

INJURIES OF THE INFANT DURING DELIVERY*

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IN ANALYZING the theme assigned to me, I was carried in retrospect to the winter of 1907. It was my good fortune to spend several hours of each day with Dr. Störk, one of the pathologists in the Allgemeines Krankenhaus, in Vienna. Here it was not uncommon to witness from ten to fifteen or more autopsies almost every day. Adult autopsy material was always abundant, it being the rule that all patients dying in the institution be subject to postmortem investigation. Daily I observed large numbers of bodies of newborn babies in the morbid anatomy room, but in these, routine postmortem studies were not made. Naturally, I was led to speculate as to the cause of fetal death. The question arose as to whether all were inevitable and whether some, at least, were not preventable.

In recent years, the question of fetal injury and fetal death has been receiving more and more the long deferred attention it justly deserves. Noteworthy strides have been made in maternity work, but the high plane on which practical obstetrics should stand has not been attained. In this country, there is something woefully wrong, since from the standpoint of obstetric mortality, we stand fourteenth in the sixteen leading nations of the world. In New York City, according to Polak, "one baby out of every twenty-one is born dead and one out of twenty-six dies before it is one month old, while one mother in every two hundred and fifty deliveries dies from infection or as an indirect cause of it." This author further claims that more than 61 per cent of all gynecologic surgery is a result of poor obstetric practice. Dr. Barton Cooke Hirst, five years ago, in a paper entitled: "The Obstetrical Department of a Modern Medical School," drew attention to the defects in the teaching and practice of obstetrics in America. In Pennsylvania, the maternal mortality has not changed in the past seventeen years. The mortality was 6.1 per cent per thousand in 1906, and it was precisely the same in 1923. Twelve hundred and fifty-one mothers died in confinement in 1922, and the toll in 1923 was 1,373.

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It is impossible to compute the vast multitude of women rendered physically incompetent or at least partially handicapped by complications arising in both pregnancy and labor. *I believe that no other function performed by the human organism exacts such an enormous penance in morbidity and mortality as does pregnancy with its culmination in labor.* It is said to stand second to tuberculosis as a cause of death in women between the ages of fifteen and forty-five.

When the true status of obstetrics as a major surgical specialty is accorded the place it should rightfully own, the illusive term "physiologic process" will no longer hold as a common medical phrase, since in so many instances pregnancy, with its consummation in childbirth, becomes a pathologic problem.

It may not be prudent to deal in prophecy, but it seems reasonably safe to assert that 50 per cent or more prospective mothers will inevitably suffer with some type of physical incompetency, often of a most subtle form. With this knowledge gradually becoming ingrained in the mind of the profession, expectant mothers will receive the long deferred antepartum, intrapartum, and postpartum care their condition demands.

Statistics disclose that from 3 to 5 per cent of all babies die during delivery. It is estimated, according to the United States Department of Labor, Children's Bureau, that in this country the annual death rate of babies less than one year old, including stillbirths, totals 300,000. It is authoritatively stated that at least 50 per cent of these deaths (150,000) are wholly unnecessary. This report further shows that slightly more than 42 per cent of the babies dying under one year of age did not live to complete the first month of life. Of the 42 per cent mentioned, seven-tenths died as a result of antenatal conditions or from accident or injury sustained at the time of birth. Of the babies who lived less than one week, 83 per cent died of the causes mentioned, and of those that lived less than one day, the causes named were responsible in 94 per cent of cases.

While statistics provide fairly reliable data respecting fetal death in its relation to pregnancy and parturition, statistics cannot compute, nor can the human mind fully comprehend the vast army of infants left physically disorganized or mentally crippled; herein lies the dark tragedy of childbirth.

Fortunately, in recent years, this catastrophe affecting the human family is receiving more and more attention. Ehrenfest says: "Wider interest in the causation and prevention of parturitional injuries of the infant, while of relatively recent date, is growing rapidly and is obvious to anyone conversant with modern obstetrical literature." Again, "Today we are facing the surprising fact that in at least 40 per cent of the autopsies properly performed on stillborn infants and

those dying within the first few days after birth, some sort of intracranial lesion is found."

In this connection, it may be of interest to cite the status of obstetrics, especially as regards the welfare of the child, in countries other than our own. A relatively high puerperal infant morbidity and infant mortality is not restricted to any nation on earth.

In England, according to Holland, infant mortality has been reduced one-half in the past twenty-two years, or from 154 per thousand in 1900 to 77 per thousand in 1922. The number of deaths occurring in the first four weeks postpartum, however (neonatal mortality), has shown only a slight decline. Holland points out that nearly one-half of the deaths "occurring" during the first year of life "occur" during the first month and nearly one-half of these "occur" during the first week. It has been shown clearly by Holland, that the large proportion of these are due to obstetric accidents or obstetric injuries.

An analysis of the possible injuries to which the infant is exposed during delivery discloses that damage may be inflicted anywhere from the cutaneous envelope (the omnipresent caput succedaneum) to the mucous lining, including in the area between the bony architecture and the parenchymatous organs as well.

The most serious damage, both in its immediate and remote results, is that sustained by the cerebrospinal system.

Schwartz, in a series of investigations on newborn infants asserts that the pathologic conditions arising in the first month of neonatal life are dominated by injuries sustained by the brain during labor. Fischer, from postmortem studies, found that 10 per cent of the deaths occurring in the newborn during the first four weeks postpartum, were the result of cerebral damage inflicted at the time of birth.

Before considering this phase of parturitional damage, I wish to direct attention to the possible trauma inflicted to the buccal mucous membrane by the method customarily employed in removing secretion from the baby's mouth. Manual removal with the gauze-enveloped finger must inevitably traumatize, more or less, the mucous membrane. With the mucosa broken, infection is certainly possible, since it is well known that the mother's milk contains a wide variety of bacteria, including staphylococci, colon bacilli, and, in as high as 49 per cent of cases, streptococci. Fortunately, only 2 per cent of the latter are found hemolytic. Furthermore, it is equally well known that shortly after birth myriads of bacteria appear in the baby's mouth. To exclude or minimize the possibility of buccal infection, we have abandoned the usual plan of cleansing the mouth and are now using in the Jefferson Maternity Hospital an electric aspirator, fashioned after the aspirating device commonly used by the laryngologist. This method is on trial, and whether or not it will afford any

safeguard against infection, only a fair test will tell. The method will at least keep traumatizing fingers out of the baby's mouth.

Another condition, though not strictly an injury, yet one which may legitimately be placed in the category of birth accidents, is infection of the stump of the umbilical cord. Some authorities consider such infection responsible for as high as 10 per cent of the mortality of infants less than one month old. What part the constantly soiled silk braid commonly used in ligating the stump plays in acting as a culture medium, one cannot say. It may have an influential rôle and it may not, though the method does not rest upon sound surgical grounds. Recently, we devised a "metallic ligature." This is composed of German silver and it is now used instead of ordinary silk braid. Whether or not it provides the bactericidal power silver is thought by some to possess or any other advantage over the old method, remains for further study alone to reveal. It does exert constant pressure and hemostasis is assured. It does not cut the cord, no tying is required, and it may be used, always resterilized, a great many times. It is inexpensive and may be purchased at a cost not exceeding ten cents.

Passing now to the serious accidents and injuries of parturition, I shall briefly consider those affecting certain nerves, the spinal cord, and the brain. To these special types of birth injury considerable attention has been directed during the past few years.

Trauma, according to Von Reuss, results either from trouble in the genital passage of the mother, or from obstetric maneuvers, either manual or instrumental. In artificial deliveries it is either manual manipulation in breech or transverse presentations (version and extraction) or the obstetric forceps which damage the child. In spontaneous delivery the cause lies chiefly in disproportion between the child and the mother's pelvis, in pelvic deformities, or in malpresentations.

Damage may occur particularly after long labors and also in precipitate labor in which the child is forcibly driven through the pelvic canal. While it is well to recall that almost all forms of injury to the child may arise during spontaneous or normal delivery, the large proportion of injuries occur after difficult manual or instrumental labor. It is of interest to note at this time that accumulated evidence tends to disclose that conditions heretofore regarded as congenital are in reality late expressions of damage sustained during birth, conditions which, in the beginning, did not give rise to prominent symptoms and which were undetected because of indifferent care or lack of knowledge on the part of the obstetrician.

The late recognition of many birth injuries may probably be attributed to the attendant, who regards his obligation discharged when the umbilical cord is tied and dressed. We should not leave the patient with the assumption that our duty ceases with the birth of the

baby. In order to afford every possible safeguard for the child, those born in our department in Jefferson Hospital are placed under the immediate care of a competent pediatrician. This ideal method is not practicable in general work, but it should constitute a routine feature of neonatal work in institutional practice.

NERVE INJURIES

Parturitional nerve injuries are limited almost exclusively to the facial and brachial plexus. These are nearly always the result of complicated labors and usually of artificial deliveries. E. Stransky analyzed 94 case records of birth palsies which he collected from the literature. In these the type of delivery was as follows:

Manual assistance (Extraction, freeing of arm),	50 cases.
Forceps,	31 cases.
Protracted and difficult labor,	27 cases.
Asphyxia,	11 cases.
Spontaneous labor,	2 cases.

While nerve injury may occur in all varieties of presentations, most authorities believe that the Duchenne-Erb type of palsy, which involves the fifth and sixth cervical nerves, is found almost exclusively after breech presentations. This point, however, still seems open to controversy. Ehrenfest assigns direct pressure of a forceps blade as occasionally responsible. More frequently, he states, trauma inflicted in delivering the after-coming head is the causative factor. Respecting the mechanical factors as influential in obstetric paralyses, those upon which responsibility is usually placed are:

1. Direct compression, manual or instrumental.
2. Traction resulting in overstretching.
3. Traction causing plain tearing.
4. Compression or traction followed by blood extravasation or inflammatory disorganization.

Either of these destructive forces may follow the Prague or Mauriceau-Smellie-Veit method of breech extraction. Direct pressure by the tip of one blade of the obstetric forceps is said to be definitely causative in a certain number of cases, but this, according to Stolper (quoted by Von Reuss) is only possible when the forceps are applied to the head in oblique position or when the rules of proper application are not observed or deflection is overlooked. In certain cases serious nerve trauma has resulted from pressure of a hematoma, and even pressure of the umbilical cord may sometimes, though rarely, account for nerve damage in the region of the brachial assembly (Roulland). Pressure of the clavicle on the brachial nerves is said to be a cause in some cases, especially if the arm locks over the head in vertex presentation, and Dr. Burr, of Philadelphia, in 1920, referred to trauma of the cord itself as sometimes causative.

A paper by Gilmour recently appeared, reporting twenty-five cases of brachial birth palsy, of which twenty-three were of the Duchenne-Erb variety. Two were of the general arm variety, but there was no instance of a pure Klumpke type. As to the cause in these cases: all but three of the births were described as long or difficult, though in one case the period of labor was short, only lasting five or six hours. In two, delivery was natural and unassisted. In the rest, chloroform was used to facilitate instrumental or manual delivery. Three infants were said to have been asphyxiated and to have required prolonged resuscitation. The presentation was vertex in sixteen cases; breech in four cases and irregular in type in five cases.

Six forms of brachial plexus damage are described, according to the site and extent of the injury.

1. The most common form is the Duchenne-Erb type, in which the upper part of the plexus is affected. The damage involves the fifth and sixth cervical roots or the trunk formed by their union. Functional disturbance is observed in loss of power in the muscles about the scapula and arm, giving rise to the typical deformity in the arm, forearm, and hand, described sometimes as the "tipping" attitude.

2. Involvement of the eighth cervical and first thoracic nerves or the trunk formed by their fusion is usually described as Klumpke's type. Loss of function occurs in the muscles of the hand and also in the large flexor muscles of the forearm. The second thoracic root is sometimes affected, and, as a result, the muscles supplied by the musculospiral, the extensors of the hand and fingers, are also palsied. In addition, owing to the intimate relationship of the first thoracic to the sympathetic, changes in the oculopupillary reaction occur. Damage of the lower section of the plexus is followed by more extensive and serious paralytic disturbance than injury of the upper section.

3. In certain instances the damage of the plexus is more or less complete, resulting in loss of power of all of the muscles of both the arm and forearm. In this type serious bone lesions, it is claimed, are usually an accompaniment of the primary damage. Posterior subluxation of the humeral head has been pointed out as a cause by Thomas, of Philadelphia, and others.

4. In certain other cases there is a combination of the upper and lower types, with transition from partial to total paralysis.

5. In still other instances damage is more or less isolated and palsy of a single muscle, such as the deltoid or supinator longus, occurs.

6. The damage may involve both sides, resulting in a bilateral palsy, though this is extraordinarily rare.

Paralysis of the Lower Extremity.—Damage of the cord or lower spinal roots, resulting in paralysis of the lower extremities, is exceedingly uncommon. Von Reuss refers to a case of complete paraplegia. It existed from birth and was not associated with loss of sphincter con-

trol, thus indicating an injury involving the spinal roots of the second and fourth lumbar and the first and second sacral segments. Injury was thought to be caused, in this case, by excessive traction during delivery.

Obstetric Facial Paralysis.—From the obstetric standpoint palsy of the muscles supplied by the seventh nerve fall into two groups: those following spontaneous labor and those following manual or instrumental delivery.

In the first group injury is sustained only when there is frank disproportion between the diameters of the fetal head and the maternal pelvis. The trouble is seen chiefly in the various forms of contracted pelvis, especially the flat pelvis, the head presenting transversely, with excessive cranial stress being directed from the sacral promontory, the symphysis, or an abnormal bony prominence. As a rule, the trouble arises after primary cephalic presentations, rarely after breech presentations.

The palsy may result: first, from damage in the central origin (basal) of the nerve; second, from injury of the cortical motor area; and, third, from damage of the peripheral portion of the nerve itself, especially that portion about or just beyond its emergence from the stylomastoid foramen, or of its branches. The palsy, therefore, may be the result of intra- or extracranial injury.

The third type of damage is by far the most common (this applies to the second group), resulting in most instances from direct pressure of a forceps blade. Some cases, probably a relatively large number, result from violent edema or a large blood collection following forceps trauma. At any rate, it is estimated that at least 10 per cent of the facial birth palsies follow difficult forceps delivery, and only occasionally is palsy observed after spontaneous labor.

The incomplete nature of the paralysis and the fact that in most instances the damage is not permanent is explained on the basis, first, that severe compression is not made on the trunk itself but on its branches, especially those coursing through the soft parotid gland; and, second, that damage of a temporary nature only is, therefore, sustained.

Von Reuss, whose work has been drawn upon constantly in the preparation of this paper, also directs attention to the temporary and incomplete nature of obstetric facial paralysis, and, owing to this feature of the disorder, he prefers the term "paresis" instead of "paralysis."

Intracranial injury of the nerve may be suspected if the characteristic signs of the facial palsy are associated with evidences of hypoglossal paralysis or a simultaneous palsy of the third nerve with ptosis of the eyelid.

Facial nerve palsies, like those involving the brachial plexus, are nearly always unilateral. Bilateral palsy is exceptional.

Since it is not possible to determine accurately the site and extent of injuries resulting in paralysis without postmortem investigation, we are naturally led to the study of lesions resulting in death.

One of the most noteworthy monographs on this phase of birth injury has been contributed by Eardley Holland, of London, England. This work was taken up under the auspices of the Local Government Board of London. It was begun in March, 1914, and the report was presented in March, 1922. It is based on the most painstaking autopsy studies of the bodies of three hundred newborn babies of viable age.

The examination was undertaken to determine the cause of death in "stillbirths."

In this report it is pointed out that death may occur at three periods:

- A. Antenatal (when the fetus is usually macerated).
- B. Intranatal, (during labor).
- C. Postnatal, (when fetal heart beats at birth but respiration is never established).

The deaths were classified as accurately as possible, according to the primary causes, as follows:

1. Maternal states, such as syphilis and toxemias.
2. Complications of labor, such deformed pelves and placenta previa.
3. Placenta states, such as retroplacental hemorrhage.
4. Fetal states, such as prematurity and deformities.

Among the actual causes of death, reference was made to the two conditions which were considered of special interest, namely: syphilis and excessive cranial stress; the first, because of its low incidence, and the second, because of its unexpected importance. By most writers syphilis is regarded as the most common cause of stillbirths, but, according to Holland's report, only a relatively small percentage can be attributed to this disease. His investigations respecting this feature of the studies were most complete, yet among the three hundred fetuses examined there were only forty-two cases of proved syphilis and six of probable syphilis, or 16 per cent in all. Fourteen cases were classed as possible syphilis, but in these there was no evidence of the disease in the fetus or placenta. The observations made with respect to excessive cranial stress, defined "as a compound compressive stress, roughly regarded as consisting of two elements, first, a general compression of the whole head and, second, a simple longitudinal compression by opposite forces, acting at the ends of the long diameter of the pelvis," and their bearing upon the use of forceps and the conduct of breech deliveries are exceedingly valuable and suggestive.

The effect of cranial stress upon the brain and membranes is discussed in detail, and many interesting theories regarding the effect of molding upon the cranium and its contents are presented. Of 167 fresh fetuses examined, the tentorium cerebelli was found torn in eighty-one (48 per cent); the injury was associated with laceration of the falx cerebri in five cases, and with subdural hemorrhage in all but six.

Of the eighty-one cases, forty-six were delivered by the head and thirty-five by the breech.

Forceps were used in twenty-five of the vertex presentations, the indications being: Contracted pelves, placenta previa and prolonged second stage. In some of the cases signs of considerable force having been employed were evident. Holland in this connection states: "while the forceps may save many lives it is also responsible for the unnecessary injury and death of many others."

The thirty-five breech deliveries represent 75 per cent of the total number of breech deliveries examined. The frequency with which the tentorium is torn during breech birth is due, in the opinion of Holland, to the haste customarily advised and employed in extracting the after-coming head. He urges a revision of obstetric teaching with respect to this procedure.

From this report it is apparent that more babies were killed by the complications of labor than died during pregnancy or from maternal or placental diseases.

The observations made by Holland regarding the incidence of fetal injury and fetal death in breech deliveries are in accord with those made by Pierson in the Sloan Hospital, New York.

This author reports 142 viable primary breech deliveries, with natal or neonatal death in eighteen, or 12 per cent. He also reports eighty-seven viable version and breech extractions with natal or neonatal death in eighteen, or 26 per cent. As regards the cause of death, Pierson found spinal cord hemorrhage in seventeen, or 47 per cent of the total of thirty-six cases. Fractures of the vertebrae were found in fourteen, or 38 per cent. Intracranial hemorrhage was present in 44 per cent, though this was marked in only 25 per cent.

In an analysis of the spinal fluid of 423 newborn negro babies, Roberts found that sixty, or more than 14 per cent, contained blood. In the sixty babies in whom spinal hemorrhage was found, the trouble was attributed to trauma in fifty-eight and to hemorrhagic disease in two cases.

Sharpe and Maclaire, in a series of noteworthy studies made of 400 newborn babies in whom spinal puncture was performed within twelve to forty-eight hours after birth, found evidence of excessive cranial stress by the presence of blood in the cerebrospinal fluid in from 7 to 13 per cent of the cases.

Spencer, in a study of 130 stillborn children, found intracranial hemorrhage in fifty-three or 40.7 per cent. Twelve of the babies were delivered by forceps, and in all of these hemorrhage was found. Wallich, quoted by Birnbaum, in 143 post-mortem studies of stillborn babies, found intracranial hemorrhage in fifty-eight, and Litzmann, also quoted by Birnbaum, found spinal meningeal hemorrhage in thirty-three of eighty-one autopsies performed on stillborn infants.

Sharpe and Maclaire, in a very recent series of one hundred spinal punctures performed on newborn babies, found blood contamination in six.

Pierson, in studying his series of cases with reference to the nature of delivery, encountered difficulty with the head in 57 per cent; with the arms and shoulders in 25 per cent; with the cervix in 11 per cent, and with the placenta and cord in 28 per cent.

This author points out that trauma alone was the probable cause of death in 56 per cent of the thirty-six cases. Asphyxia, thought to be the most prominent cause of death in breech delivery, was probably accountable in only 5 per cent. Trauma with asphyxia was thought responsible in 39 per cent. Pierson believes that birth injuries and shock following breech delivery cause a greater fetal morbidity and mortality than asphyxia. Accordingly he advises against unnecessary haste in breech extraction and indicates that hasty action, prompted by fear of asphyxia, is not justified. The diagnosis of death from asphyxia in breech deliveries, he claims, is only justified, first when, there is strong clinical evidence of asphyxia but none of injury, and second, when complete autopsy studies show characteristic signs of asphyxia, but none of injury.

In emphasizing the importance of undue haste in breech extraction, he refers to Potter and others who claim that from fifteen to twenty minutes may safely

be allowed to elapse in delivering the after-coming head. Potter has taken as long as twenty-three minutes in performing an extraction without injury to the child. Indeed, this well-known proponent of the operation of version, on more than one occasion, has even with safety delivered the placenta before the child.

From a study of injuries of the infant during delivery, it is observed that many are largely preventable. The means of prevention may be divided into: first, a wider adoption and higher standard of prenatal care and, second, more thorough intranatal training and better practice.

In conclusion, may I again quote from Holland, who says: "Antenatal methods are the strategy and intranatal methods the tactics of obstetrics." "Obstetrics," he states further, "is the Cinderella of medicine and she is only beginning to ascend to a proper position among her sisters."

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