

MORTALITY RATES AND CAUSES OF DEATH IN PREMATURE INFANTS

M. Gurdevski

A task of paramount significance which is set before our Public Health Services is the control of infant mortality. Further decrease of infant mortality rates demands a complete and thorough investigation into its causes.

All authors are unanimous in their conclusions that the largest part of infant mortality covers the neonatal period and that mortality rates of premature newborn infants are higher than in mature ones. Prematurity according to the studies of various authors (1, 7, 8, 12) varies between 4% and 10% of all births. Taking into consideration that premature infant mortality is much higher than that of mature ones its great importance in overall infant mortality rates and in the necessity for its thorough investigation immediately becomes clear.

The pathology of premature newborn infants is insufficiently investigated both from clinical and morphologic aspects.

From the statistical studies of K. Pavlov and D. Bobev on the causes of deaths in the perinatal period it becomes clear that the results vary in various maternity wards in the various districts of the country. This lays even more stress on the necessity to investigate the causes of neonatal mortality in Varna District.

Studies so far in this country cover perinatal mortality rates. Taking into consideration that mortality rates in the neonatal period are highest in premature infants we studied the causes of death only of live born premature infants assuming that such a study may provide better chances for the prophylaxis of neonatal mortality.

Our study was carried out on the basis of necropsy material for the period January 1, 1962 to October 1, 1963 at the Chair of Pathological Anatomy of the Higher Medical Institute in Varna.

The infants subjected to necropsy come from the area of Varna City and Varna District. For that period 151 necropsies of infants aged between 0 and 1 month were performed. Out of them 91 or 60,2% were premature infants. This fact once again emphasizes the abovementioned view that mortality among premature infants is much higher than among mature ones.

According to grades of prematurity most of the deceased infants belong to grade III of prematurity, namely 34 infants. Next follows I grade — 31 infants and least — II grade — 26 infants. According to these data it is difficult to draw a conclusion which grade of prematurity leads to highest mortality rates as we do not dispose of data on the numbers of the premature newborn infants.

On the basis of postmortem examinations carried out by us, the causes of death in premature infants may be classified as follows (Table 1).

Table 1

Incidence rates and causes of death in immature infants

Degrees of immaturity	Number of autopsies	Intra-cranial haemorrhage	Bronchopneumonia	Pulmonary hyaline membranes	Disorders Sepsis	Congenital heart failure	Diffuse peritonitis	Erythroblastosis	Diaphragmal hernia
degree weight 2001—2500	31	7 22,8%	13 41,8%	5 16,1%	4 12,9%	1 — 3,2%	—	1 3,2%	1 3,2%
II degree weight 1501—2000	26	10 38,4%	8 30,7%	5 19,2%	2 7,6%	—	1 3,7%	—	—
III degree weight 1001—1500	34	15 44,1%	14 41,1%	5 14,7%	—	—	—	—	—
Total	91	32 35,1%	35 38,4%	15 16,3%	6 6,5%	1 1,1%	1 1,1%	1 1,1%	1 1,1%

It is obvious from Table 1 that of the total number of deceased premature infants, the majority have died of bronchopneumonia — 38.4%. Next ranks — 35.1% — intracranial hemorrhage and third — 16.3% — pulmonary hyaline membranes. This ratio is not the same for all degrees of prematurity. While in I grade bronchopneumonia is almost twice as common as intracranial hemorrhage, in II and III degree prematurity the commonest cause of death is intracranial hemorrhage followed by bronchopneumonia.

Studies of other authors in this country (1, 7, 8) which do not follow up infant mortality after the degree of prematurity display certain differences as regards the incidence rates of intracranial hemorrhage. According to data of the Research Institute of Pediatrics the commonest cause of death in premature infants is bronchopneumonia with intracranial hemorrhage ranking second. According to the material of "Maternity Home" and II Municipal Maternity House in Sofia and the Clinic of Gynecology and Obstetrics in Plovdiv (8) intracranial hemorrhage ranks first, followed by bronchopneumonia. G. Mikhailov finds that 95% of intracranial hemorrhage in premature infants occurs in II and III degree of prematurity. Our data also confirm that intracranial hemorrhage is observed mainly in infants of II and III degree of prematurity. The fact that intracranial hemorrhage is more common in higher degrees of prematurity should be explained by underdevelopment of tissue and chiefly by the imperfect construction of the walls of the blood vessels (9). No lesser importance for intracranial hemorrhage is ascribed to asphyxia which occurs much more easily in premature infants, owing to the tendency of the lungs toward atelectasis as a result of the underdevelopment of elastic fibres in the lungs. Asphyxia and related disorders of the cerebral hemodynamics according to Dorofeev are of primary importance for the occurrence of hemorrhage in the arachnoid and pia mater and the brain substance.

The distribution and massive hemorrhage in the ventricles and brain substance are not characteristic of asphyxia. It is determined by infections and toxemia of pregnancy as well as by abnormal delivery.

Intracranial hemorrhage is most common in premature infants, owing to the low adaptive capacity of the heart and respiratory muscles to the increased blood supply to the lungs. The draining of the blood in vena cava superior is thus hampered and the pressure is transmitted to the brain substance and the choroid plexus (4). Asphyxia itself never leads to laceration of the falx and the tentorium. This may be supported by presenting a typical case.

Necropsy record No. 2/1962. A III grade premature newborn infant. Born in asphyxia, which continued after birth and the infant displayed marked cyanosis several times during the first 24 hours. On the second day of life the infant died. Clinical diagnosis — prematurity, cerebral hemorrhage. Postmortem examination revealed the following: Massive hemorrhage in the arachnoid and pia mater and the lateral ventricles. No laceration of the falx and the tentorium.

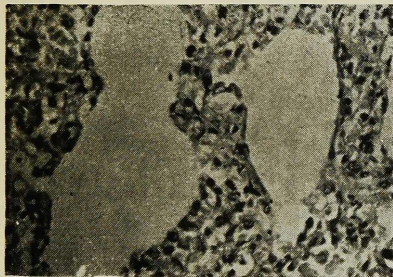


Fig. 2 — Interstitial bronchopneumonia, autopsy record No. 349/1962. H. E. Stain, Magnif. 10×65

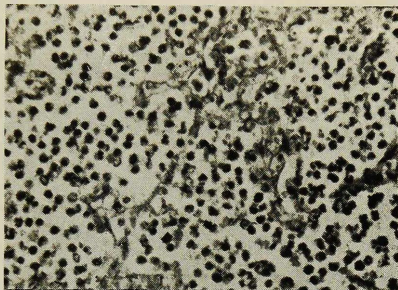


Fig. 1 — Catarrhal bronchopneumonia, Autopsy record No. 6/1962. H. E. stain Magnif 10×65

In this case most probably the hemorrhage is a result of asphyxia and the subsequent hemodynamic disorders of the brain.

According to their localization intracranial hemorrhages in our material may be divided as follows: in the arachnoid and pia mater — 21 cases, in the brain substance with perforation in the ventricular system — 7; and only in the brain substance — 4 cases. According to data also of other authors (3) largest is the number of cases of hemorrhage in the arachnoid and pia mater.

Although the morphologic appearance of the hemorrhage may reveal the causative factors, nevertheless in our cases it is difficult to ascribe

the causative factors, nevertheless in our cases it is difficult to ascribe

the hemorrhage only to the influence of one factor. Most probably the causes are complex — birth trauma, asphyxia, impediment in the adaptation of the cardio-vascular system to the new conditions owing to immaturity of the tissue etc.

The observance of these factors and their more efficient control during delivery and prior to birth may decrease the incidence rates of intracranial hemorrhage in premature infants.

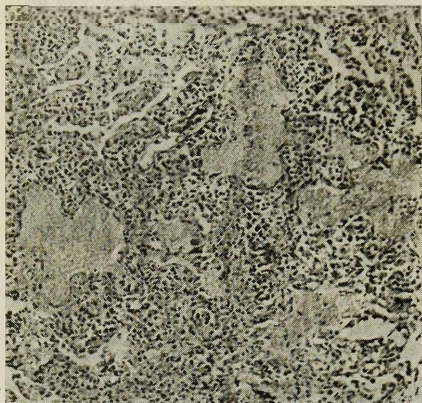


Fig. 3 — Pneumocystic pneumonia, Autopsy record No. 250/1962. H. E. stain Magnif. 10X20

Bronchopneumonia ranks first as a cause of death of 1 grade premature infants and second in the remaining degrees of prematurity.

According to morphological data bronchopneumonia in our material is distributed as follows: catarrhal — 20; interstitial — 5; hemorrhagic — 6; pneumocystic — 2; aspiration — 2. (Fig. 1, 2, 3, 4).

No systematic bacteriologic examination has been carried out. For that reason we cannot classify bronchopneumonia according to etiology.

The abovementioned data indicate that bronchopneumonia remains a fundamental problem for this group of infants. The great diversity of morphological signs in bronchopneumonia should be ascribed to diverse etiologic factors as well as to the low resistance of the organism during this period of life and also to the various stages in the course of the inflammatory process. In the pathogenesis of pneumonia in premature infants such factors as decreased reactivity of the organism and lower adaptive capacity of the respiratory and the cardio-vascular system should be taken into consideration. As a result of that there easily occur hemodynamic disorders and atelectasis of the lungs. These factors should be born in mind in the prophylaxis of pneumonia of premature infants.

On the third place among the causes of death of the newborn premature infants rank the pulmonary hyaline membranes. Although many authors do not consider this ailment an independent nosologic entity, it takes a considerable place in neonatal mortality and particularly of premature infants. For this reason it deserves a more detailed discussion.

Until recently this disease though displaying a characteristic morphologic pattern and a well defined clinical picture was not well known

to clinicians. This may explain the fact that in the three big maternity houses in Sofia (1) from 1949 to 1952 neither clinically nor on post-mortem examination was ever made the diagnosis of pulmonary hyaline membranes. Most probably many infants who died with the diagnosis of "debilitas vitae", have suffered from pulmonary hyaline membranes. Now almost all authors (2, 6, 10) express the view that pulmonary hyaline membranes result in high mortality rates in newborn and particularly in premature infants. K. Pavlov has found pulmonary hyaline membranes in 26,4% of the newborn infants who have died before the 7th day after birth.

In our material of 91 necropsies of premature infants 15 or 16,3% suffered from pulmonary hyaline membranes. In the various degrees of prematurity the cases are equally presented.

The following are pointed out as favourable factors for the occurrence of pulmonary hyaline membranes: vascular permeability, aspiration of amniotic fluid, necrosis of the alveolar epithelium, the effect of oxygen on the alveolar epithelium etc. It is assumed that they are encountered more frequently in boys and in infants born from mothers suffering from diabetes and by Caesarean section. Our observations give us no grounds to draw such a conclusion. Both sexes are almost equally represented and most of the cases occur in normal pregnancy. All infants with pulmonary hyaline membranes subjected to postmortem examination by us have died before the third day of life, but usually the infants die in the first several hours. The following case is very demonstrative:



Fig. 4 — Aspiration bronchopneumonia, Autopsy record № 279/1962. H. E. stain, Magnif. 10×65.

Necropsy record No. 279/1962. A newborn premature boy weighing 1700 g. Born after a normal pregnancy, cried immediately after birth, but about 30 minutes later started to groan, relaxed, cyanosis appeared on the lips, auriculae and the limbs. Breathing became superficial, irregular and the infant died several hours later. Clinical diagnosis: partus prematurus, haemorrhagia cerebri.

Pathoanatomical findings: atelectasis of the lungs and a marked venous stasis in the visceral organs. Histological examination of the lungs revealed a secondary atelectasis, hyperemia and the presence of homogenous, rosy, ribbon-like formations in the lumen of the alveolar ducts and alveoli (Fig. 5).

In 6.5% of the postmortem examined premature infants sepsis was present. As compared with the preantibiotic era sepsis is less frequently encountered despite the fact that newborn and premature infants display a tendency toward generalization of the inflammatory process. Thus for

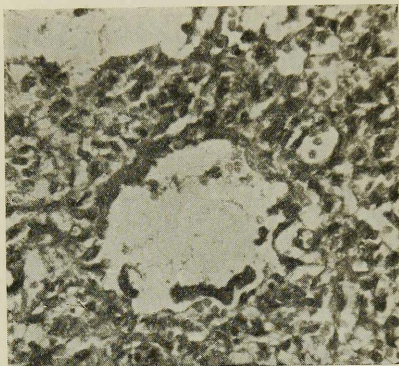


Fig. 5 — Pulmonary hyaline membranes. Autopsy record No. 279/1962. H. E. stain, Magnif. 10×65

instance, according to data of M. A. Skvortsov for the period 1936 to 1943 only umbilical sepsis amounted to 9.6% of necropsies of infants below one year of age. According to the port of entry of the infection our cases are distributed as follows: umbilical sepsis — 3 cases, otogenic — 1, cutaneous — 1 and one case in which it occurred as an intrauterine infection. The latter case is interesting, and we shall present it with more details.

swollen with tight abdominal walls, short limbs and neck. Died three hours and a half after birth. Sent for necropsy with the diagnosis: monster.

Pathologoanatomical findings: purulent leptomeningitis, serous pericarditis, catarrhal and at places interstitial bilateral bronchopneumonia, hydrothorax, ascites and persisting ductus Botalli.

Necropsy record № 236/1963. Born premature of 1 degree, uttered a flabby cry. At birth the abdomen was

The remaining postmortem examined infants have died of: congenital heart failure incompatible with life — 1 case, diffuse peritonitis following laparotomy for umbilical hernia — 1 case, erythroblastosis — 1 case, congenital diaphragmatic hernia — 1 case.

With regard to the duration of life — see Diagram 1.

Out of 91 postmortem examined infants 84 or 92.3% have died in the neonatal period, i.e. up to the 28th day of life. The majority of the infants — 41 or 45% have died in the first 24 hours after birth. In this group most of the deceased are infants with III grade immaturity — 18 infants or 44% of the infants who died on the first day after birth. This indicates that the higher the degree of prematurity, the earlier the infants die. The next "hazardous" period for the premature infants is the period up to the 7th day following birth. Between the first and the seventh day 30 infants have died, i.e. for the period from birth till the end of the first week a total of 71 infants have died, which amounts to 78% of the perished immature infants. Therefore the most dangerous period for the newborn immature infants is the first week of life. Our data confirm the

views of other authors (1, 7), that infants who survive the first week of life seldom die.

The high mortality rates among premature infants in the first hours or days of their life are explained with the transition from intrauterine to extrauterine life and the difficult adaptation of the insufficiently mature organism to the new conditions of life. Based on these premises the greatest efforts of obstetricians and pediatricists should be directed to the early period of the life of premature infants. When favourable conditions for the bringing up of immature infants are created the infants may become viable and healthy and may develop normally.

Conclusions

1. Mortality rates among premature infants are substantially higher as compared with those in mature ones. In the material studied by us 60,2% of the postmortem examined infants aged up to one month are premature.

2. The most common cause of death in I degree premature infants is bronchopneumonia, second ranks intracranial hemorrhage. In II and III degree of prematurity the infants die chiefly of intracranial haemorrhage, followed by bornchopneumonia.

3. In higher degree of prematurity intracranial hemorrhage is the most frequent cause of death: I degree — 22,8%, II degree — 38,40%, III degree — 44,1%.

4. Premature infants die usually in the first 24 hours — 45% or during the first week of life — 78%. The higher the degree of prematurity the earlier the infants die. This is indicative of a comparatively low adaptive capacity of the insufficiently mature organism.

5. The analysis made by us directs towards prophylactic and therapeutic measures in immature infants at the time of birth as well as in the early postnatal period.

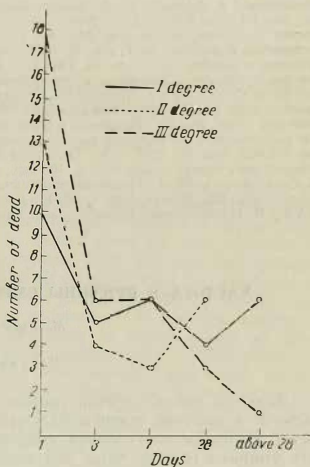


Diagram 1 Periods of occurrence of death after birth

REFERENCES

1. Бобев, Д. Неонатална смъртност и борбата с нея, 104 стр. „Наука и изкуство“, Пловдив, 1954 г.
2. Ганчев, Св. Въпроси на педиатрията, акушерството и гинекологията, стр. 32, кн. 4/1961 г.
3. Дергачев, И. С. Патологическая анатомия новорожденных и грудных детей. Многотомное руководство по патологической анатомии, том III, стр. 505, Медгиз, 1960 г.
4. Дергачев, И. С. Вопросы охраны материнства и детства, кн. 10, стр. 84, 1963 г.
5. Дорофеев Н. М. Вопросы охраны материнства и детства, кн. 1, стр. 48, 1963 г.
6. Кауфман О. Я. Вопросы охраны материнства и детства, кн. 1, стр. 52, 1963 г.
7. Коева, К. и В. Киселкова. Недоносені деца, 136 стр., „Медицина и физкултура“, София, 1957 г.
8. Михова М., Ю. Якубов, С., Дамова. Причины за антенатална и интранатална смъртност на плода и постнатална смъртност на новороденото. По някои въпроси на борбата с детската смъртност у нас, стр. 51, „Медицина и физкултура“, София, 1959 г.
9. Михайлов Г. Към хистогенезата на вътречерепните кровоизливи у недоносени деца. — *Научни трудове НИИП*, том IV, 1962 г.
10. Павлов К. Патологоанатомични промени у деца, починали през перинаталния период, 108 стр., „Медицина и физкултура“, София, 1959 г.
11. Скворцов М. А. Патологическая анатомия важнейших заболеваний детского возраста, стр. 425, Медгиз, 1946 г.
12. Ульрих И., Пржадин М., Кубат К., Мелихар В. Профилактика перинатальной смертности, стр. 88, Медгиз, 1963 г.

ЧАСТОТА И ПРИЧИНЫ СМЕРТИ У НЕДОНОШЕННЫХ

М. Гырдевски

РЕЗЮМЕ

Делается анализ причин смерти 91 вскрытых недоношенных детей. Частота и причины смерти рассматриваются по степени недоношенности, и срокам наступления смерти после рождения. Недоношенные дети умирают гораздо чаще чем доношенные — 60,2% вскрытых в возрасте до I месяца. Более легкие степени недоношенности умирают чаще всего от бронхопневмоний — I степени — 41,8%, II степени — 30,7%, III степени — 41,1%, а более тяжелые степени недоношенности — в результате внутречерепных кровоизлияний: I степени — 22,8%, II степени — 38,4%, III степени — 44,1%. Чем выше степень недоношенности, тем раньше погибают дети, что указывает на пониженную адаптационную способность незрелого организма. Указываются некоторые из факторов, ведущих к заболеваниям в раннем послеродовом периоде у недоношенных детей, и рекомендуются профилактические мероприятия.