Ontogeny of IgA in Normal and Neonatally Bursectomized Chickens, with Corroborative Data on IgY and IgM[1] (37294)

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A probable analogue of mammalian IgA which is antigenically distinct from the two previously described immunoglobulins IgM and IgY (IgG) has recently been identified in the chicken (1–4). We have previously reported that IgA is the predominant immunoglobulin in duodenal, bile, and tracheo-bronchial secretions of the chicken. The molecular weight of IgA in bile is ~ 385,000. While serum IgA exists predominantly in a polymeric form having a molecular weight of > 200,000 there is also a form of lower molecular weight (~ 170,000). IgA is not present in the serum of newly hatched chicks and thus is probably not passively transferred from the yolk to the chick as is IgY (4). The purpose of this communication is to describe the ontogeny of serum IgA in normal and neonatally bursectomized chicks in comparison with IgM and IgY.

Materials and Methods. Dekalb 161 strain white leghorns (Pan American Hatcheries, Hammond, LA) were hatched and reared in our laboratories. Neonatal bursectomy was performed within 18 hr of hatching. Chicks were bled at intervals by jugular puncture and serum IgA, IgM and IgY concentrations were determined by single radial immunodiffusion in agarose using heavy chain specific antisera as described previously (4, 5). The sensitivity of the assay was 0.02 mg/ml for IgA, IgY and IgM detection.

Results. The mean serum IgY levels in 8 normal and 13 bursectomized (Bx) chickens are shown in Fig. 1a. Maternally derived serum IgY was rapidly catabolized over the first 2–3 wk to a minimum of 1.2 mg/ml in the normal chickens. Subsequently serum IgY increased due to synthesis by the neonates to a maximum of 4.9 mg/ml at 56 days, and a mean concentration > 3.4 mg/ml was maintained for the remaining 38 days of observation. IgY levels in Bx chickens reached a minimum of 0.4 mg/ml around Day 26 and subsequently increased approximately in parallel to the increase in normal chickens to a maximum of 4.0 mg/ml on Day 56 when the bursectomy phase of the experiment was terminated.

IgM was detectable in 7/8 sera from normal 4-day-old chicks with a mean concentration of 0.04 mg/ml and increased rapidly to 1.1 mg/ml on Day 40 (Fig. 1b). Subsequently the rate of increase was much less and by Day 94 the mean IgM concentration appeared to have stabilized at ~ 1.4 mg/ml. IgM was not detectable in the sera of Bx chicks at 4 days of age but was present with a mean concentration of 0.07 mg/ml at 12 days. Subsequently IgM levels in Bx chicks increased approximately in parallel with the values in normal chicks but instead of leveling off after Day 40 continued to increase to a mean value of 2.5 mg/ml on Day 56.

IgA was undetectable in normal sera up to 8 days of age but was present in all sera at 12 days with a mean concentration of 0.07 mg/ml (Fig. 1c). IgA could be detected in some sera by Day 10 with a mean concentration of ~ 0.02 mg/ml. The IgA concentration increased rapidly until around Day 26 when it began to level off and approximately the same content was maintained from

[1] Supported in part by National Science Foundation Grant GB-31001, a grant from the John A. Hartford Foundation, Inc., and a grant from the National Tuberculosis and Respiratory Disease Association.

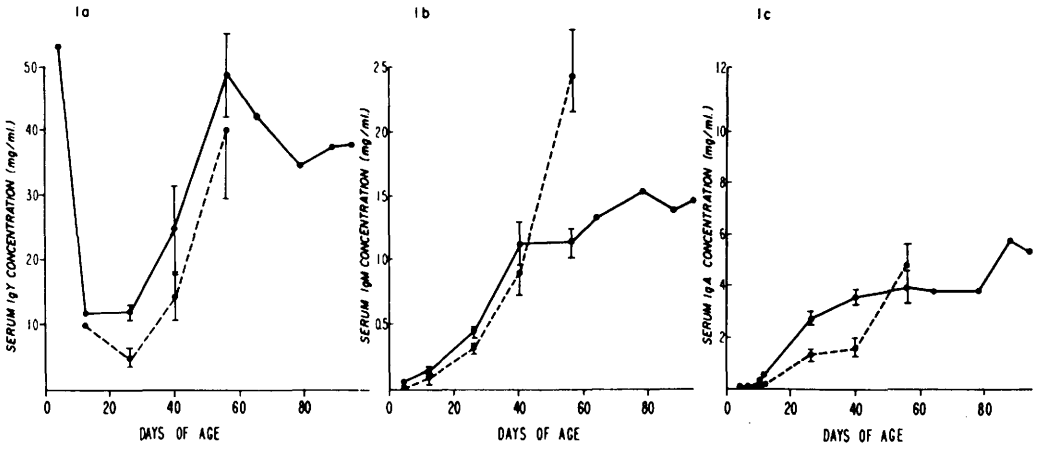

FIG. 1. The ontogeny of IgY, IgM and IgA in normal (●—) and bursectomized (● - -) chickens. (a) Serum IgY; (b) serum IgM; (c) serum IgA. Vertical bars represent ± the standard error of the mean.

Day 40 (0.36 mg/ml) through Day 78. From Days 78 to 87 a sharp increase to 0.59 mg/ml was measured and this approximate level was maintained to the end of the experiment. Serum IgA levels in normal chickens continued to increase beyond 94 days of age. The mean IgA concentration in sera from 19 normal chickens at 115 days of age was 0.67 mg/ml.

Only 6 of 13 Bx chicks had detectable IgA on Day 12, with a mean concentration of ~ 0.02 mg/ml. The subsequent rate of increase was less than in normal chickens. On Day 40 the IgA values in the Bx birds ranged from 0.02 to 0.26 mg/ml (mean = 0.16) and in the normal birds from 0.25 to 0.47 mg/ml (mean = 0.36). Following Day 40 there was a rapid increase of IgA in Bx chickens so that by Day 56 there was no difference between Bx and control levels.

Discussion. The present results concerning IgM and IgY ontogeny in normal and Bx chickens are compatible with previous reports by others who have described a delayed onset of IgY synthesis (6) and a supranormal production of IgM (7) in Bx chickens.

Our results concerning IgA ontogeny indicate that IgA was first detectable in normal serum on Day 10, at least 6 days later than IgM. The IgA concentration increased rapidly to around Day 26, then began to level off. This stabilization preceded the leveling off of the IgM concentration, which occurred after Day 40, and coincided with the period when IgY increased most rapidly. However adult levels of IgA (~ 0.67 mg/ml) were not attained until after 94 days of age. Thus IgA in chickens as in most mammalian species reaches adult levels relatively late compared with the other major immunoglobulins (8).

Neonatal bursectomy caused a transient depression of serum IgA during the first 40 days of life followed by a rapid increase to normal levels. Unfortunately the Bx animals were sacrificed on Day 56 and it was not possible to determine whether or not this rapid increase would continue to supranormal levels.

We have previously found that treatment of chick embryos with anti-μ followed by neonatal bursectomy produced animals lacking IgM, IgY and IgA (5). In the latter study some chickens suppressed with a suboptimal embryonic dose of anti-μ produced IgM but not IgA, but in no case was IgA present and IgM absent. Moreover, some chickens suppressed by repeated injections of anti-μ and not bursectomized produced IgM but had long-lasting deficits in IgY and IgA. It is thus apparent that IgA production is bursa dependent and the results with anti-μ indicate that IgA-forming cells may be descendants of cells which formerly made IgM.

Several attempts to selectively suppress IgA formation by embryonic or neonatal injections of anti-α in conjunction with neonatal bursectomy have failed. This may be due to insufficient dosage or improper timing of the treatment, but could also indicate that IgA-forming cells arise from IgM- or IgY-forming precursors which would not be affected by treatment with anti-α.

Summary. The ontogeny of IgA in chickens was similar to that of mammalian species in that adult levels were attained relatively late compared with the other major immunoglobulin classes, namely IgM and IgY. Surgical bursectomy at hatch resulted in a delayed appearance of serum IgA in subnormal levels for the first $\sim$ 40 days of life. By Day 56 the serum IgA levels of normal and Bx birds were similar.

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Received Jan. 18, 1973. P.S.E.B.M., 1973, Vol. 143.