

Management of Cord and Placental Blood and Its Effect Upon the Newborn

PART I

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SUMMARY

A comparative study was made of erythrocyte counts and weights of the newborn at term. Three groups were used: Cases in which the cord was clamped at once, those in which the cord was allowed to pulsate five minutes, and those in which the cord and placental blood was stripped into the baby. Standards and procedure were set up so that there would be a minimum of error.

Evidence was elicited showing that babies in the "pulsating" and the "stripped" groups received a significant amount of blood which was beneficial. The amount varied, but when the stripping method was used, the term baby received about 100 cc. of blood.

Babies receiving this blood had higher erythrocyte counts, higher hemoglobin values, higher initial weights, less weight loss, and less rapid loss of weight.

It is believed the additional blood supplied is of benefit especially to prematures and to those infants who are in any degree of shock following long labors, difficult deliveries, abruptio placenta, placenta previa, or compression of the cord.

The added blood benefits the baby by combating the initial shock, by aiding in filling the capillary bed of the expanding lungs, by increasing iron reserve, by lessening demand upon blood-forming organs (especially in prematures), by protecting the breakdown of body proteins and by aiding the transition from one source of oxygen to another.

Five minutes, as a rule, is not long enough

to wait for pulsation if the baby is to receive its quota of available blood.

Stripping of cord and placental blood into the infant is not a harmful procedure when done gently and is particularly useful in cases where the condition of the mother or child is such that it is inadvisable to wait for the uterus to force the blood physiologically into the child.

The additional blood does not cause icterus.

The pulsating of the umbilical cord plays only a minor role in the process by which the baby receives blood after the second stage of labor. The pressure of the uterine contractions upon a blood-filled placenta, forcing blood through the umbilical vein into the child, plays the major role. Pitocin and/or ergot preparations would aid in this process.

Anemic mothers have a tendency toward having anemic babies.

Venous pressure experiments using a phlebomanometer showed pressures before and after stripping, the force of uterine contractions on the umbilical vein pressure and the variation in pressure with crying and at rest. The giving of 100 cc. of blood by stripping affects the venous pressure of the child very little, if done slowly. If the stripping is done rapidly, there is a transient rise with a return to normal within a few minutes.

A survey of 1,900 diplomates of the American Board of Obstetrics and Gynecology showed that there is wide variation in the management of cord and placental blood. Of 455 specialists who stripped the cord, five thought there was some increase in icterus, and one reported cardiovascular distress.

THE patient in premature labor with a questionably viable baby is a familiar and all too-frequent problem. The usual precautions are taken: The fetal heart is carefully observed for signs of distress, analgesia is held to a minimum, Vitamin K is administered. When dilatation of the cervix is complete and the presenting part on the perineum, an anes-

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Chairman's Address: Presented before the Section on Obstetrics and Gynecology at the 78th Annual Meeting of the California Medical Association, Los Angeles, May 8-11, 1949.

thetic having minimal effect upon the baby is given, usually caudal or low spinal. An episiotomy is made and the premature child carefully delivered. The umbilical cord is then usually cut immediately, the air passages cleared, and the child rushed to the incubator. A pediatrician is summoned and all agree that if the child "has the spark" it will survive; if not, it will die. Why do some not have the "spark"? One reason which prompted the study here presented was to try to answer this question.

A statistical survey of the maternal and infant mortality at the Hospital of the Good Samaritan over a 20-year period showed a dramatic decline in

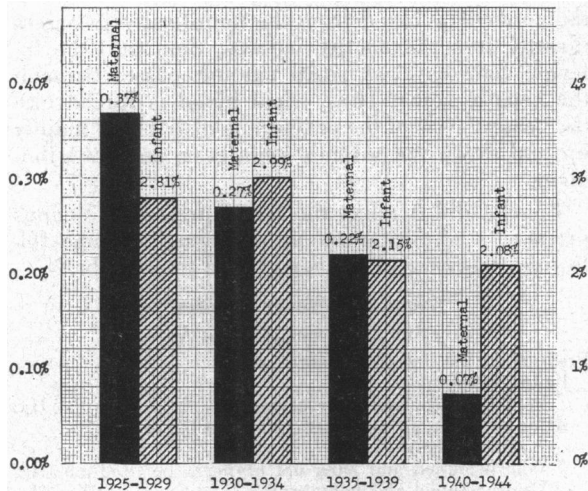


Chart 1.—Maternal mortality and infant mortality at the Hospital of the Good Samaritan in periods of five years. (Based on material from: Fagan, Robert H.: Maternal and infant mortality, *West. J. Surg., Obst. & Gynec.*, 55:584-596, November, 1947.)

the maternal mortality rate (from 0.37 per cent to 0.07 per cent) while the infant mortality rate decreased only from 2.81 per cent to 2.08 per cent (Chart 1). A high percentage of the infant deaths was due to prematurity.

Premature babies not only appear to be underdeveloped but are often in varying degrees of shock. Can this be partially due to an insufficient blood volume? Since anemia is almost a constant finding, perhaps what they need most for survival is blood.

Anemia is due to several factors: (1) The underlying cause of the premature labor may be abruptio placenta, or placenta previa, either of which would deprive the infant of its normal quota of blood. (2) Compression of the cord with the resulting interference of blood flow to the child. (3) Poorly developed blood-forming organs, which is characteristic of prematures. Such babies quickly use up their reserve supply of blood.³ (4) Immediate clamping of the cord deprives the child of blood present in the cord and placenta. At the 28th to 30th week in the circulatory system of the baby, cord, and placenta, it is believed about 50 per cent of the blood volume is in the cord and placenta. It is felt that the premature baby needs a good share of this cord and placental blood to give it the best chance for survival.

In 1885, Engle⁶ reported twice as great a mortality in premature infants whose cords were tied early as in those whose cords were tied late. This is understandable because the placenta reaches its maximum relative size at about the fifth month and contains a greater proportion of the fetoplacental blood volume.

There are times when the condition of the mother or baby, or both, makes it inadvisable to wait until the cord stops pulsating or the uterus to compress placental and cord blood into the baby, and since the giving of a transfusion to a premature baby in an incubator is a difficult and often traumatic procedure, it occurred to the authors that the immediate, gentle stripping of the cord and placental blood into

the baby might be the simplest and surest method of giving the blood they all seem to need. Also it was felt that, because of the need for haste, this might be the method of choice in term babies delivered by cesarean section. At term, about one-third of the total blood volume in baby, cord, and placenta is in the cord and placenta⁵ and part of this might benefit especially those babies who were in mild or severe shock following prolonged labor, forceps delivery, or other obstetrical procedures or conditions such as placenta previa, abruptio placenta, and compression of the cord.

In order to determine the effect of cord and placental blood upon infants, blood studies were made in three groups of cases: First, those in which the cord was clamped at once; second, those in which the cord was allowed to pulsate five minutes; and third, those in which the cord and placental blood was stripped into the infant.

Complete blood cell counts and bleeding and clotting time determinations were made in all cases within two hours of birth and on the fifth postpartum day. The counts were all done by the same laboratory and a large percentage by the same technician. The mothers were at term, Rh positive, had uneventful prenatal courses, normal labor and delivery. Demerol, scopolamine, and seconal were given for analgesia and a low spinal was the anesthetic used in all cases.

It has been known for years and proved by many workers^{2, 4, 10, 11, 13, 17, 18} that if there is a waiting period following delivery at term, before the cord is clamped, the baby will receive on the average of an additional 90 cc. of blood. Budin² (1876) and Schucking¹⁷ (1877) were the first to prove this fact. Schucking believed the increased volume occurred because the blood was forced into the child by uterine contractions. This has been noted by other workers, and the authors satisfied themselves that this was true by repeating Schucking's experiments and putting the child on scales with the cord attached and watching the weight increase, especially with each contraction of the uterus. This emphasizes that it is primarily the contracting uterus upon a blood-filled placenta which forces blood into the fetus, and not the pulsating of the cord.

Most observers, and especially De Marsh,⁴ believe this additional blood to be beneficial to the baby. It has been said that "not to let the baby have this blood is equivalent to allowing an adult to bleed 500 cc." Physiologically the baby needs this blood because: First, it helps fill the capillary bed of the expanded lungs; second, it increases the iron reserve. Wilson, Alt, and Windle²⁰ state: "The amount of iron lost to the newborn when 100 ml. of placental blood is prevented from reaching the child amounts to 54 mg. This is enough to lower the hemoglobin level of a four-months-old infant from 12 to 9.3 gm. per 100 ml. of blood. It seems likely, therefore, that the loss of placental blood may predispose infants to anemia later, since the principal blood reserve lies in the circulating hemoglobin rather than in the tissues." Third, it lessens the

demand upon the splenic reservoir of blood.²¹ Fourth, in premature babies it lessens the demand upon the poorly developed blood-forming organs.³ Fifth, it is a source of nourishment which protects infants against the breakdown of body proteins. An increased excretion of nitrogen occurred in infants whose cords were cut early.¹⁶ Sixth, less weight loss and more rapid weight gains were noted when the cord was cut late. This was first observed by Schiff in 1892.¹⁶ Seventh, higher erythrocyte counts and hemoglobin values bridge more smoothly the transition from one source of oxygen to another by maintaining a higher oxygen carrying capacity.¹⁴ Eighth, it would help maintain an adequate blood pressure, since all premature infants have relatively low blood pressure readings.¹

The stripping of blood from the cord was started with caution, since it is a controversial procedure. De Lee³ states in his text: "It is an error to force blood of the placenta into the child by stripping the cord towards the child. This overloads blood vessels, causes icterus, melena, even apoplexy." However, after consulting various pediatricians, cardiologists, and obstetricians, it seemed doubtful that harm could be done if the stripping were done gently and slowly. If 100 cc. of Rh-positive blood were physiologically beneficial to the term baby (or about 50 cc. to premature infants) it would seem to make little difference whether it were: (1) forced into the baby by uterine contractions; (2) stripped into the baby, except that by stripping the baby received blood at once and with ease; or (3) given by syringe as a transfusion.

Several questions presented themselves in proceeding with the stripping method:

1. How much blood was stripped into the baby?
2. Through which cord vessels did it pass?
3. Where did it go immediately after leaving the cord?
4. Did it affect the blood pressure to a harmful degree?
5. What effect did it have clinically upon the infant and the blood picture, as compared to the other groups in the series?

The first, as to how much blood was stripped into the baby, was easily answered from reports in the literature,⁴ and by observations. The amount reported was about 100 cc. In the authors' cases, the minimum was 75 cc., and the maximum 135 cc., and there was no relationship between the long and the short cords as to the blood volume. The short cords had more tortuous vessels or larger vessel diameters, or both.

The second question, through which cord vessels did the blood pass, was answered by clamping off the umbilical vein and measuring the amount stripped from the hypogastric arteries, and in other cases clamping off the hypogastric arteries and measuring the amount stripped from the umbilical vein. Only a few drops could be stripped from the hypogastric arteries and about 100 cc. could be obtained from the umbilical vein.

Third, where did it go immediately after leaving

the cord? The blood from the umbilical vein passes directly into the ductus venosus, then into the inferior vena cava. A small amount passes through the hepatic veins. Thus, when blood is forced into the venous system, the pressure is distributed mainly up and down the infant's vena cava and its tributaries.

Fourth, did it affect the blood pressure? Venous pressure studies showed no significant change following stripping of the cord blood into the baby.

Venous Pressure Studies*

Subject: Female Infant A

Pressure in the umbilical vein:

Before stripping—	
Vein occluded and baby crying.....	22 mm. Hg.
After stripping an estimated 100 cc. of blood	
into the baby—	
Vein occluded and baby not crying.....	11 mm. Hg.
Vein occluded and baby crying.....	20 mm. Hg.

Subject: Male Infant B

Pressure in the umbilical vein:

Before stripping—	
Vein occluded and baby not crying.....	7 mm. Hg.
After stripping (rather rapidly) an estimated	
100 cc. of blood into the baby—	
Vein occluded and baby not crying.....	45 mm. Hg.
Five minutes later.....	11 mm. Hg.

It is believed the immediate rise in pressure was due, in this case, to the rather rapid stripping of blood into the baby.

Subject: Female Infant C

(With cord clamped midway between placenta and baby)

Venous pressure on baby's side.....	24.6 mm. Hg.
Venous pressure on mother's side.....	25.4 mm. Hg.

Approximately two minutes later 10 units of Pitocin® was given and the pressure on the mother's side rose to 110 mm. Hg., and then to 130 mm. Hg. This is extremely significant since it illustrates the method by which a baby obtains blood—the strongly contracting uterus causing a very high umbilical vein pressure which easily overcomes the relatively low venous pressure of the baby.

Uterine contractions and crying of the baby caused wide variations in umbilical pressures:

Uterus relaxed.....	10 mm. Hg.
Uterus contracting.....	18 mm. Hg.
Baby crying.....	18 mm. Hg.
	21 mm. Hg.
Baby at rest.....	8 mm. Hg.
	12 mm. Hg.

Further pressure studies are being carried out and will be reported at a later date.

Fifth, the clinical effect upon the infants receiving blood by stripping was beneficial. In the 50 cases no harmful effects were observed and there was no increase in icterus.

It is commonly thought that babies receiving this blood by "pulsating" or "stripping" have a high incidence of icterus. This was not borne out in the author's series, or by Franklin, Frankael, or Find-

*Venous pressures were recorded by using the phlebomanometer on the umbilical vein of a newborn baby with the placenta attached. The umbilical vein was obstructed with a hemostat. (See Figure 1.)

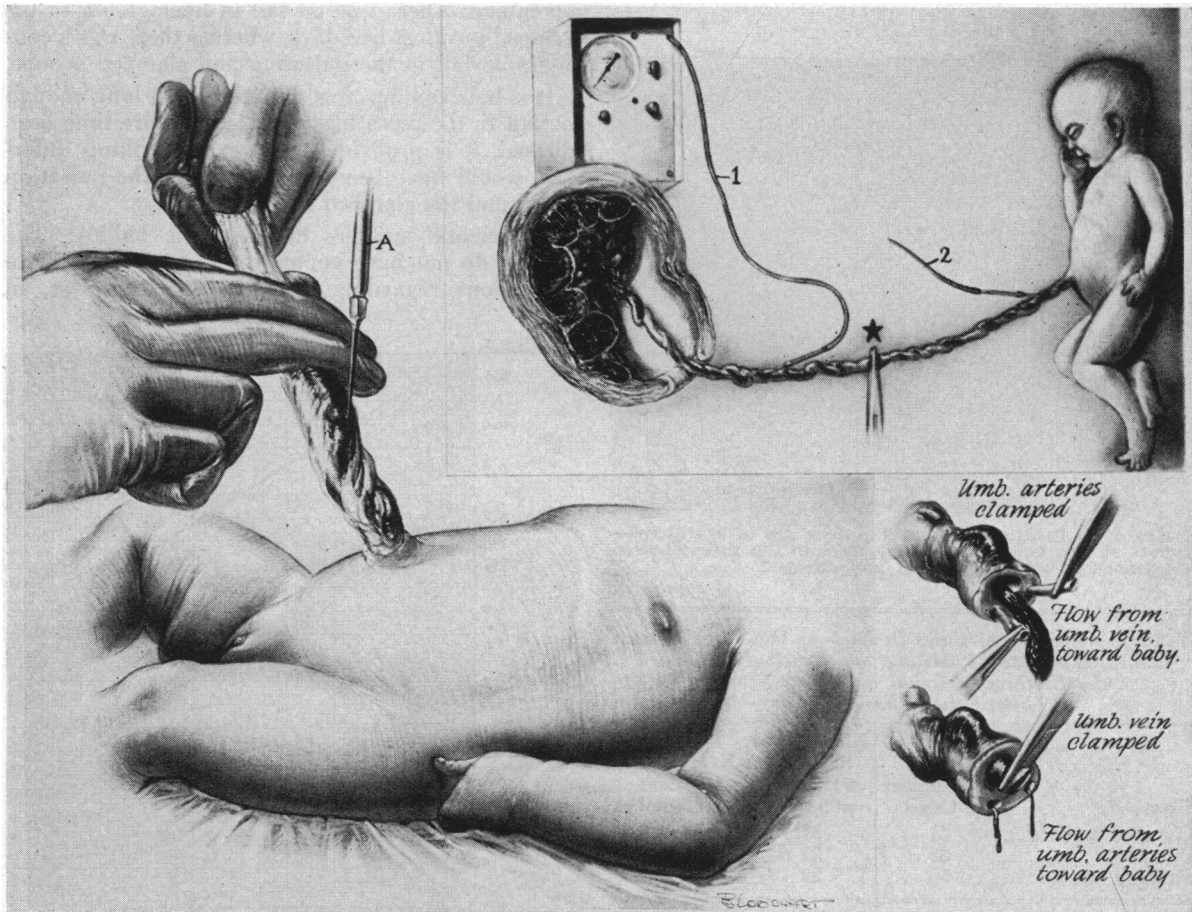


Figure 1.—Showing the method used in determining venous pressures.

lay, Higgins, and Stanier,^{7, 8, 9} who could detect no difference in rates of fall of hemoglobin as between infants who were jaundiced and those who were not. Another argument against a theory of excessive hemolysis is that no hemolysin can be demonstrated in the blood of the newborn (except in erythroblastosis).^{7, 19} Hoet¹² and Renaer¹⁵ explain icterus in terms of failure of the liver to excrete pigment at the normal rate. With this, Weech¹⁹ agrees, stating that if hepatic function is mature, excretion will be prompt; if immature, excretion will be delayed and serum concentration of bilirubin will rise.

In the series here reported there were 42 cases in which the cord was clamped at once, 36 cases in which the cord was allowed to pulsate five minutes, and 50 cases in which the cord and placental blood was stripped into the baby. For the sake of simplicity they shall be referred to as “clamped,” “pulsating,” and “stripped.”

It is believed that the blood cell counts made on the fifth day offer a truer picture than the counts made at two hours, since the later counts reflect hematologic adjustment. The difference might be compared to the difference in accuracy between evaluation of the blood picture immediately following a blood transfusion or a hemorrhage, and evaluation some time later.

Table 1 and Chart 2 show the average erythrocyte count at two hours and at five days, in the three classes—clamped at once, pulsating, and stripped. It is interesting to note the relatively small drop in the “stripped” cases. This is against the general impression that more blood causes icterus.

TABLE 1.—Average Erythrocyte Count at 2 Hours and at 5 Days in Three Classes: Clamped at Once, Pulsating, and Stripped.

Class	Average at 2 Hours	Average at 5 Days	Expressed as Per Cent of Difference	Aver. at 2 Hours
Clamped at once..	5,377,073	4,946,097	430,976	—8.02
Pulsating	5,958,888	5,369,166	589,722	—9.90
Stripped	5,851,800	5,742,800	109,000	—1.86

The difference between the averages for clamped and pulsating are about the same as in other published series.^{4, 10} The difference between the averages for “clamped” and “stripped” at five days—796,703 erythrocytes—is much greater and certainly significant.

Table 2 shows the number of cases in each of the three classes—clamped at once, pulsating, and

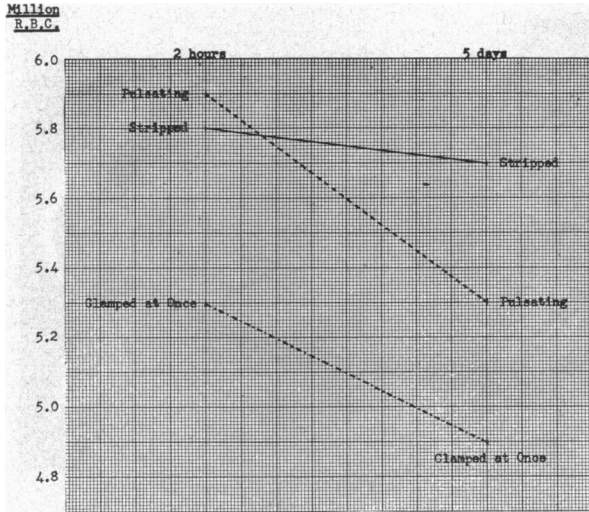


Chart 2.—Relation between the averages of erythrocyte counts at two hours and at five days in the three classes—clamped at once, pulsating, and stripped.

TABLE 2.—Number of Cases in Each of the Three Classes (Clamped at Once, Pulsating, and Stripped) in Which the Erythrocyte Count at 5 Days Showed Lower Values Than at 2 Hours

Class	Total Number of Cases	No. of Cases Showing a Decline at 5 Days	Expressed as Per Cent of Total Number
Clamped at once	41	31	75.6
Pulsating	36	27	75.0
Stripped	50	29	58.0

stripped—in which the erythrocyte count at five days was less than at two hours. In 42 per cent of the “stripped” cases there was no decline at all.

Chart 3 shows the relation between the averages of erythrocyte counts at two hours and at five days in cases in which the counts were above average at two hours: There was a rapid drop in all three groups, but it was less in the stripped group.

Chart 4 shows the relation between the averages of erythrocyte counts at two hours and at five days in cases in which the counts were below average at two hours: In this group there was a much less rapid drop in the clamped-at-once and pulsating categories; in the stripped cases there was an actual increase.

Chart 5 shows average weights at birth, at the time of lowest reading, and at five days in the three classes. In the clamped-at-once category, the average decline from the birth weight to the lowest weight was 7.7 per cent; in the pulsating group, 6.9 per cent; in the stripped group, 4.3 per cent. Thus, in those cases in which the cord was stripped, the babies weighed more, because of receiving more blood, they lost weight less rapidly and their total loss was less.

Chart 6 shows the average hemoglobin content, expressed in grams per 100 cc., at two hours and at five days after birth. Here again stripping showed to

advantage: There was no fall in hemoglobin in the stripped group at five days, whereas there was a considerable fall in the pulsating and clamped groups.

It is believed that five minutes is not long enough to wait in the pulsating group; had more time been allowed, it is probable that a more striking difference would have been noted between the pulsation group and the clamped series.

Do anemic mothers have anemic babies? The authors do not have enough cases to draw definite conclusions regarding this question; however, in

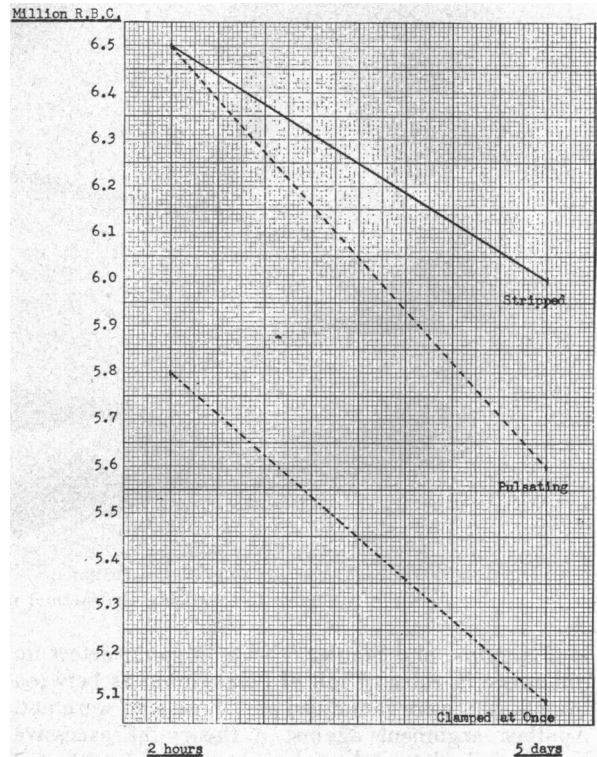


Chart 3.—Relation between the averages of erythrocyte counts at two hours and at five days in cases above average at two hours—clamped at once, pulsating, and stripped.

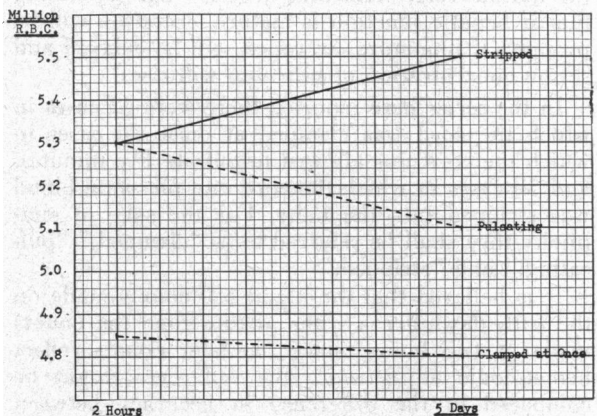


Chart 4.—Relation between the averages of erythrocyte counts at two hours and at five days in cases below average at two hours—clamped at once, pulsating, and stripped.

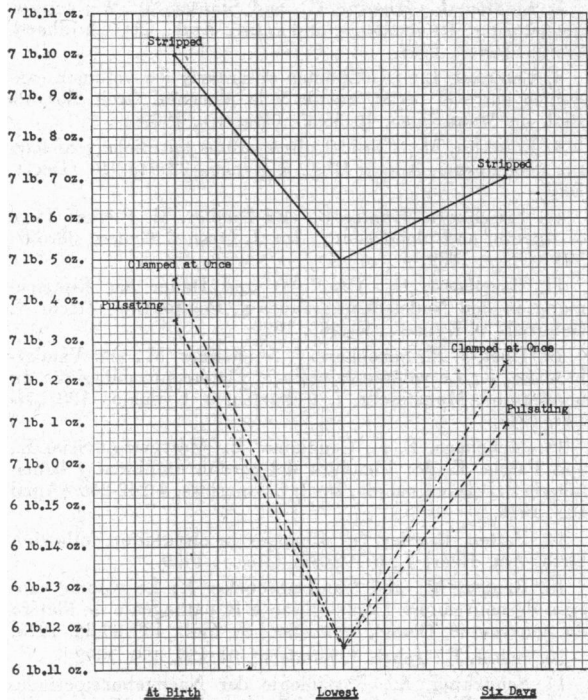


Chart 5.—Average values at birth, at time of lowest reading, and at six days in the three classes—clamped at once, pulsating, and stripped.

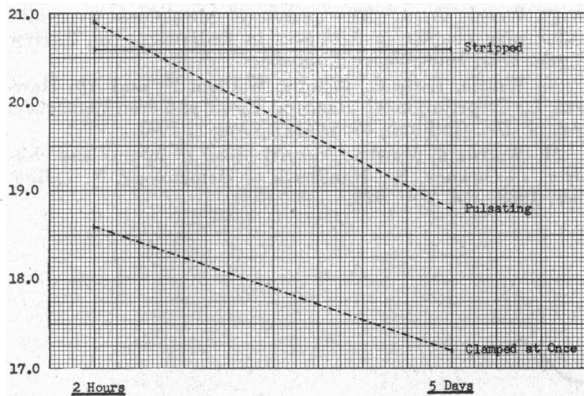


Chart 6.—Average hemoglobin content expressed in grams per 100 cc. at two hours and five days after birth—clamped at once, pulsating, and stripped.

the cases of ten mothers who had low hemoglobin values (72 per cent or under) on their fifth postpartum day and who had lost less than an estimated 200 cc. of blood at delivery, there was a tendency toward lowered hemoglobin content in the blood of the babies. The babies in these ten cases had an average of 15.8 grams of hemoglobin per 100 cc. (a value of 93.8 per cent) compared with the average in the clamped group of 17.5 grams per 100 cc. and a value of 102.4 per cent.

In order to determine the usual practice regarding the management of cord and placental blood, and to obtain an opinion regarding the possible harmful effects of "stripping" the cord, a questionnaire was sent to 1,900 diplomates of the American Board of Obstetrics and Gynecology. Replies (1,198) came

from almost every state. Tables 3, 4 and 5 show the results.

TABLE 3.—Time of Clamping the Umbilical Cord

1,198 answers received to 1,900 questionnaires sent to diplomates of the American Board of Obstetrics and Gynecology		
Cord clamped immediately after birth	497	41.5%
Cord clamped less than 5 minutes after birth	400	
Cord clamped after pulsations have ceased	191	
Cord clamped somewhat later; exact time not indicated	110	
Number of cases in which cord was clamped somewhat later.....		
	701	58.5%
Total number of answers.....	1,198	100.0%

TABLE 4.—Stripping of the Umbilical Cord

1,198 answers received to 1,900 questionnaires sent to diplomates of the American Board of Obstetrics and Gynecology		
Obstetricians stripping the cord:		
Occasionally	53	
Frequently	1	
Always	22	
In prematures	21	
Not specified	358	
Number of obstetricians stripping the cord.....		
	455	38.0%
Number of obstetricians not stripping the cord.....		
	743	62.0%
Total number of answers.....	1,198	100.0%

TABLE 5.—Obstetricians Reporting Harmful Effects from Stripping of the Umbilical Cord

Number of obstetricians practicing stripping of the umbilical cord.....		455
Obstetricians complaining about harmful effects of stripping.....		6 = 1.3%
<i>Nature of Complaint</i>		
Icterus	5 = 1.1%	
Cardiovascular distress (following vigorous stripping)	1 = 0.2%	

From these figures it must be concluded that there has been no uniformity as to the teaching in our medical schools regarding the management of cord and placental blood and no consistency of practice among specialists in obstetrics. However, of 455 specialists who stripped the cord, only one noted harmful effects other than icterus, and this a questionable effect of stripping.

PHYSIOLOGY OF FETAL-PLACENTAL CORD CIRCULATION

The fetal circulation is well known to all obstetricians up until the delivery of the child. What happens and what should be done between the second and third stages of labor has caused a great deal of confusion and there is wide variance in practice. The authors believe that as soon as the child is delivered there is an immediate reduction in the size

of the placental site, the placenta begins to separate at once, and thus placental circulation is disrupted. Then the uterus contracting upon a blood-filled placenta forces blood through the umbilical vein into the baby. It has been shown that the strongly contracting uterine muscle causes a high venous pressure which easily overcomes the weaker venous pressure of the fetus. The umbilical vein remains dilated long after the umbilical arteries have ceased to pulsate. The cessation of pulsation of the cord is not the criterion as to the proper time for clamping the cord. Instead, when the contracting uterus no longer causes pressure in the umbilical vein, *that* would be a much better time to sever the cord. De Marsh, Alt, Windell, and Hillus⁴ found that after the cord stopped pulsating they were able to obtain an average of about 60 cc. from the cord by stripping.

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The authors wish to thank all those who aided in this study; the nursery and delivery room nurses, the record room personnel of the Hospital of the Good Samaritan; the clinical laboratory which donated time and material, and Dr. Travis Windsor, head of the Cardiovascular Foundation at the Hospital of the Good Samaritan, without whom the venous pressure studies could not have been done.

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