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Proper nutrition is essential in the care of the infant with cleft lip or palate, as these infants are often plagued with feeding difficulties from birth. This paper reviews recent literature on the many feeding practices in use today and discusses the current trend toward a multidisciplinary approach to treatment for the cleft lip / palate child. It also presents a brief review of experimental animal studies which have implicated nutritional deficiences in the causation of cleft lip / palate.

Introduction

CLEFTS of the lip or palate are among the most common major birth defects. One in every 600 to 700 babies born in the U.S. today has a cleft of the lip and / or palate.[1] Current literature[2] suggests that the number of clefts is increasing. Although among American blacks the frequency is lower, in the Japanese, Chinese, Eskimos, and American Indians it is substantially higher.[3] Also, while there is universal agreement that clefts occur more often in boys, the incidence of isolated cleft palate is reportedly higher in girls.[4]

There are many types of cleft and many degrees of severity: clefts of the lip, the soft palate, the hard palate, the submucosa, and many combinations of these. The cleft can be unilateral, bilateral, or median (rare), and complete or imcomplete (partial).[7] Surgically, there is no single correct way to repair a cleft, as each face will grow differently. Moreover, the timing of treatment depends upon direction, amount, and time of facial growth.[12,13]

Etiology

Both genetic and environmental factors have been demonstrated to play a role in the etiology of clefts. Warkany,[9] in tracing the beginnings of experimental teratology, noted that the prevailing scientific opinion fifty years ago was that most congenital malformations were genetically determined and inherited. Since that time, however, research has implicated evnironmental factors, such as parental age,[10] a maternal history of abortions and stillbirths,[2] and prematurity[11] in the predisposition toward clefting.

Experimental animal studies have shown that a number of physical and chemical agents can disturb development and induce clefting. It was Warkany[14] in 1943 who was first able to produce cleft palates in rats by a riboflavin deficiency. The view today is that a majority of congenital deformities are due to a combination of exogenous factors and a gene pattern which predisposes to malformations.[15] Recently, Roberts and Juriloff[16,17] have supported this theory by show-

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ing a relationship between a cleft palate trait and a riboflavin deficiency in chickens with cleft palate.

In 1959 Deuschle, Geiger, and Warkany[18] produced cleft palates in rats with hypervitaminosis A. In 1967 Myers[19,10] demonstrated *in vitro* that the mechanism for clefting with excess vitamin A was underdevelopment of the palatal shelves so that they failed to meet; the shelves could fuse if they grew enough to meet. This effect was contrasted in the same studies to the action of 6-aminonicotinamide which appeared to involve an interference with the ability of the shelves to fuse. Also in 1967 Chamberlain[21] studied the same effect in rats and showed that cleft palates could be prevented by giving injections of nicotinamide in a two-hour period either before or after the antivitamin was given. In a study by Nanda in 1970,[22] excess vitamin A given along with cortisone produced 100 per cent clefting in the offspring.

Clefting has also been induced in mice by a pyridoxine deprivation[23] and by restraint and deprivation of both food and water during the time of fetal palatal closure.[24,25] L-glutamic acid, on the other hand, has been demonstrated to significantly decrease the incidence of both cortisone-induced and caffeine-induced cleft palate.[26]

Surgical Repair: Current State of the Art

The surgical repair of clefts of the lip (formerly termed "harelip") and cleft palate began almost 1600 years ago, in approximately 390 A.D., when an unknown Chinese surgeon successfully closed the cleft lip of eighteen-year-old Wei Yang-Chi, who subsequently became the Governor General of six Chinese provinces.[27] Fabricius of Aquapendente in 1619 was probably the first to mention that many newborn infants with cleft palates were unable to suck and frequently starved to death as a result. By the eighteenth century, several complicated devices had been developed for holding together cleft lips and filling in palatal perforations of almost any shape or size.[8]

Even thirty years ago the outlook for the child with cleft lip and palate was not optimistic. The stereotypic orofacial cripple of that time often had a case history of thirty or more surgical procedures and was characterized by unintelligible and unpleasant speech, incongruent dental arches, and a midface severly arrested in growth.[28]

But in the 1960s the picture began to brighten with the development of the special cleft palate clinic. By coordinating the services of the plastic surgeon, pediatrician, audiologist, dentist, nurse, orthodontist, otolaryngologist, psychologist, social worker, speech pathologist, and speech therapist, the clinic was able to provide an individualized treatment program designed to achieve the best possible results in the shortest possible time with the least possible trauma to the child. At present, largely because of the successful work of the cleft palate clinic, the prognosis for the child born with cleft lip or palate is more favorable than for any other serious congenital defect.[29]

Feeding and Nursing Care

Before the plastic surgeon can perform his first operation, before the orthodontist can prescribe the first corrective measure, before growth and development progress to a stage where speech production is involved, the baby must be fed and nourished properly. Unless adequate nutrition is provided, the outlook for successful treatment by any specialist is diminished. Particular care is required so that the child will be able to tolerate surgery at an early age.

From the beginning, infants with cleft lip/palate may encounter difficulty with feeding, characterized by inefficient suction, nasal regurgitation, and choking episodes. Individual feedings are often laborious, time-consuming, and anxiety-provoking, with ingested volumes lower than in normal infants and often inadequate,[5,7,12,29-33] The normal child can squeeze the nipple with the lips and maintain suction at the same time during the act of swallowing. However, it is difficult for the child with cleft lip/palate to maintain the pressure needed for sucking on the nipple.[34] Difficulties also arise from fluids which enter the nasal passages through the opening in the palate and interfere with normal breathing. One author suggests that the child's reaction, stemming from his fear of choking, may be to thrust his tongue forward or some other improper feeding habit.[35]

Studies on the height and weight of children with cleft palate have produced controversial results. While several[36-38] have found these children to be shorter and lighter than their normal siblings or other controls, other studies[39,40] have indicated that they catch up and may even surpass norms for height and weight by age ten. In one study[2] a correlation was shown between severe feeding difficulties in infancy and below-average weight in later childhood; however, the possibility of prenatal factors cannot be disregarded.

Feeding the infant

Although no special infant formuala is required and vitamins are given as usual, feeding methods depend entirely upon the individual child's case and the advice of the cleft palate team. There are as many different views on the best method of feeding the infant as there are methods. Most authors agree that the mother should be actively involved in the feeding process as soon as it is possible, although they generally discourage breast feeding because of the time and effort required.[12,31,41-43] A few authors, on the other hand, feel that the physiological and psychological advantages to both infant and nursing mother warrant breast feeding

whenever possible.[1,5,7,34,43] Admittedly, many obstacles must be overcome, i.e., a prosthetic device must be made to cover the defect in the palate; this device must then be changed periodically as the baby grows; the baby may take two or three months to become proficient at breast feeding; and the mother must express milk after every feeding at first and at least once a day even after breast feeding is fully established to ensure a continuing, adequate flow of milk.[43]

Many feeding devices have been recommended for use with the cleft lip/palate child. A prosthetic device called an obturator is considered by some to be vital to successful feeding sessions,[31,32,44-48] while others feel that it is uncomfortable, unnecessary, or has no substantiated effectiveness.[1,5,7,8,12,30,34,41,44] This feeding plate is usually constructed of acrylic resin and indicated only where a sucking reflex can be stimulated. Preferably it is inserted within twenty-four hours after birth, ideally before the infant has had its first feeding, in order to accustom the baby to the feeling of the appliance. With the gap of the palate thus occluded, the nasal cavity is sealed off, and the baby can obtain milk from a regular nipple. Because of the predisposition to middle ear infection in the cleft child,[1,29,45,46] scrupulous care must be given to cleansing the appliance as well as the mouth and the nose. All milk residue and mucous should be removed by giving the baby a small amount of water after feeding, and by swabbing the areas surrounding the cleft with cotton or gauze moistened with water or a half-and-half solution of water and hydrogen peroxide.[41]

Often the newborn infant with a cleft may be fed in the usual way with an ordinary bottle or nurser by just softening and enlarging the hole in the nipple. This practice is strongly advocated by some authors[7,8,42,45,49] for the psychological benefits of minimizing the baby's differences from the normal child. Should normal bottle feeding be impossible, other commonly used feeding aids include the Brecht feeder, BENIFLEX® cleft palate feeder, bulb syringe with attached rubber tubing, medicine dropper, cup and spoon, restaurant-type plastic catsup dispenser, and specially adapted nipples (the bifid nipple, lambs nipple, and flanged nipples). These nipples assist in feeding by avoiding the opening in the palate, either by straddling the cleft (bifid nipple), surpassing the cleft to carry the flow of milk directly into the back of the throat (lambs nipple), or by covering the cleft (flanged nipple). In rare cases, tube feeding may have to be implemented, but this is to be used only as a last resort.[8,31,32,45]

Feeding the child: Preoperative and postoperative

Closure of the cleft lip can usually take place by six weeks of age, although the age range among American surgeons is anywhere from ten days to five months.[33] A general "rule of ten" often followed states that, excepting medical contraindications, the child is ready for cheiloplasty when its weight is ten pounds and the hemoglobin is ten gms per dL. Infants may be fed up to one hour preoperatively if under six weeks old, up to three hours preoperatively if older. Postoperative feeding for the baby is the same as described before, with special care given to protect the suture line and keep it clean.[34,51] Sometimes hand restraints are employed to prevent the baby from disturbing the sutures.[29]

Palatoplasty usually is not attempted before one year of age because the small size of the pharynx in children of that age could lead to breathing difficulty after soft palate closure.[8] Depending on the child's speech pattern, the first palatoplasty may be performed at eighteen months of age.[34] Requirements necessary to proceed with an operation to close the cleft palate are the absence of upper respiratory tract or other infection and a hemoglobin of ten gm per dL or more. It is also desirable that the child be gaining weight.[8,34]

Postoperatively, clear liquids may be given from a cup or spoon (no straws) for one or two days. Intravenous support may be indicated, depending on oral intake. Patients are allowed to move about, but may not open their mouths wide or chew food or gum. No oral temperatures are allowed. Again, hand restraints may be necessary to prevent disruption of the sutures.[8,29,33,34] Patients are usually discharged on day five to day seven with home care instructions. The dietitian may prove to be invaluable at this time to instruct the parents on a postoperative diet which should be followed for three weeks.[8]

The cleft palate diet[54] is a transitional diet from a full liquid to a regular diet. It provides approximately 2200 calories with 93 gm protein and is nutritionally adequate for vitamins and minerals, as established in the Recommended Daily Dietary Allowances. Meats, fruits, and vegetables are strained. Hard-to-chew, gummy foods, raw fruits and vegetables, and creamed dishes are omitted. Spicy and acid foods often irritate and should be avoided if they do. Pureed foods may be diluted with milk, fruit juice, or broth. Some children accept purees better if they are thickened with bread, graham cracker, or vanilla wafer crumbs.[52]

Five or six small meals a day are sometimes tolerated better than three large ones, but as soon as possible the mealtimes should coincide with those of other children in the family.[12] After healing is complete, the child should be encouraged to try new foods or foods which may have previously caused difficulty.

Conclusion

Cleft lip and palate are congenital defects with complications in respiration, feeding, and speech. Treatment and therapy cannot be oversimplified, for the child with a cleft

presents an intertwined nutritional, surgical, dental, emotional, social, developmental, and vocational problem requiring the expertise of professionals as well as loving supervision for many years of optimal habilitation.

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