INTRA-CRANIAL INJURIES OF THE NEW BORN

BY

DAVID FREDRICK COLE

A THESIS SUBMITTED FOR THE DEGREE OF

DOCTOR OF MEDICINE

UNIVERSITY OF WISCONSIN

1931

CONTENTS

CHAPTER I

INTRODUCTION.

The close connection of intra-cranial birth injuries with early infant deaths, vague lethargic conditions of indeterminate diagnoses among the new born, paraplegias, mental retardation as well as slow growth in stature, and feeblemindedness has been recognized for centuries, but its study has been neglected until quite recently. However, along with other advances in science this field of medicine has been studied extensively and thoroughly during the last two decades. This is due perhaps to better methods of laboratory proceedure, to the increasing recognition of pediatrics as a specialty, to more completely and carefully performed necropsies, and to the demand by the public for more prophylactic therapeutics in place of symptomatic therapeutics after the damage has already taken place.

For many years the process of delivery of a foetus through the birth canal has been well understood as have many of the lesions incurred by such a proceedure; yet when we look for accessory causes of intra-cranial injuries during birth and later manifestations and results, we find there has been and still is a wide variation of opinions and a confliction of ideas. In this paper I shall attempt to summarize the observations and data of some thirty odd writers who have carefully studied the problem, giving the most common discoveries and opinions of the investigators on this subject.

CHAPTER II

FREQUENCY OF INTRA CRANIAL INJURIES

The frequency of intra cranial injuries found at necropsies have been reported from as low as twenty per cent of foetal deaths by Archibald to as high as sixty five per cent by Crothers. A fair medium is forty to fifty per cent as given in a recent article by Margaret Warwick of the University Hospital at St. Paul, Minnesota. Even her figures are vulnerable, for Dr. Warwick's report is on necropsies of two hundred isolated cases which died from intra cranial hemorrhage. In its limited field the report is accurate, yet many children who have intra cranial injuries show but slight if any clinical signs and recover with no apparent injury. Necropsies performed upon cases later in life and contributed to intra cranial injuries are but conjectures and clinical symptoms alone without necropsies are of slight value.

Consequently an average figure must be taken from the reports of Spencer who gives forty per cent of deaths in early infancy due to intra cranial injuries. Pierson gives as his figure forty four per cent and Crunchshank finds thirty seven per cent as his figure. Sharpe and Mc Claire rate intra cranial hemorrhage among consecutive cases delivered as nine to thirteen per cent after having done a routine spinal puncture on a series of new born. Again in such a group errors may occur through puncture of small vessels on the way to the canal or through not obtaining bloody fluid in cases where the injuries are within the ventricles or anterior subarachnoid spaces and do not reach the canal for several days. Suffice is to say that intra cranial injuries

are the most common cause of death in infants under two weeks of age. Most authorities agree that it is the greatest single cause. We are also deeply interested in those cases of intra cranial injuries which survive, though they do present latter manifestations. These cases will be spoken of in detail under the chapter on "Effect of Intra Cranial Injuries upon Society".

CHAPTER III

THE CAUSES OF INTRA CRANIAL INJURIES.

The causes producing intra cranial hemorrhage are listed under three primary headings. Sharpe and Mc Claire list them as follows:

1. Trauma
    1. Due to prolongation of labor
    2. Rapid, spontaneous or precipitate births
    3. Forceps manipulations
    4. Administration of pituitrin
    5. Manipulation for resuscitation.

2. Asphyxia
    1. Compression or poor cord circulation during labor causing a hypertension and rupture of venules and arterioles.

3. Intra uterine blood diseases and delayed clotting time.

Note. Foote who has done extensive research on coagulation time of infants, finds it to average seven minutes and to be within five to nine minute limits normally. This estimate is accepted as correct by other medical men.

Warwick and Ehrenfest classification is as follows:

1. Trauma
    1. Molding of head during labor
    2. Promiscuous use of forceps.

2. Congestion or status of vessels in protracted or complicated labors.

3. Diseased conditions of the foetus.

Munes and Eustis give the same classification -

1. Trauma

2. Asphyxia

3. Foetal diseases.

Munes and Eustis believe that traumatic factors play a small part in per centage of deaths due to intra cranial injuries. However, they do relatively few necropsies but rely upon clinical symptoms, grouping the cases under asphyxia. Perhaps many cases of trauma would be found if more autopsies were performed. They do believe, however,that sudden change of skull contour is the prime damaging factor in producing intra cranial injuries.

Dr. Santose lists the factors under the same three headings, but believes trauma produces eighty to eighty five per cent of the injuries and asphyxia and hemorrhagic diseases cause very few. There are many subsidary causes for the three primary headings listed above.

Alfred Gordon states that seventy to seventy five per cent of breech deliveries show some evidences of intra cranial hemorrhage. He also believes that forcep application in cases with contracted pelves adds many cases.

Crunchshank expands on the application of forceps in anterio-posterior diameter as a common cause.

Holland believes contracted pelves is the most significant single cause of intra cranial injuries. He also stresses the fragility of intra cranial structures in premature infants and their suscep-

tibility to injury. He agrees with Gordon of the large number of breech deliveries who show injuries.

Dick disagrees with Warwick and Radda, who estimate hemorrhagic disease to be the cause of intra cranial hemorrhage in twenty and twenty five per cent of the cases respectfully and regards trauma as the prime factor. He proceeds to believe that hemorrhagic disease is used too often in diagnosis as a cloak to cover some one's error during a delivery, though he does not believe that obstetricians can be blamed very often for direct traumatic factors. Sudden pressure or release of pressure from the head, or long molding processes are equally injurious. Breech deliveries are responsible for more than any other single factor in producing injuries and the most dangerous combination is a premature breech.

Baker lists a series of factors involved in production of intra cranial birth injuries. The following according to his idea are all involved in producing tears and injuries.

1. Breech deliveries
2. Application of forceps
3. Rapid second stage of labor
4. Prolonged second stage with capillary oozing.
5. Contracted pelves
6. Prematurity of the foetus.

Rodda, in a series if statistics of new born infants from

clinics of Minnesota University in nineteen twenty concludes that fifty per cent of intra partum deaths or deaths during the first few days of life are due to intra cranial injuries with breech deliveries and premature heading the list, though the second stage of labor may have been entirely normal. Sharpe and Mc Claire in 1926 performed five hundred spinal punctures on consecutive cases, finding forty five bloody or blood tinged fluids. In their estimation the injuries were all results of trauma and from labor histories found that the factors involved were:-

1. Protracted labors
2. Forceps applications
3. Precipitated labors
4. Advanced age of primipara
5. Obstetrical manouvers.

John Signoulli classifies his causes to include:-

1. Hemorrhagic diathesis
2. Constitutional diathesis
   a. Sepsis
   b. Congenital lues
   c. Leukemias
   d. Prematurity.
3. Traumatic injuries.
   a. Instrumental
   b. Non-instrumental
   c. Manipulations for resuscitation.

In Abts pediatrics the statement is made that obstetrical proceedures are seldom the cause of intra cranial injuries, but molding of the head with overlapping of the parietal bones, which occurs in all

deliveries, then sudden release tears the delicate cranial structures. Extreme overlapping or forceps pressure alone might cause these injuries.

Sharpe and Mc Claire from observation of seventy three consecutive cases with intra cranial injuries, whose blood clotting time had been taken and who later succumbed and necropsies were performed leaving no doubt as to correct diagnosis, found the clotting time to have been normal in thirty five cases, increased in six and decreased in ten. It was not taken in twenty two cases. This corroborates the theory held by the majority of writers who are of the opinion that hemorrhagic diseases are over-stressed as a cause of intra cranial birth injuries.

J. B. De Lee of Chicago believes intra cranial birth injuries are caused by a sudden release of the head during the second stage of labor. At this point the rest of the foetus is under pressure and the head becomes congested. He compares it to Caisson's disease and thinks the damage occurs when the rest of the body is delivered with sudden release of cerebral congestion.

Aaron Capper stresses the fact that premature infants, especially those under 2500 grams or five pounds, 270 to 280 days periods average twenty per cent intra cranial injuries, adding that the smaller or more premature the foetus the more susceptible it is. He also states that the Schultz resuscitation method traumatizes the infants, thus agreeing with many others, and believes its use should be discontinued.

Daniel H. Bessener speaks of another problem causing intra

cranial injuries, and cites cases of over term or past due foetuses in which labors were prolonged and often required forceps application for termination. Here is an important and common cause for intra cranial injuries.

There is no single factor then which has been found to cover the whole etiology of intra cranial birth injuries. Instead a large group of causes can be found, some more important than others. The most common and dangerous of them all is overlapping of the cranial bones during molding as the head passes through the canal, even in normal deliveries, and it is the hardest to attack from a preventative standpoint. Holland states that "It is this simple longitudinal stress in molding of the head which plays such an important role in tentorial tears."

One who has seen the delivery process of the lower animals and also human deliveries can understand why intra cranial injuries are so common in the latter and rarely if ever occur in the former. For instance in the delivery of a calf or colt there is no chance or need of "head molding" or injury as in infants because, to cite one reason, the size of the head in comparison with the shoulders is very much less in these animals than in the child. Thehead acts only as a mild dilator in animal births and is followed closely by the shoulders, which hold the canal open. If a breech delivery occurs, the head bears no stress whatever. If there is dystocia in animals it occurs not by virtue of the cephalic diameter but because of the shoulder diameter.

Among rodents Dr. Hisan has well proven in his experiments the osteoclastic weakening of the pubic arch which gives increased motion and diameter of the pelvic ring itself at time of labor. These factors vary fundamentally from the situation in childbirth where the head has the largest diameter, is spherical and moleable, allowing overlapping of the parietal bones, thus causing injuries to the fine delicate foetal structures. There is no solution to the pelvic ring damage, and the only space obtained is that which is gained by compressin the soft tissues within the ring or molding processes of the infants skull.

The traumatic factors in producing intra cranial birth injuries has been discussed, bringing us to the second primary cause, which most writers consider under the term asphyxia. Cerebral congestion with rupture of the vessels falls under this classification and is the result of prolonged and obstructed labors. This may be due merely to compression of the cord, or prolonged labor brought about by a slowly dilating cervix or arrest of the head in the canal or on the perineum. Such a prolonged high pressure congests the delicate vessels and ruptures them, disseminating into the undeveloped, young cells of the foetal brain, blood, which may strike the respiratory center and cause asphyxia, clear up without pathology or organize and remain as a permanent injury. Though no reports have been compiled on intra partum pressure in the vascular system of the foetus, cases with intra cranial hemorrhages having a normal or decreased clotting time and no signs of traumatic injuries other than ruptured vessels and extravasation of blood within brain

tissue, also occurring in cases of prolonged or protracted labors, points to congestion as the causative factor.

The third primary factor of production of intra cranial birth injuries is hemorrhagic disease of the foetus. From the statistics of many men it would seem that this factor is cited too frequently as causing intra cranial injuries. In a series of five hundred spinal punctures by Mc Claire and Sharpe, taking consecutive cases, forty five fluids or nine per cent, showed blood present. Not a one in this number had increased clotting time. In another series by Warwick of two hundred cases in which fifty three per cent, not consecutive cases, showed intra cranial hemorrhage 20.5 per cent were listed as due to hemorrhagic disease. Rodda offers those cases of intra cranial hemorrhage caused by hemorrhagic disease as twenty five per cent, but aside from these two writers other men equally familiar with this subject seem to favor trauma as the greatest causative factor and consider a small per cent due to hemorrhagic diseases. This latter theory seems much more plausible than the former and statistics in which clotting time is given shows no connection between intra cranial injuries and delayed, normal, or increased clotting times. Neither do they show abnormal blood counts or intra cranial injuries among infants who have hemorrhages in other viscera. It seems that the vein of a majority are correct in placing hemorrhagic diseases very low in per centage, trauma as the greatest cause and congestion intermediate in causation of intra cranial birth injuries. Secondary factors fall under the above three primary causes.

CHAPTER IV

PREVENTION OF INTRA CRANIAL BIRTH INJURIES.

The prevention of intra cranial birth injuries must be governed by elimination of causative factors listed earlier in this paper, which seems to quite fully cover the problem. These factors must be eliminated as far as possible by the obstetrician. The pediatrician and surgeon are of vital importance in handling such cases as occur despite good obstetrical regime.

To prevent injuries due to trauma the obstetrician is called upon to consider many conditions which requires excellent judgment as the individual cases present themselves. Those problems resulting from prolonged labor are probably as difficult as any with which the obstetrician will be confronted. Some types of prolonged labor as those due to poor muscle turgor of the uterus, adhesions to the uterus, or cervical rigidity play a small part in causing injuries. It is after the membranes rupture that molding and congestion take place. Much can be done to prevent a certain percentage of prolonged labors from occurring by careful examination and mensuration of the birth canal before confinement, and correction of pathology early in pregnancy. Contracted pelves should be diagnosed before labor rather than after labor has begun so that plans for an alternative method of delivery can be considered. Abnormal positions if diagnosed may be externally rotated into more satisfactory presentations. Ironing out the perineum when the head is descending slowly may markedly decrease delivery time.

There are numerous methods at hand to partially control rapid, spontaneous, precipitate labors. Gas, ether or chloroform can be utilized during the second stage of labor and the desired speed of delivery handled quite successfully. Pressure or support to the head as it comes to the floor of the perineum not only lessens congestion and molding but helps govern speed of expulsion. It is well also to use precautions with multiparas who are prone to have precipitate labors. All patients should be talked to before labor is advanced, in order that they may obtain a better understanding of how they can cooperate.

The application of forceps rests entirely with the obstetrician, and is a grave problem. He must use his best judgment as to when they are needed and know the limits of his ability to use them. Forceps applied high, in antero-posterior diameters, in contracted pelves and for that matter in anything but a low forceps in normal pelves is a potential factor for injury. Obstinence from using them unless absolutely required should be adhered to unless the person using them is very proficient with them. Rotation before application is indicated only an antero-posterior application at presentation. Knowledge as to whether the canal and head are of such dimensions as to allow delivery is essential.

Irving has found only 0.5% of babies who died from intra cranial injuries were delivered by low forceps, which is but 0.2% higher than perfectly normal deliveries. He found three per cent

among mid forceps deliveries and two and six tenths per cent of high forceps.

Copper states that 20% of premature births have birth injuries. Understanding the susceptibility of immature infants more care should be taken to lessen their number. The mother should be carefully and routinely examined and any pathology which can be found if corrected may lessen immature deliveries. The induction of labor prematurely should be done only when indications are decisive and proper methods for delivery chosen if such proceedure is taken. Vigorous methods of resuscitation as the Shultze method are considered an important factor in production of many intra cranial injuries of the new born. This is so easily eliminated by substitution of an equally efficient and less traumatizing proceedure. Irving suggests clearing all mucous from the mouth and upper respiratory tract, then gently pinching the alae of the nose together, placing a gauze over the mouth and blowing lightly into the child's mouth. This answers two purposes. It gives 3.5 to 4 per cent carbon dioxide which stimulates breathing after the lungs have been inflated by the same act. Pressure over the lower costal region after inflation completes the respiratory phase. This method eliminates the dnagers of trauma.

A breech presentation is always a potential danger of injury. When combined with a premature infant, a contracted pelvis or an overdue and oversized foetus trauma, congestion and intra cranial injuries frequently occur. Breech deliveries diagnosed before labor begins

are best handled by external version into cephalic presentation, a precaution which should be taken when possible. This is especially important in prematures. Repeated transformation of breech to cephalic should be done in cases where the foetus returns to the former position. In contracted pelves or oversized foetus' in a breech position, it might be well to consider Caesarean section unless there are marked contraindications. Irving has found Caesarean deliveries to have but 0.3% intra cranial injuries as compared to 2.6% among breech extractions.

In cases of elderly primipara where no pathology is apparent but physiological changes have occurred and the tissues are more resistant, assistance may be required at various levels of the canal to prevent a protracted labor. If the cervix is firm and refuses to dilate well, Harris' manual dilatation is useful. Later when the head reaches the perineum it may be delayed by the tissue resistance. Ironing out of the perineum, an episiotomy or low forceps at such a time often shortens labor and is especially valuable if there is excessive molding or the foetal heart rate beings to fluctuate widely.

Prenatal attention to and care of the mother affords perhaps the most extensive opportunity available for prevention of birth injuries to the child. Keeping the mother healthy is a problem of primary importance. The importance of the first visit, by the patient, should be realized by the doctor. A complete history and physical examination, urinalysis, blood chemistry, and Wassermann should be taken; precautions which later may save much grief and time during the con-

finement. These also give the doctor a sense of surety in handling the case as well as an opportunity to correct many abnormalities and pathology which careful handling may bring to light. The importance of such precautions cannot be over emphasized after one has read of and seen the disaster which failure to appreciate and carry out such proceedures often causes. Any chronic or acute disease which a mother might have are discovered at such examinations. Toxins from such sources are potential activators of premature deliveries. Such prematures are less strong than premature infants from healthy mothers and intra cranial injuries are very common among them. Early mensuration may bring to light contracted pelves. The pelvic contraction cannot be corrected if present, but more attention will be paid to the patient, the pregnancy will not be allowed to run over term and if the condition is quite extreme with a child in abnormal position to be delivered by the safest route because of its value, as it would be in the only pregnancy of an elderly primipara, Caesarean is to be seriously considered.

Pelvic examinations leads one to discover malpositions of the uterus or pelvic tumors which may be corrected before confinement if it is quite apparent that they may cause dystocia during the delivery.

Frequently repeated visits by the patient and routine laboratory proceedures on the patient will enable one to arrest conditions which might continue and be detrimental to the development of the child, ifnot treated. These simple troubles may lead to premature births, but regulation of exercise, food and simple habits often carry the preg-

nancy past such dangers. These frequent and careful attentions to the mother may eliminate many cases of premature and over-term infants both of whom are more susceptible to intra cranial injuries than a normal term foetus. Proper diet may not only prevent toxic conditions in the mother but from the foetus as well. In this way, a more healthy child is produced whose physiological being is more stable whereby hemorrhagic deaths may be considerably lessened. It is also at these frequent visits that abnormal positions are picked up and can be changed.

CHAPTER V

THE EFFECT UPON SOCIETY

The effect upon society which intra cranial birth injuries cause is difficult to estimate. The early deaths may take from us a Lincoln or Roosevelt or eliminate from our ranks unwanted criminals. We have no way of knowing this, but from our daily walks in life we come in contact with paralytic cases, epileptics, mentally deficient people, and in asylums see individuals whom we pity and cannot ignore.

Siegmund stresses the damage done in proportion to the injury as much more extensive among infants than adults, because the active growth and metabolism in infants is greater and disturbances in the cranium may exert marked injurious influences on the central nervous system especially the medulla. Sub dural hemorrhages may entail external hydrocephalus, intra cranial hemorrhages may lead to internal hydrocephalus. He states that many cases of encephalodystrophia or fatty degenerative processes are due to birth injuries. He also states that injury to vessels cause stasis, diapodesis of erythrocytes and leukocytes, and impaired nourishment to tissues which may develop to cause complete areas of necrosis. These areas stand in close relationship with cysts, porencephaly, sclerosis and mecrogyria which are commonly found at necropsies of children under six months of age.

Alfred Gordon of Philadelphia states that encephalopathies from intra cranial injuries may cause chronic mental inferiority or a crippled central nervous system, manifesting itself in paraplegias, diaplegias, hemiplegias, contractures, athetosis, chorieform conditions,

convulsions, amourosis and mental deficiencies. These lesions may be of any extent or intensity. They may appear early or late, be great or slight and may include imbeciles or only mild disturbances hardly noticed later in life.

Capper states that many cases recover completely if extravasation is small. The ultimate fate of others is varied. The child may remain retarded mentally or physically until puberty and then become normal, or be affected both mentally and physically in his early years with no effects later. Static speech and function may reappear again later. Five per cent develop epilepsy, five per cent develop Little's disease and seven per cent become idiots and imbeciles. Some have psychic infantilism, while some are retarded in school as children and later find their way to homes for imbeciles and idiots.

Abts Pediatrics lists the effects of intra cranial injuries as all grades of mental deficiencies, palsies or Little's disease, epilepsies and not uncommonly hydrocephalus.

In 1862 Little, himself, from whom we name spastic paralysis, after numerous necropsies on infants rates intra cranial birth injuries as the cause of seventy five per cent of such paralytic cases.

Dicks states that a large percentage of paralysis of late childhood can be traced by pediatricians and orthopedists to intra cranial injuries incurred at birth.

CHAPTER VI

CONCLUSIONS

The causes of intra cranial birth injuries are quite well known at the present time and the primary causes are agreed upon by the majority of medical men.

The prevention then lies in elimination of the causes of intra cranial injuries. Due to the fact that some will continue to occur in spite of the best obstetrical proceedures and in normal deliveries they cannot be entirely abolished, but much can be done to decrease their numbers.

The effects both immediate and later in life of cases with intra cranial injuries incurred at birth, upon society are detrimental in three manners. First they take from the world during the first few days of life otherwise healthy infnats who might be geniuses or candidates for weighty responsibilities. They leave with the world a class of individuals mentally hampered, who must eek out an existence as best they can, not being responsible or efficient enough to command worthwhile positions in life and often requiring some indiwidual or organization to foster them. The third class are idiotic, condemned at once or eventually arriving at institutions where they linger on, completely negative, at state and public expense.

Buyers estimate that of such inmates of asylums three to seven per cent are there because of damage done by intra cranial birth injuries. This number, though small, is quite unnecessary and which

with obstetrical judgment, pediatrical and surgical consultation on infants who manifest symptoms of intra cranial injuries could be practically eliminated, at least markedly reduced.

BIBLIOGRAPHY

1. Archibald: Amer. Pract. Surg. Vol. 5, p. 208

2. Crothers: Surg. Gyne. and Obst. Vol. 37, p. 790

3. Warwick: Am. Jour. Dis. Ch. Vol. 21, p. 488

4. Spencer: Obstet. Soc. London. Vol. 33, P. 203

5. Pierson: Surg. Gyn. And Obst. Vol. 37, p. 802

6. Cruichshank: Lancet. April 1923. Vol. 1, p. 836

7. Sharpe and Claire: J.A.M.A. Vol. 86, p. 332

8. Sharpe and Claire: Am. Jour. Obst. and Gyn. August 1924

9. Lippman: N.Y. Med. Jour. CIII, p. 68

10. Sidburg. Archives of Pediatrics. XXXVII, p. 545

11. Foote: Am. Jour. Dis. of Child. Vol. 20, 18

12. a. Ehrenfest)
b. Warwick)) Am. Jour. Dis. Child. Vol. 26, 503.
c. Munes and Eustis)

13. Santose: Post Graduate Lect. Course, 1924 (Private notes of Dr. V. Kooh, Janesville, Wis.

14. Gordon: Am. Jour. Dis. Child. Vol. 27, p. 330

15. Holland: Am. Jour. Obs. and Gyn. Vol. 12, p. 871

16. Capper: Am. Jour. Obst. and Gyn. Vol. 18, p. 106

17. Bessener: Med. Jour and Record. Vol. 131, p. 193

18. Dicks: Am. Jour. Obst. and Gyn. Vol. 12, 871

19. Baker: J. Obst. and Gyn. Br. Inp. Vol. 33, 224.

20. Radda: New Orleans Med. and Surg. Jour. Vol. 79, 435

21. Sharpe and McClaire. New Orleans Med. and Surg. Jour. Vol. 79, 435

22. Signorilli: New Orleans Med. and Surg. Jour. Vol. 79, 435

23. Opts' Volume VII, p. 88

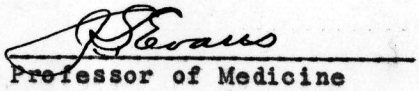
24. De Lee: J.A.M.A. Vol. 86, 332

25. New Eng. Med. Jour. August 11, 1930

26. Buyers: New Eng. Med. Jour. August 11, 1930.

****

Approved by



Professor of Medicine

Date

May. 20th., 1931