night vision.

With large numbers of pigeons and pens it may prove advantageous to install an automatic watering cup system, as pigeons readily adapt to these. Either a float system or individual receptacle with weight controlled flow may be used (Clarkson, Prichard, Lofland *et al.* 1963).

F. REPRODUCTION

1. Breeding Behavior

Under the appropriate conditions of light, warmth, and nutrition, pigeons will breed and lay year round. Doves tend to be somewhat more seasonal, with a reduced productivity from November through February.

Young pigeons reach sexual maturity by six to seven months, as do doves. They breed well for at least five to six years and will continue to reproduce, but less regularly, into an old age of 10 or more years (somewhat less for doves).

Pigeons and doves are monogamous; however, established pairs can be manipulated if required and new mates will be accepted. It is advisable not to allow previous mates access to each other, however, as, having long memories, they may return to their original monogamous relationship.

Pairing among the grouped birds starts with a courting ritual in which the male pigeon struts and pirouettes (doves bow) before the hen. Acceptance is signalled by the female following the male to a nesting place that he will have chosen, though the nest will not be started for two or three days. The cock brings the nesting material (straw, twigs, etc.) and the hen builds. About a week later, the first egg is laid, a second one follows in about 45 hours (40 hours in doves). Pigeons will lay successive clutches of two eggs at five week intervals and will raise from 10-22 young per annum, with 15 to 16 considered a good commercial production average (Levi, 1969; Kendall and Scanlon, 1981; Hollander, 1954; Sturtevant and Hollander, 1978).

2. Incubation and Hatching

Both partners share in the incubation and either one will sit if the eggs are seen to be unattended, though the male most often sits from 10:00 a.m. to 4:00 p.m. (Hollander, 1954).

The duration of incubation is 18 days from laying of the first egg in pigeons, but only 15 days in doves (Silver, 1978). Hatching takes about 24 hours from first pipping of the shell.

Pigeon eggs can be incubated artificially using modified poultry incubator trays, with similar temperature, humidity, and rotational regimens as for chickens.

3. Rearing

The newly hatched squab is atricial (born naked and helpless) and, if orphaned, will need heat to 32^{o}C (90^{o}F) initially, and frequent feedings with a high protein, high fat, vitamin and mineral supplemented diet. Wood pigeons have been hand reared on a diet of vitamin and mineral supplemented raw eggs for the first week, with the addition of increasing amounts of ground

grains and turkey starter, fed twice daily, till weaning (Fazlul Haque, Broom and Gaitens, 1982).

Squabs of both pigeons and doves are fed with the previously described "crop milk". Squab growth is amazingly rapid, and they normally double their birth weight of approximately 20 g (1 oz.) over the first 48 hours and again by four days. They will be 20 times their birth weight by weaning, at three to four weeks, and as big as their parents by seven to eight weeks. Pigeons start to fly at four weeks, doves at three.

Weaning is a critical period as, until then, the squab has been totally dependent and must, once it can fly, follow and learn to feed and drink by imitating its parents.

It is essential that two adjacent nests be provided, as pigeons will start a new clutch three weeks after the previous hatch and will divide their time between sitting on the new eggs and feeding the squabs in the other nest. This rapid reproductive cycle will usually slow down, or stop briefly, for the annual fall molt.

4. Sexing

Several methods may be used, though none is particularly simple. The cloacal method involves distinguishing between the single left oviduct opening of the female and the two sperm ducts of the male. The latter empty one on either side of the cloaca, onto small papillae. This method can only be used on mature birds and requires the use of a disposable, clear plastic, nasal speculum.

Direct visualization of either the single left ovary or the two testes may be accomplished under anesthesia by laparotomy, if it is necessary to sex an immature animal. This is a slow procedure and not without some risk, though the identification should be sure.

Genetic methods of sexing may be used on some, but not all, breeds. This will be based on colour and feather pattern differences, involving sex linkage and/or autosexing. Similar methods are also applicable to doves, amongst which the eggs from crosses between blond females and white males can actually be sexed at three days incubation, by candling. In this cross, the male embryo will have easily seen dark eyes, as opposed to the almost colourless ones of the female embryo (Hollander, 1954).

G. RESTRAINT AND MANIPULATIONS

1. Capture and Handling

Pigeons in flypens may be difficult to capture during daylight. If the lights are turned on after dark, pigeons will almost instantaneously become alert and take off from their roosting places. However, their night vision is poor and, if approached in the dark and dazzled by a flashlight, they can easily be picked up. Although at first they may resent capture, both doves and pigeons will

usually become very tame from gentle and repeated handling, in the laboratory situation.

2. **Physical Restraint**

This is not difficult and, as the pigeon will not peck, it may readily be clasped by its feet, held between one's index and middle finger while the wings are encircled with the thumb and remaining fingers.

A number of restraining devices may be improvised from such things as rounded quart sized juice containers or a length of plastic tubing of the appropriate diameter. Use of a stockingette tube for this purpose has proven useful prior to X-ray or inducing anesthesia, to prevent self-injury.

3. **Sampling and Manipulations**

Injections should generally be made using a short, 27 gauge needle to minimize trauma. Subcutaneous injections should be given high on the bird's neck. Intramuscular injections may be given into the pectoral muscles,, but not the leg muscles because drainage from this region will pass through the bird's renal portal system. Intraperitoneal injections are contraindicated and should as a general rule, be avoided. If this site must be used for some reason, then extreme care must be taken to avoid accidentally depositing the material into the air sacs. A point mid-way between sternum and cloaca along the midline, with the needle directed cephalad at a shallow angle just under the abdominal wall, should be used (Green, 1979).

Small samples of blood may be collected in a micro pipette after nicking the side of a toe with a lance. Venipuncture for injection or for the collection of quantities of blood (up to 10 cc from mature, large birds) is easily performed with a 20 gauge needle, using the wing (alar) vein after swabbing the area with alcohol. Chemical restraint is not necessary for this procedure if the pigeon is held manually by an assistant and a few feathers are plucked from the site.

Chronic cannulations of the carotid artery can be performed on anesthetized pigeons and maintained successfully if the catheter is exteriorized at the occiput so that it cannot be reached by the bird's beak (Wendt, Normile, Dawe *et al.* 1982). Cannulations of other blood vessels, such as the wing vein and femoral artery, may also be readily performed and are well-tolerated in pigeons and presumably also in doves.

Esophageal and crop intubation for force feeding is easily performed with a metal tube and dose syringe; up to 60 cc may be injected into the crops of mature birds in rapid succession by this method (Clarkson, Prichard, Lofland *et al.* 1963).

When interpreting radiographs, it must be remembered that birds have no diaphragm and have very large air sacs. The latter will provide excellent negative contrast to most of the bird's organs, thus enhancing the usefulness of radiography in the diagnosis of many avian diseases.

4. **Euthanasia**

Under most circumstances, pigeons and doves may be killed most humanely and quickly by cervical dislocation. A bird that is accustomed to being removed from its cage and/or flypen may be caught and taken to another room for this to be done. However, where restraint and removal may be expected to cause panic and vocalization, it may be more humane and far less frightening to the remaining birds if cervical dislocation is performed immediately on capture. It is the specific and repeated "fear vocalization" cry that will upset and panic other birds, not the (uncomprehended) sight of another bird being subjected to euthanasia.

Carbon monoxide or carbon dioxide, as long as the euthanasia chamber is completely prefilled with the gas, are each effective, relatively rapid, and painless methods of avian euthanasia. An overdose of a barbiturate anesthetic agent i.v. into the wing vein is also effective.

H. **ANESTHESIA AND SURGERY**

1. **Pretreatment**

Prior to undertaking the anesthesia of any bird, the anesthetist and/or surgeon not experienced in the anesthesia of this class of animal should refer to one of the several reviews on this subject available in the veterinary literature. There are many aspects of the anesthetic responses of birds that differ markedly from those of mammals (Green, 1979; Amand, 1977; Langham, 1981; Jones, 1973).

The choice of anesthetic and method will, to a considerable extent, be governed by the experience and preferences of the operator. A number of injectable and inhalation agents, alone or in combination, have been used with variable success in pigeons.

Prior to anesthesia, food should be withheld for six to 12 hours to ensure that the crop is empty, so as to avoid possible regurgitation.

Intubation, if called for, should not present a problem in the sedated bird, provided that the anatomy of the region has first been reviewed. With beak opened and tongue pulled forward, the airway can be easily visualized and a small diameter endotracheal tube inserted without the need of mechanical aids.

2. **Injectable Anesthetics**

Agents such as ketamine, xylazine, and short acting barbiturates, have been used for sedation and for surgical anesthesia, either alone or in various combinations (Bree and Gross, 1969; Altman, 1980). It has been reported that pigeons do not tolerate xylazine well (Gandal, 1969), and persons using any of the injectable agents should constantly be alert to the fact that there is always a distinct possibility of adverse reactions. Urethane at 1 g/kg i.p. has been recommended for long lasting anesthesia in pigeons (Desmedt and

Delwaide, 1966); however, because of its potential as a chemical carcinogen and because, as stated above, injections by the i.p. route are generally contraindicated, use of urethane cannot be advocated.

3. **Inhalation Anesthesia**

Anesthetic induction with such agents as nitrous oxide, halothane, and methoxyflurane by mask or chamber are preferred by some. These agents should not be used in a closed container. Ventilation is critical, as the bird's air sacs provide a very extensive surface area for absorption and will store large amounts of (residual) anesthetic gas. The procedure of choice, by many anesthetists, is initial sedation or light induction with an injectable agent such as ketamine, followed by intubation and maintenance with an inhalation anesthetic.

The onset of apnea in birds is often very sudden and fatal. Consequently, the depth of anesthesia must be carefully monitored at all times, with the operator being prepared to initiate immediate steps for ventilation support. Gas flow should be high to ensure clearance of expired gases and should be approximately three times the respiratory minute volume of the patient, which in a 300 g pigeon is 250 ml (Green, 1979).

4. **Assessment of Depth of Anesthesia**

This is best judged on the reflex from pinching the pericloacal skin or the toe. The corneal reflex cannot be used, as movement of it and the nictitating membrane (third eyelid) persists throughout anesthesia. Birds do not usually exhibit Stage II excitement as do mammals; consequently, lightly anesthetized birds may appear to be in deep sleep from which, unfortunately, they may be aroused by the initial incision.

5. **Surgery**

Methods of implantations and neurosurgery (Gandal, 1969) as well as for stereotactic implantation of electrodes (Desmedt and Delwaide, 1966) have been developed and described for both pigeons and doves. Prior to surgery, the site should be prepared by plucking the feathers, scrubbing, and treating the area with a long acting, residual disinfectant. This procedure, if carefully carried out, reduces the possibility of abscessation, particularly of the large feather follicles, during the healing process.

6. **Post-Operative Recovery**

Following anesthesia with an injectable agent, recovery will be safeguarded if air and O_2 are administered to the respiratory system to assure proper ventilation and clearance. This is because large amounts of the anesthetic agent will be released into the air sacs and will tend to accumulate and be taken up to excess by the parabronchial capillaries. This will impede recovery and may even prove fatal.

Recovery should take place at a temperature of 35°-40°C (95°-104°F). Wing damage that sometimes takes place during the excitation phase of recovery can be prevented by placing the pigeon in a stockingette or other restraining device.

I. HEALTH CARE

1. General Precautions

Pigeons and doves are hardy birds and those that are raised in commercial or laboratory breeding colonies and supplied for research purposes rarely become diseased or present serious health hazards. This is not necessarily true of birds from the hobbyists and fanciers, nor of the feral "street pigeon" population.

All newly acquired birds should be subjected to a period of quarantine away from other birds of the colony, during which they should be observed closely. This is a particularly necessary precaution when pigeons are obtained from a dealer and/or local hobbyist, as parasitic and respiratory diseases may frequently be encountered in such birds.

Overt signs of disease may not be shown during the early stages of sickness in pigeons and doves, as is also true of most wild species of birds, for to show signs of ill health and weakness in nature is to invite attack. Consequently, by the time that signs of sickness are actually discerned, a pigeon's energy reserves may have become over-extended. Once these reserves are exhausted, the bird's health will deteriorate rapidly, with collapse and death coming quickly. For these reasons, a close watch is particularly important for non-specific signs such as depression, weakness, anorexia, and deviations from established behavior. If noted, they call for immediate attention, with aggressive follow-up once a diagnosis has been established. Aid in rapidly establishing a diagnosis should be sought from a specialist in avian diseases***.

Any pigeon that is found dead in a colony, regardless of whether the cause is thought to be known or not, should be subject to a thorough necropsy, preferably by a veterinary pathologist familiar with avian diseases****.

2. Infectious Diseases

Bacteria, viruses, and occasionally fungi may all cause disease in both pigeons and doves. Unfortunately, there are almost no current reviews devoted specifically to the common diseases of pigeons (Schrag, 1974). Most of the information on this subject has been published as isolated papers in a wide range of research and medical journals, often from European countries in languages other than English and French. The journal "Poultry Abstracts" is a good source of information on current international publications concerning pigeons and dove diseases****. Some brief reviews and mention of pigeon diseases have also been included in general reference works to the diseases of birds, wildlife, and zoo animals (Petrak, 1982; Hofstad, 1978).

a. **Salmonellosis**

Among the bacterial diseases, salmonellosis (paratyphoid) has been reported to be the principal enzootic disease encountered in laboratory pigeons in the USA although the infection is usually only expressed by mild enteric signs and does not constitute a major problem (Clarkson, Prichard, Lofland *et al.* 1963). Although several *Salmonella* biotypes are a serious zoonotic hazard to humans, pigeon strains of *Salmonella typhimurium* do not play a significant role in human salmonellosis (Oye and Von Borghijs, 1979). However, feral pigeons are important carriers in the spread of this disease to other species (Williams, 1978).

b. **Avian Tuberculosis**

Mycobacterium avium, the causative organism of avian TB, occurs among feral pigeons and has been reported in commercially acquired White Carneaux pigeons of a research colony. The risk of infection from this ubiquitous organism increases with age and duration of exposure. Wood pigeons and starlings are reservoirs of infection for the spread of this microorganism to other animals. Signs of the infection include lameness, "wry neck," skin lesions, and loss of appetite. The disease might be confused with salmonellosis, some forms of which show similar signs (Pond and Rush, 1981; Thoen and Karlson).

c. **Mycoplasmosis (catarrh)**

The causative organism of this infection is probably present in a latent state in most pigeons, which when stressed may come down with a clinical upper respiratory infection (Schrag, 1974; Sinclair, 1980). The signs of catarrh may be confused with ornithosis (psittacosis). Diagnosis should be confirmed by culture and the making of a mycoplasma antigen for serological testing.

d. **Chlamydiosis (Psitticosis; Ornithosis)**

This is a serious, viral, zoonotic disease in humans, for which psittacine birds and pigeons are favoured natural hosts. The number of laboratory confirmed cases of avian chlamydiosis has increased in Ontario, Alberta, and some U.S. states since 1977 (Hunter and Pettit, 1981). Pigeons are well known as clinically normal carriers. If an outbreak of the disease is suspected in laboratory pigeons, the diagnosis must be confirmed and, in most jurisdictions must be reported to the provincial public health authorities. Treatment should not be attempted. The birds should be killed, appropriately disposed of, and the facility cleaned and disinfected with formalin or some other effective virucidal agent.

e. **Other Virus Infections**

Some of the virus diseases that occur occasionally and spontaneously in pigeons are due to herpes virus, Newcastle disease virus, paramyxo virus,

adeno virus and avian pox virus, among others (Schrag, 1983; Hofstad, 1978; Fritszche, Heffels and Kaleta, 1981).

3. **Parasitic Infestations**

Parasites may be responsible for a number of serious health problems among pigeons, either directly or indirectly as vectors in the transmission of pathogens.

a. **Ectoparasites**

Ectoparasites should not be a problem in the laboratory pigeon colony; however, incoming birds should be checked during quarantine for lice and mites.

Treatment with a synthetic pyrethroid is effective and safe, although other external parasiticides recommended for poultry may also be used*****.

b. **Protozoan Diseases**

The hypoboscid fly (louse fly) is the vector for the protozoan *Hemoproteus* responsible for "pigeon malaria," a severe anemia of particular concern in the racing homer breed. Treatment lies in control of the vector by pyrethroids or other insecticides.

Canker (Trichomoniasis): Infection with the protozoan parasite *Trichomonas gallinae* is the potentially most serious protozoan disease of columbids. Its distribution is world wide and it occurs with some frequency among wild pigeons and those raced by fanciers. However, it should not be a problem in laboratory pigeons. Natural infection amongst several species of wild doves has been reported from the USA including Hawaii (Kocan and Banko, 1974).

c. **Helminths**

Domestication and intensive confinement rearing of pigeons has increased awareness of clinical disease and mortality from heavy infestations with internal parasites such as *Ascaridia* (round worm), *Capillaria* (crop worm and hair worms), *Syngamus tracheae* (grape worms) and *Tetrameres fissipina*, which affect the proventriculus. The capillaria worm is probably the most widespread and serious internal parasite to pigeons in central Canada. It may be effectively treated with dimetridazole. Tetramere and ascarid infestations may also prove serious if heavy enough, and are reported of frequent occurrence in the USA (Schock and Cooper, 1978).

4. **Other Health Considerations**

Genetic and nutritional defects will occur occasionally in breeding colonies and may be controlled by proper management and selection procedures.

Administration of medicaments may be through the feed or drinking water where dosage is not critical. A better control over the actual dose taken may be obtained with individually caged birds and measured food and/or water consumption. Exact dosage will require individual oral administration or injection. Injection sites have been discussed above (Sampling and Manipulations).

Sulfa drugs should be used with caution if at all, as they may cause a blood dyscrasia, (aplastic anemia); if there is any indication of this developing from a first dose, a repeat treatment will almost always prove fatal.

Finally, the advisability of utilizing the services and expertise on avian health matters that is available through the veterinary services branches of all provincial governments cannot be overemphasized.

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