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ABSTRACT

Irritability levels and activity reactivity to aversive tactile stimuli were compared for 144 full-term neonates and 191 preterm infants. Irritability ratings increased across the five trials both during and post stimulation for full-term females and males and for preterm females, but not for preterm males. Activity ratings decreased across trials during stimulation for all groups except preterm males, and post stimulation for all groups. Females were more irritable than males during stimulation and full-term infants were more active than preterm infants on the initial trial. No other sex or term group differences were observed during or post stimulation. Findings have implications for future studies of infant brain development and stimulation. (Author/AA)

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Preterm Infants' Responses to Aversive Stimuli

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ABSTRACT

Irritability levels and activity reactivity to aversive tactile stimuli were compared for 144 fullterm neonates and 191 preterm infants. Irritability ratings increased across the five trials both during and post stimulation for fullterm females and males and for preterm females, but not for preterm males. Activity ratings decreased across trials during stimulation for all groups except preterm males, and post stimulation for all groups. Females were more irritable than males during stimulation, and fullterm infants were more active than preterm infants on the initial trial. No other sex or term group differences were observed during or post stimulation. Both degree of irritability and activity increased from the stimulation to the post-stimulation periods. There were significant correlations between irritability during and post stimulation, and between activity during and post stimulation. Findings are discussed in terms of patterns of reactivity to repeated presentations of aversive tactile stimuli, the contrast in direction of effects across trials for irritability and activity, cumulative effects across trials in response to aversive stimulation, and sex and term differences.

INTRODUCTION

Temperament and behavioral reactivity to aversive stimulation have been demonstrated to be related to the integrity of the central nervous system. One area of reactivity that has received attention in the neonatal period has been reactivity to tactile stimulation. Strong evidence that neonatal reactivity to tactile stimuli reflects stable aspects of behavior comes from studies that have demonstrated relations between the neonatal reactivity and later infant measures. The present study evaluated the neonate's response to an aversive, but non-tissue-damaging tactile stimulus; specifically, the presentation of a cold disc on the neonate's thigh. This procedure has been found to describe reliable individual differences in early reactivity to aversive stimuli, and has been incorporated into larger assessments of individual differences and neonatal temperament.

Behavioral reactivity to this procedure was evaluated in fullterm and preterm infants. It is well established that preterm infants are at high risk for developmental disabilities when compared to fullterm infants. It also has been demonstrated that there are temperament and other behavioral differences between fullterm and preterm infants in the neonatal period. One area still to be explored for the preterm infant is the ability to process, respond appropriately to, and adapt to, aversive tactile stimuli. Behavioral reactivity to a series of presentations of the cold disc by the fullterm infants would describe individual differences in adaptation to such aversive stimuli. A comparison of the preterm infant's reactivity to such stimuli with that of the fullterm infant would provide additional insight into the early organization of behavior for this high risk group. For this purpose, irritability and activity in response to the cold disc were compared for fullterm and preterm infants.

METHOD

Subjects

The sample included 70 female and 74 male fullterm infants, and 108 female and 83 male preterm infants. Mean birth gestational age for the preterm infants was 34.46 weeks (range: 25 weeks to 37 weeks). The infants were tested at the time of medical stability and just prior to discharge from the hospital. Mean test chronological age for the fullterm infants was 3.33 days (SD = 1.76) and for the preterm infants was 15.38 days (SD = 13.94). (Three infants were tested beyond 45 days of age.)

Procedure

Infants were assessed in a room off the hospital nursery while in a quiet, awake behavioral state. A stainless steel disc, 6.5 cm by 3.8 cm, was immersed in ice water for three minutes and then placed on the infant's left thigh for five seconds. Recordings were made of degree of irritability and activity during the five-second placement and for the five-second period following the removal of the disc from the thigh. Irritability was rated on a five-point scale ranging from "1" not irritable to "5" crying intensely. Activity was rated by number of limbs moved (0 to 4) together with vigor of movement (small = 1, moderate = 2, intense = 3).

The procedure was repeated for five trials. The infant was required to be quiescent before each trial, and the disc was placed in the ice water between trials. The interstimulus interval was 60 seconds. If the infant was irritable, soothing attempts were made before the next trial. Infants who were not able to be soothed within three minutes did not receive further trials. Five trials were completed for 52 female and 62 male fullterm infants and 93 female and 70 male preterm infants. There were no significant differences between term and/or sex groups in number of trials completed. For infants who became irritable, latency to irritability and latency to soothe, in seconds, also were recorded.

RESULTS

Separate 2 x 2 (term x sex) repeated measures multivariate analyses of variance (MANOVAs), with either irritability during, irritability post, activity during, or activity post for each of the five trials as the repeated measure, were computed. Means and standard deviations by term and sex are presented in Table 1 for irritability, and in Table 2 for activity.

Repeated Measures

The first question to be addressed was whether there was a pattern of responses across the five trials. The results of the repeated measures analyses indicated that there was a significant main effect for irritability both during and following stimulation [F (4,270) = 5.70, $p < .0002$; and F (4,270) = 10.64, $p < .0001$, respectively]. During stimulation, there was an increase in irritability across trials for the total sample of fullterm infants, demonstrating that there was a pattern of response to repeated presentations of aversive tactile stimuli [F (4,110) = 2.38, $p < .05$]. A similar increase in irritability across trials was observed for the total sample of preterm infants [F (4,159) = 3.85, $p < .005$]. Additional analyses, however, indicated that there was an effect for sex, where preterm females demonstrated an increase in irritability across trials during stimulation, but preterm males did not [F (4,89) = 3.36, $p < .01$; and F (4,66) = 1.19, $p < .32$, respectively]. An effect for sex was not observed for the fullterm group.

Post stimulation, there also was an increase in irritability across trials for the total samples of fullterm and preterm infants [F (4,110) = 6.52, $p < .0001$; and F (4,159) = 6.23, $p < .0001$, respectively]. An effect for sex was observed again: whereas both fullterm females and fullterm males demonstrated this increase in irritability across trials, in the preterm group only the females demonstrated this increase, while the males did not: [Fullterm females, F (4,48) = 2.59, $p < .05$; Fullterm males, F (4,58) = 4.09, $p < .005$; Preterm females, F (4,89) = 7.14, $p < .0001$; Preterm males, F (4,66) = 1.00, $p < .41$].

For activity, there was a significant main effect both during and post stimulation [F (4,270) = 6.85, $p < .0001$; and F (4,270) = 2.80, $p < .03$, respectively]. During stimulation, there was a decrease in activity ratings across trials for the fullterm infants [F (4,110) = 5.45, $p < .0005$]. Similar to the findings for irritability, then, a pattern of response to aversive tactile stimuli was observed when measured by motor activity. The activity pattern, however, demonstrated a decrease in reactivity across trials, in contrast to the increase across trials observed for irritability ratings.

A decrease in activity ratings across trials also was observed for the total sample of preterm infants [F (4,159) = 3.59, $p < .008$]. An effect for sex was observed: again, both fullterm female and fullterm male infants demonstrated this decrease in reactivity, but in the preterm group only the females decreased reactivity across trials, whereas the males did not: [F (4,48) = 2.38, $p < .06$; F (4,58) = 4.37, $p < .004$; F (4,89) = 3.58, $p < .009$; and F (4,66) = 1.86, $p < .13$, respectively].

Post stimulation there also was a decrease in activity across trials. The analyses for term or sex effects for changes in activity ratings post stimulation across trials revealed no significant effects for either.

Group Differences During and Post Stimulation

The next question to be addressed was whether there were term and/or sex differences in irritability and activity during and post stimulation for the five trials. For irritability, there were no effects for term during stimulation or for the five seconds post stimulation. There was, however, a significant effect for sex for irritability during stimulation [F (1,273) = 3.83, $p < .05$], with females (mean = 2.10, SD = 1.49) having higher irritability ratings than males (mean = 1.83, SD = 1.36). There was no effect for sex for irritability in the five second period following stimulation.

The results of the MANOVAs computed for activity revealed that there were no overall effects for term or sex. Univariate analysis revealed, however, that fullterm infants had higher activity ratings during trial 1 than did preterm infants. Although the multivariate analysis was not statistically significant, the result of a univariate analysis in this instance was deemed important because of the potential meaningfulness of differences in infants' initial reactivity to an aversive stimulus based on term status.

During-Stimulation to Post-Stimulation Periods

The relations between irritability during stimulation and irritability post stimulation, and between activity during stimulation and activity post stimulation were examined next. The results of matched *t* tests indicated that, for each trial, both degree of irritability and activity ratings increased from the five seconds during stimulation to the five seconds post stimulation.

For latency to irritability and latency to soothe, few group differences were observed. For latency to irritability, males became irritable more quickly than females on trial 1. Although a few other differences were observed, in general, because the differences between term and sex groups in the latency measures were sporadic, and because there was no pattern in the differences, these latency measures did not appear to add any meaningful information to the main findings of this study.

Correlational analyses were computed between irritability during and post stimulation for each trial, and between activity during and post stimulation for each trial. The results indicated that infants who were highly irritable during stimulation were likely to be highly irritable post stimulation, and infants who were highly active during stimulation were likely to be highly active post stimulation.

CONCLUSIONS

There is a pattern of reactivity to repeated presentations of an aversive, non-tissue-damaging, tactile stimulus in the fullterm neonate. When measured by irritability, ratings increased across the five trials both during the five-second application of the cold disc and for the five seconds following removal of the stimulus. There was a cumulative effect over the five trials, therefore, that was expressed as irritability for the fullterm neonate. When measured by activity, in contrast, ratings decreased across the five trials both during and after application of the cold disc. There appears to be an adaptation in the activity response to an aversive stimulus, even though the overall arousal level of the neonate, expressed through irritability, increased. This contrast in direction of response across trials for irritability and activity may reflect the ineffectiveness of motor activity to remove the stimulus so that more energy is deflected to crying, which serves as a communication of distress.

Similar patterns of reactivity were observed for female preterm infants, but not for male preterm infants. Thus, there was a compounding effect of prematurity and male status that provides a measure of early risk, so that the preterm male infant can be described as less well integrated in the pattern of reactivity to aversive tactile stimuli than the preterm female infant.

Finding no term effects for irritability ratings indicated that, in contrast to responses to less aversive situations, the preterm infant is capable of reaching an arousal level similar to that of the fullterm infant. Finding higher activity ratings during trial 1 for fullterm infants than for preterm infants indicated that initial reactivity in this area for the preterm infant is not on the same level as that for the fullterm infant. That the preterm infant's activity response reached the level of the fullterm infant's in the five seconds following removal of the cold disc on trial 1 demonstrated that the preterm infants were capable of responding on the same level as the fullterm infants, but it took them longer to reach that level.

Table 1

Means and Standard Deviations (SD) for Irritability Ratings by Term and Sex

	Term				Sex			
	Fullterm		Preterm		Female		Male	
Measures	Mean	SD	Mean	SD	Mean	SD	Mean	SD
During								
Trial 1	1.83	1.26	1.83	1.28	1.82	1.28	1.83	1.27
2	2.13	1.55	2.06	1.42	2.24	1.51	1.93	1.43
3	2.22	1.60	2.12	1.49	2.31	1.61	1.99	1.44
4	2.06	1.51	2.03	1.47	2.26	1.53	1.80	1.40
5	2.12	1.60	2.11	1.54	2.24	1.64	1.98	1.47
Post								
Trial 1	1.89	1.31	1.97	1.41	1.91	1.34	1.97	1.40
2	2.24	1.61	2.14	1.47	2.23	1.53	2.13	1.54
3	2.45	1.70	2.16	1.53	2.38	1.63	2.17	1.58
4	2.31	1.64	2.31	1.58	2.49	1.63	2.12	1.56
5	2.51	1.69	2.43	1.70	2.55	1.73	2.36	1.66

Table 2
Means and Standard Deviations (SD) for Activity Ratings by Term and Sex

	Term				Sex			
	Fullterm		Preterm		Female		Male	
Measures	Mean	SD	Mean	SD	Mean	SD	Mean	SD
During								
Trial 1	37.42	7.94	33.82	11.00	34.85	10.26	35.95	9.58
2	35.94	9.44	35.24	9.89	36.43	9.14	34.56	10.20
3	34.34	10.05	32.91	11.65	34.06	10.98	32.92	11.03
4	32.26	11.76	32.67	12.76	33.69	12.11	31.18	12.48
5	32.07	11.95	31.25	12.35	31.60	12.24	31.58	12.15
Post								
Trial 1	37.32	9.46	37.71	9.09	37.16	9.83	37.98	8.54
2	37.79	8.38	37.25	9.89	37.48	9.86	37.49	8.52
3	36.53	9.84	36.35	11.21	36.42	10.79	36.44	10.47
4	35.71	11.53	34.97	12.55	35.83	11.98	34.67	12.28
5	34.80	11.41	35.53	11.10	35.20	11.64	35.26	10.76

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