



Ketamine Hydrochloride as a General Anesthetic for Domestic Fowl Chicks: Onset and Recovery from Anesthesia

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Abstract

The domestic fowl, as a species, is considered a unique experimental model in immunological research where the humoral and cellular components of the immune response can be delineated by selective surgical bursectomy of newly hatched chicks combined with sublethal whole-body X-irradiation. Search for an effective, safe, and a short-acting general anesthetic for application in such young birds is, therefore, essential. Ketamine is a phencyclidine derivative with analgesic and anesthetic properties in both mammalian and avian species. Studies on its efficacy on young or naturally small birds, however, are apparently lacking. Our previous studies indicated that dose levels as high as 51 mg/kg and 37.2 mg/kg are not lethal to 2-day- and 6-day-old Hisex White domestic fowl chicks when given intramuscularly, respectively. Results of the present study show that the onset of ketamine anesthesia varied between 40 - 98 seconds in 2-day-old chicks of this breed depending upon dose level. The dose and response are inversely related ($y = -19.3x + 107.5$) where “y” is the time for onset of anesthesia in seconds and “x” is the dose as mg/bird. The time for recovery from anesthesia also varied (6.6 - 74.7 min) depending upon dose level. The dose and response, however, are positively correlated ($y = 20.92x - 21.15$). Doses ranging between 43.77 to 47.74 mg/kg are considered optimum to produce anesthesia with onset in 74 - 77 sec and recovery within 12 - 15 min. It is concluded that Ketamine has the potential for application as a general anesthetic for domestic fowl chicks for bursectomy. Critical clinical tests are necessary to evaluate further the performance of this drug when administered to young chicks.

Subject Areas

Veterinary Medicine

Keywords

Ketamine Hydrochloride, Domestic Fowl, Chicks, Anesthesia

1. Introduction

Ketamine is a phencyclidine derivative with analgesic and anesthetic properties in both mammalian and avian species. The drug is recommended as a suitable injectable general anesthetic in a wide range of avian species [1] [2] [3]. It has a wide margin of safety in most of these species [4]. According to Ludders and Matthews [5], the drug is suitable for chemical restraint for minor surgical and diagnostic procedures. Despite such wide application and reliability of the drug, studies on its efficacy on naturally small or young birds are apparently lacking.

The domestic fowl (*Gallus gallus domesticus*), as a species, is considered a unique experimental model for the study of immunological mechanisms in birds where the humoral and cellular components of these mechanisms can be delineated by selective abrogation of bursal or thymic functions. Several techniques [6] have been used to ablate both the bursa and bursa-derived migrating lymphocytes. These include hormonal injection in chick embryos, surgical extirpation of the developing bursa during embryonic life, *in ovo* intravenous injection of antibody specific for the IgM heavy chain or treatment with cyclophosphamide, colchicine or infectious bursal disease virus. Schusser *et al.* [7] developed a technique targeting genes in the chicken genome leading to loss of antibody production and a block in B-cell development. Surgical bursectomy at hatching, on the other hand, particularly when combined with sublethal X-irradiation, has been shown to have a profound suppressive effect on the subsequent ability of the chicken to form antibodies to several antigens [8] [9]. This surgical approach, however, requires an effective, safe and a short-acting anesthetic agent to enable surgical operation in such small birds. In an earlier study [10], we studied the quantal response of 2-day- and 6-day-old Hisex White domestic fowl chicks to ketamine hydrochloride anesthesia upon intramuscular injection. The results of these studies indicated that dose levels as high as 51 mg/kg and 37.2 mg/kg are not lethal to birds of the two age groups, respectively. The objective of the present study was to determine the time for onset of anesthesia (measured subjectively from the instant of drug injection until the bird fell permanently to its side) and the time for recovery from anesthesia (time taken between the onset of anesthesia and the time the bird reverted to a sitting position).

2. Material and Methods

Forty 2-day-old male Hisex White chicks, weighing 32.8 - 39.5 g, average 36.2 g, were randomly divided into 4 groups each comprising 10 birds. They received ketamine hydrochloride (ROTEXMEDICA GmbH, Trittau, Germany) intramuscular injections diluted in sterile physiological saline given at doses in a geometric progression at 0.5, 1, 2 or 4 mg/bird (13.81, 27.62, 55.24 or 110.5 mg/kg body weight; bwt.) using extra fine needles.

3. Results and Discussion

Figure 1 shows that the onset of anesthesia varied between 40 - 98 seconds in

different groups of birds. The Dose and response are inversely related ($y = -19.3x + 107.5$) where “y” is the time for onset of anesthesia in seconds and “x” is the dose as mg/bird. Recovery from anesthesia, as judged by reversion of birds to a sitting position, also varied between groups (6.6 - 74.7 min) depending upon dose level (Figure 2). The dose and response, however, are positively correlated ($y = 20.92x - 21.15$). According to Sinn [11], ketamine is effective as a general anesthetic in various species of birds at doses of 5 - 75 mg/kg bwt. In this regard, results of a previous study, in which we used Hisex White chicks, indicated that a dose as high as 51 mg/kg is not toxic to 2-day-old birds of this breed [10]. In the present study, using the formula ($y = 20.92x - 21.15$), an anesthesia targeted for 15 min, as example, is expected to be produced by a dose of 47.74 mg/kg in 2-day-old chicks of average bwt 36.2 g. In our experience [9], however, this period would exceed the actual time required for bursectomy in domestic fowl chicks. Thus, to reduce this recovery time from 15 to 12 min for instance, which is an advantage, a dose lower than 47.74 mg/kg (*i.e.* 43.77 mg/kg) is required for birds to recover within this 12-min time limit ($y = 20.92x - 21.15$). The time for onset of anesthesia in this case, however, would be increased to 77 seconds ($y = -19.3x + 107.5$) as compared with 74 seconds when the higher dose (47.74 mg/kg) is used.

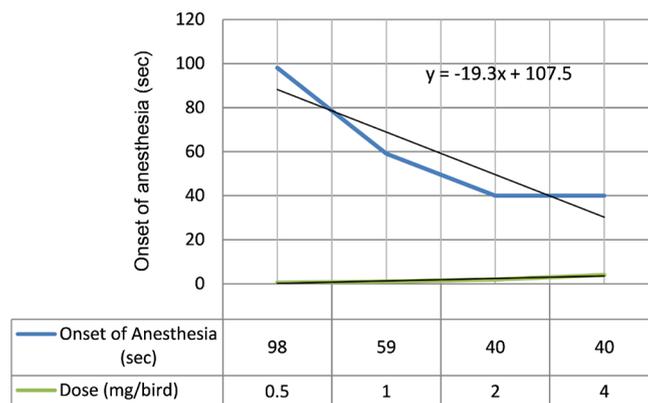


Figure 1. Onset* of ketamine-induced anesthesia in 2-day-old Hisex White chicks (MS Excel). *Mean time; n = 10.

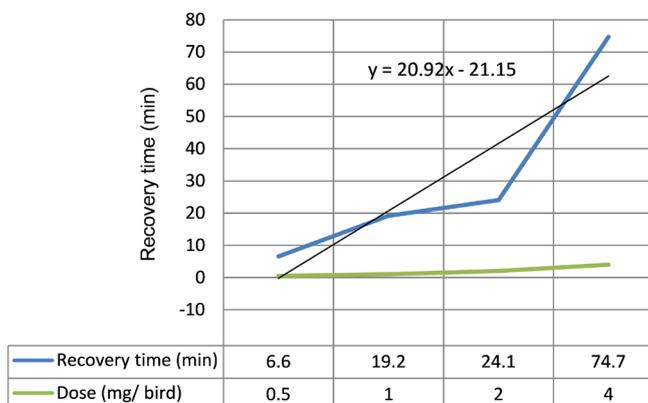


Figure 2. Recovery* from ketamine-induced anesthesia in 2-day-old Hisex White chicks (MS Excel). *Mean time; n = 10.

Ketamine is recognized as a suitable injectable general anesthetic in a wide range of avian species with a wide margin of safety in most of these species [1] [2] [3] [4]. Several undesirable effects such as muscle rigidity, opisthotonus, violent and/or prolonged recoveries, however, have been attributed to its use in a number of these species [11] [12] [13]. The drug has, therefore, been recommended to be applied in combination with other injectable agents to reduce or eliminate such untoward effects [14] [15]. Applying the above formulae, the results indicate that doses at 43.77 - 47.74 mg/kg would produce anesthesia with onset within 74 - 77 sec, and recovery as early as 12 - 15 min. It has been noticed, however, that the recovery was convulsive especially in the group treated with the extreme dose of 110.5 mg/kg and where the recovery was exceptionally protracted, lasting 74.7 min (Figure 2). In contrast, results we obtained from an earlier study [16] indicated that recovery from ketamine anesthesia was smooth in chicks of a different breed (Ros) of an age comparable to that of Hisex White when birds were treated with similar drug doses. Smooth recovery was also noticed in 40-day-old White Leghorn cockerels given ketamine hydrochloride i.m. injections at doses of 20, 30 or 60 mg/kg [17]. According to several authors [11] [13] [18], one of the greatest disadvantages of injectable anesthesia is the inter-species variability in the response to therapeutic doses as well as variability within species at the individual level. Whether the rough recovery from ketamine anesthesia reported in the present study in Hisex White is due to a breed difference remains to be verified.

4. Conclusion

Results of a previous study indicated that a dose as high as 51 mg/kg is not toxic to 2-day-old domestic fowl chicks upon i.m injection. The present findings show that doses ranging between 43.77 to 47.74 mg/kg, as predicted mathematically, would produce anesthesia with onset within 74 - 77 sec, and a recovery within 12 - 15 min. It is concluded that ketamine has the potential for application as a general anesthetic for domestic fowl chicks for bursectomy. Critical clinical tests are necessary to evaluate further the performance of the drug when administered to young chicks.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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