

*LEMON-JUICE THERAPY: THE CONTROL OF
LIFE-THREATENING RUMINATION IN
A SIX-MONTH-OLD INFANT¹*

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Chronic, life-threatening rumination was eliminated in a six-month-old infant by squirting a small amount of lemon juice into her mouth whenever rumination or its precursors were detected. A brief suspension of this therapy demonstrated its crucial role. Lemon-juice therapy offers a practical and acceptable alternative to other therapies for rumination, namely electric shock and massive noncontingent attention. However, since this study is limited to a single case, claims as to the effectiveness of this therapy across children are premature.

Chronic rumination is a behavior of considerable clinical significance in infants. Kanner (1957, p. 484) defined it as . . . "bringing up food without nausea, retching, or disgust. The food is then ejected from the mouth (if liquid, allowed to run out) or reswallowed". This behavior appears to be "voluntary", that is, children actively engage in behaviors that induce the rumination, *e.g.*, infants are observed to strain vigorously to bring food back to their mouth. The incidence of rumination in the general population is unknown, since it is typically confused with food allergies, especially to milk. Serious clinical problems, such as malnutrition, dehydration, and lowered resistance to disease, may prompt a life-threatening condition if significant amounts of food are lost. Kanner (1957) noted that 11 of 52 ruminating babies in one group died; Gaddini and Gaddini (1959) reported death in one of six

cases. Within the first author's experience, one of eight referred ruminating children died.

Treatment procedures for infantile rumination are diverse. Kanner (1957) noted the use of surgery, drugs, mechanical devices (*e.g.*, chin straps, esophagus blocks), thickened feedings with farina, and very high levels of attention, with the last treatment producing the most positive effects. Typically, an adult is assigned to provide the ruminating child with his undivided attention for at least 8 hr a day. Fullerton (1963), Gaddini and Gaddini (1959), Hollowell and Gardner (1965), Menking, Wagnitz, Burton, Coddington, and Sotos (1969), Richmond, Eddy, and Green (1958), and Stein, Rausen, and Blau (1959) all reported reductions in rumination and increases in weight coincident with the onset of high levels of attention. One difficulty with this treatment is that cessation of rumination is usually slow. Hollowell and Gardner (1965), Menking *et al.* (1958), and Stein *et al.* (1969), reported that rumination gradually disappeared over four to eight weeks. In contrast, Fullerton (1963) reported cessation in four days for one infant.

Since rumination is often life-threatening, a more rapid treatment has been sought. White and Taylor (1967) apparently were the first to use contingent electric shock for rumination. Although they did not report adequate quanti-

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tative data, they concluded that shock did significantly interfere with rumination. Galbraith, Byrick, and Rutledge (1970), Lang and Melamed (1969), and Luckey, Watson, and Musick (1968) reported cessation of vomiting and rumination within two to four days when shock was used. Kohlenberg (1970) shocked stomach tension that preceded vomiting. Elimination of stomach tension and vomiting occurred within one day. Bright and Whaley (1969) first attempted to eliminate regurgitation and vomiting in a retarded boy with Tabasco brand peppercorn sauce before resorting to shock. The peppercorn sauce was sprinkled on the vomitus. Very substantial reductions in regurgitation and rumination resulted, but neither was eliminated. Shock then eliminated both behaviors within three days.

The present paper reports the successful treatment of life-threatening rumination in an infant through the use of lemon juice as a punisher. Even though the infant's physical condition was serious, the authors were reluctant to resort to shock, since they felt that it might jeopardize cooperation with the pediatrics ward staff. Further, successful treatment might require the use of shock after hospital discharge by the parents, but there was evidence of family instability and neglect of the child.

METHOD

Child

Sandra was born on September 6, 1971, to an economically marginal, rural family after an unplanned, uncomplicated pregnancy. She was delivered at home by a nurse-midwife and weighed eight pounds. The next day she was admitted to the University Hospital for feeding difficulties associated with a cleft palate and lip. These difficulties were rectified with gastric tube feedings, and Sandra was discharged to her aunt nine days after admission. During the next four months, weight gain was below average, although neither mother nor aunt reported any further feeding difficulties. There were, however, indications of neglect, and Sandra was cared for during this

period by a number of different individuals, including neighborhood children.

Sandra was admitted to the University Hospital for the second time on February 29, 1972, at the age of about six months by the aunt because of a failure to gain weight associated with rumination. On examination, she was emaciated and unresponsive to her environment. There was very little grasping of objects, no smiling, no babbling, no gross movements, and some crying. She was primarily lethargic and lay passively in her crib. Exhaustive medical examinations and laboratory analyses revealed no organic cause for her difficulties. Her weight, however, was falling rapidly and was below her birth weight and below the third percentile for infant girls. Malnutrition and dehydration were pressing problems, and death, resulting from possible complications, was a distinct possibility.

Measurement of Rumination

Feeding consisted of a commercially prepared formula every 4 hr. Immediately after each feeding, ruminative behavior would begin. Sandra would open her mouth, elevate and fold her tongue, and then vigorously thrust her tongue forward and backward. Within a few seconds milk would appear at the back of her mouth and then slowly flow out. This behavior would continue for about 20 to 40 min until she apparently lost all of the milk she had previously consumed. No crying or evidence of pain and discomfort was observed during this behavior. Rumination could be interrupted by touches, pokes, or mild slaps, but would resume immediately.

This rumination behavior was recorded through the use of the 10-sec-block method (Allen, Hart, Buell, Harris, and Wolf, 1964). A check was made in each 10-sec interval for any occurrence of tongue thrusting with her mouth open. The tongue did not have to be elevated or folded, nor did milk need to be visible. A check of observer agreement was made with the help of an independent observer on one occasion in each of the four experimental condi-

tions. Observers were about 3 ft (0.9 m) apart in full view of each other. Data sheets could not be readily seen and observers would mark each interval even if no coded behaviors occurred. An agreement was scored if both observers checked the occurrence of rumination in corresponding time intervals. A disagreement was scored if only one observer had scored rumination in an interval. Agreements on the nonoccurrence of rumination were not included in these computations. The four checks on the recording of rumination yielded indices (agreements divided by the sum of agreements plus disagreements) of: 91% (42/46), 100% (11/11), 95% (75/79), and 75% (12/16).

Sandra was observed for 20 min immediately following a feeding. The observational period started when the bottle was removed from her mouth for the last time. The period ended 20 min later whether or not rumination was continuing. During the first three experimental conditions, Sandra was observed after four to six feedings daily. During the final condition, observation was reduced to one to three times daily.

Sandra was weighed daily at roughly the same time in the morning while clothed only in diaper. The same scale was used throughout this study.

Procedure

Baseline conditions involved the usual circumstances and conditions of care given on the pediatrics ward. No one individual was assigned to care for Sandra. Rumination was not treated systematically, save for some intermittent mild slapping by ward staff when rumination was observed. However, no slapping was allowed during the five observation periods during the baseline condition or at any other time subsequently.

Lemon-juice therapy was initiated on March 15. This consisted of squirting about five to 10 cc of lemon juice (unsweetened Realemon brand) into her mouth with a 30-cc medical syringe as soon as vigorous tongue movements were detected. At the occurrence of each instance of tongue movements, her mouth was filled with

lemon juice. For the next 30 to 60 sec, no more lemon juice was administered, although tongue movements might persist. Lemon juice was so omitted because it tended to produce some lip and tongue smacking. Then, lemon juice was re-applied, if ruminative tongue movements persisted or if a new episode started. During these 30- to 60-sec periods, lip and tongue movements continued to be scored as ruminative behavior. Ward staff were carefully instructed in the use of lemon juice by observing the authors and by using the lemon juice while the authors were present to give feedback. Lemon juice was to be used at any time ruminative tongue movements were observed, whether or not the authors or observers were present. This responsibility was assigned to one of two specific ward staff for each shift, in addition to their normal duties. Reports from other ward staff and observation by the authors and observers indicated that the responsible staff correctly used the lemon juice.

After 16 feedings with lemon-juice therapy, the use of lemon juice was suspended for 8 hr, during which two feedings occurred. Lemon-juice therapy was then resumed immediately following the next feeding.

During the initial lemon-juice condition, informal observation by several individuals suggested that the amount of attention given Sandra by the ward staff began to increase spontaneously. To help control for this concurrent change, the ward staff were instructed to continue this relatively higher level of attention throughout the reversal condition and into the resumption of lemon juice. The authors verified that the staff continued high levels of attention by casual observations during the 20-min postfeeding periods and at other times of the day.

After eight weeks of lemon-juice therapy in the hospital, Sandra was discharged to the care of foster parents, who were carefully instructed in the use of the lemon juice. Five months later, custody was returned to her biological parents. Sandra was seen at seven follow-up visits over a 12-month period. At 10 months posthospitalization, the Denver Developmental Screening Test

and the Vineland Social Maturity Scales were administered.

RESULTS

The baseline of Figure 1 shows that the per cent of 10-sec intervals of rumination was between 40% and 70% for the first 20 min following a feeding. Her weight was falling rapidly (baseline, Figure 2).

The initial use of lemon juice decreased rumination and vigorous tongue movements to below 10% of the 20-min period. The number of applications of lemon juice during these periods is shown on Figure 1. Weight ceased to fall and stabilized at just under eight pounds. The brief omission of therapy prompted a return to high levels of rumination (Figure 1). The resumption of the use of lemon juice again reduced rumination. After the twelfth day (Figure 1), no regurgitated milk was ever observed in her mouth. The slight rates after this time were due to what appeared to the observers as normal lip and tongue movements. However, since these met the definition of rumination, they were scored as such. These normal mouth and tongue movements were difficult for the ward staff to detect and, consequently, lemon juice was applied inter-

mittently for them. After Day 33, the use of lemon juice was dropped altogether for them.

Weight began to increase and continued to do so until discharge (Figure 2). There was a temporary reduction of weight gain, when the cleft lip was surgically repaired. Sandra was discharged with a weight of 12 pounds and five ounces, a 54% increase from pretreatment weight.

Table 1 gives the number and duration of rumination episodes observed during the 20-min postfeeding periods for each experimental condition. An episode was defined as rumination occurring on one or more consecutive 10-sec intervals followed by one or more intervals in which rumination was not scored. Duration was the number of consecutive scored intervals of rumination in an episode multiplied by 10 sec. The table shows that the reduction in rumination level seen in Figure 1 was due to both a reduction in the number and in the duration of rumination episodes. It should be noted that these numbers and durations of rumination episodes are only estimates because interval recording does not permit precise rate and duration measures.

Weight on follow-up checks continued to increase. Six weeks after discharge, the foster mother reported two brief episodes of rumina-

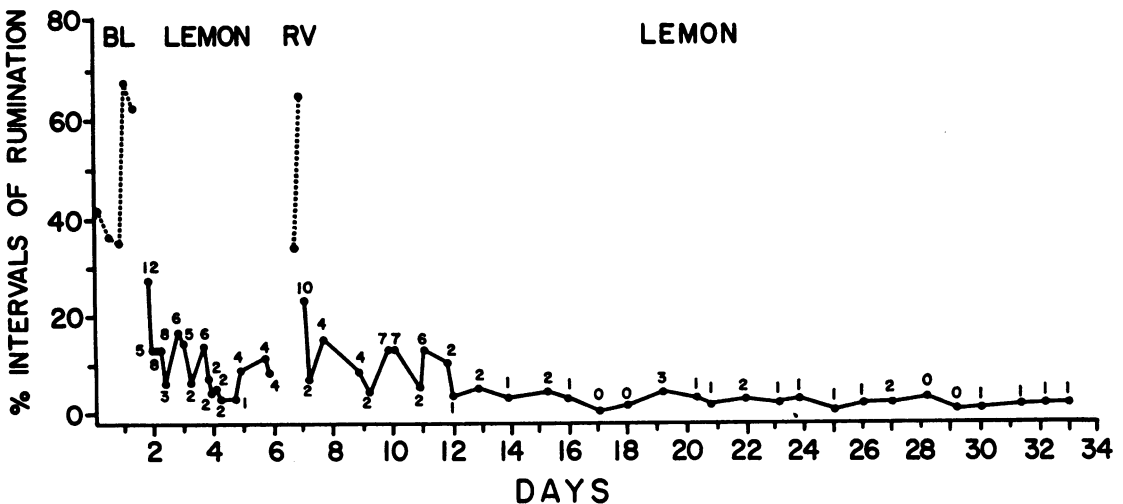


Fig. 1. Per cent intervals of Sandra's rumination during the 20-min postfeeding periods during baseline (BL), lemon-juice therapy periods (LEMON), and brief cessation of therapy (RV). The numbers over the data points refer to the number of applications of lemon juice after each feeding session.

Table 1

Mean number and duration of rumination episodes for each experimental condition.

Condition	Mean Number	Mean Duration (seconds)
Baseline	9.6	60.6
Lemon-juice therapy	4.5	33.4
Reversal	6.0	106.0
Re-instatement of lemon-juice therapy (first half)	2.8	26.4
Re-instatement of lemon-juice therapy (second half)	0.9	9.8

tion, which were followed immediately by the use of lemon juice. Sandra was returned to her natural parents in October, despite the reservations of the authors. Eight months after discharge, a severe attack of gastrointestinal difficulties associated with vomiting was reported. Rumination did not recur and lemon juice was not used. Weight on one-year followup was just over 24 pounds, which placed her at about the twenty-fifth percentile for infant girls.

Concurrent with the reduction of rumination and with the increase of weight, changes in other behaviors were observed in the hospital. Sandra became more attentive of adults about her, smiling appeared, and she began grabbing at objects near her. Babbling also appeared for the first time. These behaviors continued to increase. During the follow-up visits, it was evident that motor, social, and speech development had continued. The Denver Developmental Screening Test and the Vineland Social Maturity Scale, given 10 months after discharge when Sandra was about 19 months old, indicated only a slight developmental delay.

DISCUSSION

Although the case studies cited in the introduction of this paper suggest two different treatment modes for infantile rumination, namely massive attention and electric shock, there are questions as to the effectiveness of these treatment procedures. A treatment procedure can be

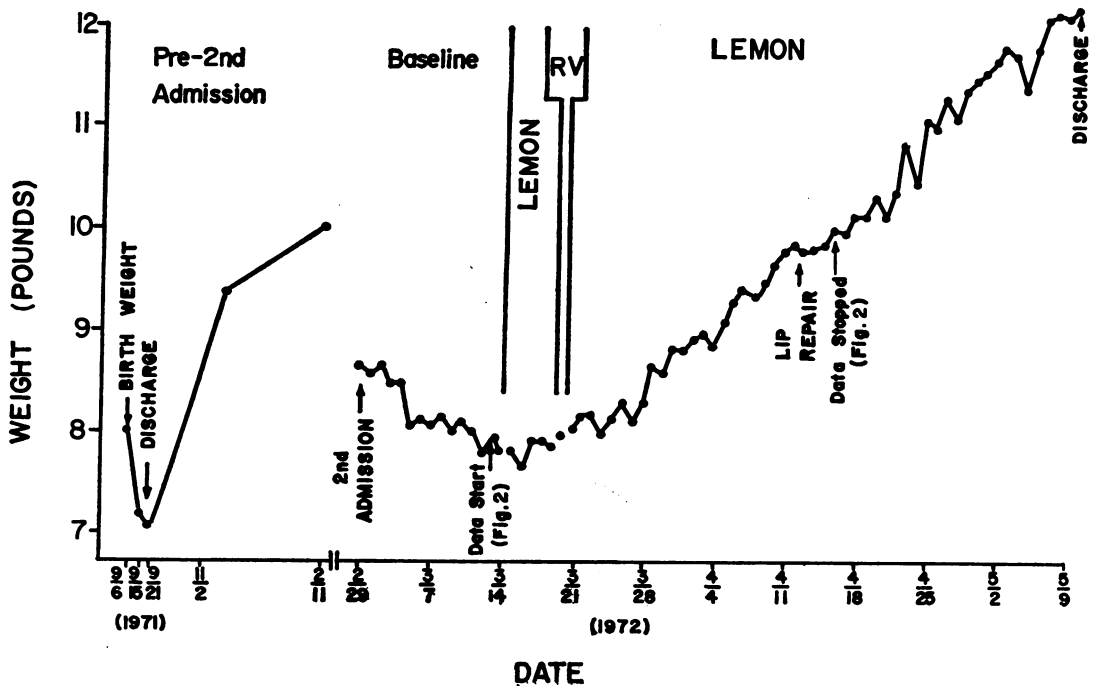


Fig. 2. Sandra's weight before admission for rumination (before second admission), during baseline before lemon-juice therapy, during lemon-juice therapy (LEMON), and during brief cessation of therapy (RV). Data shown in Figure 1 were obtained between March 13 and April 16, 1972.

demonstrated unequivocally by either: (1) omitting the treatment after its initial use and then re-applying it, or (2) using a multiple baseline design where the treatment procedure is applied sequentially to different patients or to different behaviors within a single patient. Unfortunately, none of the above cited studies utilized either of these designs. Rather, the treatment procedures were applied after an initial period of observation. No further manipulations of the treatment procedures were attempted, and possible contaminations by other time-related factors are not eliminated. Luckey *et al.* (1968) is a partial exception because rumination and vomiting in their patient recurred after contingent shock had apparently eliminated it. Shock was again used, and vomiting again rapidly disappeared.

Although the brief omission of lemon-juice therapy demonstrated its critical role, the question arises as to the critical role of the lemon juice itself, since the therapy has several components. Other contributing factors may be the interruption of the ruminative behavior, the forceful injection of a fluid into the mouth, the temperature difference between the room-temperature lemon juice and the mouth fluids, and the attention accompanying the administration of the lemon juice. This case study does not attempt an analysis of the differential role of these components. However, subsequent preliminary work with other ruminating children suggests a central role for lemon juice *per se*.

One major strength of behavioral techniques has been the ability of paraprofessionals to use them effectively. Shock, however, as a prime treatment tactic for rumination and vomiting does not lend itself to use because of the pain and suffering it entails. Even when used, some individuals may not use the shock as consistently and often as is initially necessary for it to be effective. Related to this minimal social acceptance is the problem of potential abuse. Paraprofessionals should not be trained in the use of shock when there is any suspicion of possible abuse or neglect. Consequently, shock is limited to use by professional staff in restricted settings,

and it will be avoided altogether by some institutions and agencies.

The use of lemon juice as a punisher avoids these problems. Lemon juice caused only mild discomfort, if any, to the infant, and the pediatric staff were not adverse to its use. Further, abuse would be difficult, if not impossible, and its use could be taught to most parents without fear. However, the evaluation of the effectiveness of lemon-juice therapy is limited to this one case. Whether the therapy will prove effective with other ruminating children in other settings in differing circumstances remains to be demonstrated.

Two medical complications may arise from the use of lemon juice therapy. First, since lemon juice is acid, it will irritate the interior and immediate exterior of the mouth. This irritation is minimal and disappears rapidly as the use of lemon juice decreases. Second, aspiration of lemon juice into the lungs is a possibility with serious medical complications resulting. The risk of aspiration can be minimized by keeping the child's head upright or down, not back, when the lemon juice is injected, by reducing the amount of lemon juice injected, and by minimizing the force with which the lemon juice strikes the inside of the mouth. Neither aspiration or gagging were ever observed with Sandra.

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