Feeding chicks exclusively via implanted plastic fistulas

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Abstract

Surgical introduction of a plastic tube into the crop permits remote injection of all fluids and nutrients, beginning before any normal feeding has occurred. Total alimentary intake can be controlled precisely, and hunger and thirst can be manipulated at will by this technique. Chicks raised by tube-feeding, never eating or drinking, appear to grow adequately.

The technique described below was devised to aid in studying various motivational and experiential factors in early psychological development. The eventual goals of this work are to explore with chicks such problems as the role of hunger and thirst needs in the development of activity cycles, exploratory behavior and generalized learning ability.

Essentially, the method of preparing chicks consists of fastening one end of a plastic tube inside the esophagus and passing the other end of the tube through the skin to the outside. Nutrients in semi-liquid form can then be injected directly into the crop through a light, flexible external tube attached to a syringe or pump outside the living cage.

In greater detail, the method is as follows. Leghorn chicks (Hy-Line 934) are obtained from a commercial hatchery within 24 hr. of hatching. A 100 mm section of PE 205 plastic tubing (Clay Adams) is heat flared to form a 4 mm flange at one end. Chicks are anesthetized, an incision is made in the neck and the tube is introduced surgically so that the flared end is just cranial to the crop. The other end of the tube passes under the skin to the top of the head where approximately 25 mm projects out.

About 48 hr. after hatching, the implanted tube is attached to a heat formed spiral of the same material suspended overhead, connected to a pump or syringe.

Of a number of food and water formulas that have been tried, one has proved most successful for healthy maintenance over long periods of time.²

A variety of syringe pumps and finger and rotary tubing pumps have been used. None has proved dependable over long periods and it is necessary to monitor the pump or to use a hand operated syringe to move the mixture reliably.

Despite frequent pumping irregularities, including interruptions of feeding and occasional over-feeding, two chicks were maintained by pump feeding for 30 days, two for 51 days and one for 71 days. None ever consumed food or water by mouth before or during these periods.

However, those that survived the pump-feeding experiments were in every case underweight by the 10th day, while those that received enough to assure that they did not fall below controls in body weight always succumbed by the 10th day. This raised the possibility that young chicks may not tolerate injections of quantities of food large enough to sustain normal growth.

To test this hypothesis, a group of 10 Ss was set up, tube-fed the diet² approximately every 24 min., 18 hr. a day for 10 days, by hand syringe feeding. Amounts tube-fed were determined at each feeding according to the fullness of the crop. Nothing was tube-fed during the other 6 hr. and food and water were never offered to be consumed by mouth.

On the supposition that environmental stimulation paired with tube-feeding might be important for optimal utilization of food injections, home cage doors were opened before every tube-feeding, a stimulus panel was introduced and a few pecks were elicited by pushing the chick's head against the panel during the tube-feeding.

One unoperated control group of 10 chicks was given granular Chick Startena (Ralston Purina Co.) in conventional feeders, with separate waterers 18 hr. per day, with no access to food or water in the remaining 6 hr. The other unoperated control group of 10 Ss had access to food and water 24 hr. per day.

The tube pulled out of one S on the fourth day. Figure 1 reveals that the nine remaining hand syringe fed Ss gained more in body weight during the 10 day period, by comparison to either unoperated control group. All appeared healthy and vigorous throughout the experiment.

Fig. 1. Mean body weight of tube-fed Ss, 18 hr. fed controls and 24 hr. fed controls in the first study in which the syringe feeding method was employed.

The excellent development of the hand syringe fed Ss indicated that the poor results with pump-fed birds were probably due to the very irregular delivery of food, which was the rule when the pumps were used. The main alternative explanation was that some special feature of the hand syringe feeding procedure is essential for adequate growth and development. Stimulation during tube-feeding and precise regulation of amounts tube-fed according to the fullness of the crop were both included in the hand syringe study but not in the pump studies.

In order to determine which of the procedures used in the hand syringe feeding study were essential, another hand syringe feeding study was carried out. This study employed 16 Ss divided evenly among four groups, all tube-fed 18 hr. per day. Four "no stimulus" Ss received the diet² from a cooled reservoir, as before, but lived in closed boxes and received no environmental stimulation when tube-fed. Four "warm diet" Ss received the same diet kept at 35° C., to determine the effects of some degree of spoilage of the diet. Four "milk diet" Ss received a milk-based diet which was of a less heavy consistency and moved more easily through the tubes. The milk diet was kept in a cooled reservoir and the Ss of this group received stimulation during tube-feeding. Finally, four "level dose" Ss were fed the diet from a cooled reservoir, with stimulation, but received the same amount at every feeding, regardless of the condition of the crop, over a 9 hr. period. The amount tube-fed this group was varied only at the start and again half way through the 18 hr. of tube-feeding each day.

One S in the milk-diet group died, apparently of a yolk sac infection resulting from an improper anesthetization procedure. Body weight gain among the other 15 tube-fed Ss compared favorably with weight gains among the unoperated controls. Measurements of leg and wing length indicated that the tube-fed Ss equalled 24 hr. fed controls, while 18 hr fed controls were exceeded by both of the other groups in body size. All four tube-fed subgroups gained at about the same rate.

Thus it appears likely that neither precise regulation of amounts tube-fed according to the momentary condition of the crop nor environmental stimulation at the time of tube-feeding is necessary for adequate growth. Spoiling the diet by warming it or including milk to make the diet thinner in consistency also had no obvious ill effects.

After the 10th day the 15 surviving tube-fed Ss were disconnected from their tubes and set up as groups of four Ss with granular Chick Startena in conventional feeders and separate waterers. Subsequent body weight gain was the same as that of unoperated controls, after an initial drop to the level of the 24 hr. fed controls. The initial weight loss after the cessation of tube-feeding may be explained on the basis that tube-fed chicks were totally unpracticed in normal eating and drinking and required some time to learn these behaviors. Since the tubes were left in place after tube-feeding ended, it is obvious that tubes may be installed in a way that does not interfere with normal eating and drinking.

Chicks prepared in the manner described above have been employed in a series of studies designed to analyze the effects of internal stimulus components and consumatory stimulus components in the reinforcement effects associated with feeding (Sterritt & Smith, 1965).

The method may be of more general utility, e.g., in physiological studies of nutrition and growth, in addition to its usefulness in behavioral research.

References

- STERRITT, G. M., & SMITH, M. P. Reinforcement effects of specific components of feeding in young leghorn chicks. *J. comp. physiol. Psychol.*, 1965, in press.

Notes

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2. 100 g Purina Chick Startena (Ralston Purina Co.) micromilled to approximately 80 mesh fineness, 250 ml water, 1 ml Paladac (Park-Davis), 0.1 ml Aqua Sol E (U.S. Vit.), 0.5 g Na Benzoate.