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The Placental Insufficiency Syndrome - I

by

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PART 1

Historical, Pathological & Aetiological Review

Introduction

The last few decades have seen the steady decline of perinatal mortality all over the world, in general. With the gradual reduction of perinatal deaths due to previously common causes such as prematurity, traumatic births and infections, the placental insufficiency syndrome, with its sequelae of intra-uterine asphyxia, has now come to the forefront as the leading cause of perinatal deaths. In the United Kingdom, a national perinatal mortality survey was carried out under the auspices of the National Birthday Trust Fund in 1958. During the period of this survey, 3rd to the 9th March, 1958, inclusive, complete clinical data were obtained from over 98 per cent of all the births in the United Kingdom, and autopsy studies were performed in about 88 per cent of all the perinatal deaths in the same period. The preliminary results of this National Survey have been published by Claireaux (1961, 1963), and it would be quite apparent from his results, that the placental insufficiency syndrome has been the leading cause of perinatal deaths. A review of the autopsy findings in the 2,368 perinatal deaths, that occurred in this large survey, revealed that the placental insufficiency syndrome, was either directly or indirectly responsible for about 40% of all the perinatal deaths. The other major causes were found to be prematurity (about 30%), congenital abnormalities (about 15%), and birth trauma (about 9%).

Definition

Although our attention has been drawn to this syndrome in current publications, there has been no effort made to put forth a clear cut concept of this syndrome. The following is my personal concept of the "placental insufficiency syndrome", and I have attempted to be as comprehensive, as possible.

"*The Placental Insufficiency Syndrome* is a state of dysfunction of the placenta in which there is poor overall growth or premature degeneration of the placenta, with resultant reduction in the placental reserve state, to such an extent as to be a danger to the foetus. This danger can manifest itself by retarded intrauterine foetal growth, or by a state of intrapartum foetal anoxia, either of which may predispose to perinatal death from asphyxia, intracranial haemorrhage or infection."

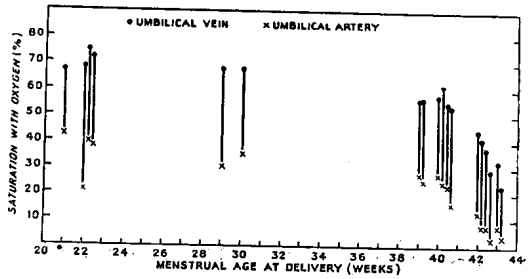
Historical and Experimental Review

As early as 1934, Sir Joseph Barcroft and his colleagues, working on goat and sheep foetus, have shown that the oxygen saturation of foetal haemoglobin deteriorated as pregnancy proceeded towards and beyond, the normal term. Again in 1945, Barcroft and Young showed that in the rabbit foetus, there is evidence of deficient oxygen saturation with special reference to postmaturity, by studying blood in the cerebral sinuses of the foetus. McKiddie (1949) suggested specifically that a falling oxygen supply might explain some of the special features seen in his cases of the prolonged pregnancy syndrome.

In 1949, guided by the work of Barcroft, and stimulated by the clinical findings of McKiddie, Walker and Turnbull in Aberdeen conducted extensive experimental studies on the oxygen saturation in the cord blood of human foetus at different periods of gestation, and in 1953 they published their findings which showed that the average oxygen saturation of foetal haemoglobin was about 70% at the 30th week of gestation, and with the advance of gestation the oxygen saturation steadily fell to reach 60% at the 40th week,

but thereafter the fall was very steep—the oxygen saturation being only 30% at the 43rd week of gestation. They concluded that the excess of foetal death in prolonged pregnancy could be due to a falling oxygen supply.

TABLE I



Percentage saturation with Oxygen of Cord blood of human foetus in normal pregnancy. (After Walker and Turnbull (1953 —Lancet, Vol. II. P. 312)

At about the same time as Walker and Turnbull, Browne and Veal at Hammersmith were conducting Uterine (Chorio-decidual) blood flow studies in both normal human pregnancy, and in cases of pre-eclampsia and chronic hypertension, with the aid of radioactive Na. 24 isotope. In 1953, they published their findings. They stated that the average uterine blood flow in normal pregnancy at the 38th week of gestation was about 600 ml. per minute, but that in cases of toxaemia and chronic hypertension, the blood flow was reduced to as low as 200 ml. per minute before foetal loss occurred. They concluded, therefore, that under normal conditions, the placenta has a considerable functional reserve status.

Pathology of Placental Failure

TABLE II

Classification of Placental Failure

MATERNAL CAUSES:

1. Defects in Utero-Decidual Circulation.
2. Defects in the Chorio-Decidual Circulation.

FOETAL CAUSES:

1. Gross Placental Atrophy or Infarction.
2. Trophoblastic Atrophy in the Chorionic Villi.

Scott Russell (1963) has pointed out that attempts to correlate placental histology and the clinical picture (including hormone studies) have proved very disappointing; and that a foetus can die despite reasonably normal histology, or live despite serious faults. He pointed out the the outstanding contribution of morbid histology to placental function has been the clear demonstration of the changing placental structure as pregnancy advances, and the consequent inference that the placental function also changes.

The pathological cause of placental failure can be broadly classified into maternal or foetal origin. From the maternal aspect the failure can be due to defects in the utero-decidual, or in the chorio-decidual circulation, such as occurs in the elderly primigravida, chronic hypertension and uterine scars. From the foetal aspect, the placental failure could be due either to gross placental infarction or to trophoblastic atrophy in the chorionic villi, such as occurs in prolonged pregnancy,diabetes mellitus and pre-eclamptic toxaemia of pregnancy. However, there is close interrelationship between the maternal and foetal aspects of placental failure, and the former invariably leads on to the latter cause.

Aetiology

Clinically, the aetiology of placental insufficiency syndrome can be broadly divided into two groups—the first group represents those condtions where there is little doubts as to the occurrence of placental insufficiency, and where the state of placental insufficiency is usually of a major degree. The second group represents those conditions where the extent of placental insufficiency is very variable, and is often of minor degree.

TABLE III

Aetiology of Major Degrees of Placental Insufficiency Syndrome

1. Postmaturity Syndrome (Prolonged Pregnancy).
2. Pre-Eclampsia/Eclampsia Syndrome.
3. Chronic Hypertensive Vascular Disease.
4. Pyelonephritis.
5. Diabetes Mellitus.
6. Elderly Primigravida.

a) MAJOR AETIOLOGICAL FACTORS

1. Post Maturity Syndrome

From the large volume of clinical publications that have appeared from time to time, there is little doubts in the minds of the practical obstetrician that the post-maturity syndrome or prolonged pregnancy does exist, and is still a major contributor to perinatal mortality and morbidity. Sir Joseph Barcroft and his colleagues (1934, 1945) have displayed this problem in the goat, sheep and rabbit foetus. McKiddie (1949), Walker and his colleagues (1953, 1958), and Browne (1961, 1963) have in a masterly way, surveyed the extent of this problem in the human pregnancy.

The incidence of prolonged pregnancy in the different communities has stated to vary between 2% (Finn Boe) and 3.5% (Browne, 1963), but the average incidence is generally, accepted to be around 3% of all viable births.

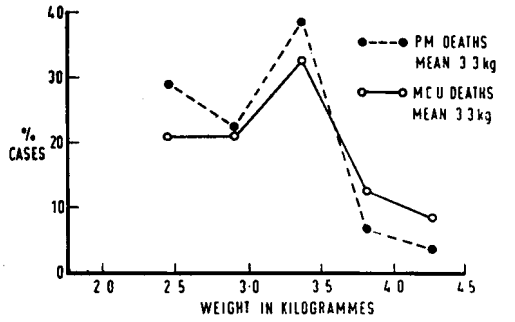
Walker (1958) has categorically enunciated the three cardinal hazards of the postmaturity syndrome, *viz.*:-

1. a rise in the perinatal mortality,
2. an increasing incidence of foetal distress, and
3. an increasing incidence of difficult and operative delivery.

He has further stressed that it was extremely important to realize that each of these three factors was an integral part of the syndrome, since they were closely interwoven clinically, and in many aspects interdependent. Both, an increasing incidence of disproportion and the state of less efficient uterine function contribute towards the increasing incidence of difficult and operative delivery, in the postmaturity syndrome. Browne (1953) in his Joseph-Price oration, four years later, come to similar conclusions, and his results are summarized in the following tables:-

TABLE IV

Relationship of Birthweight to Foetal Maturity

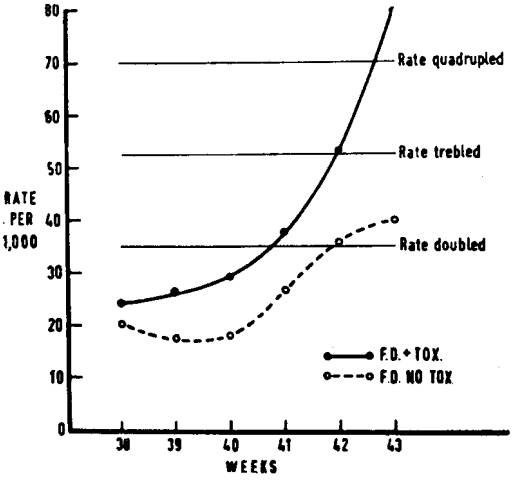


Distribution of Birthweight of infants that died perinatally at term and in prolonged pregnancy. (Hammersmith Hospital). P. M., postmature. M.C.U., mature child, cause of death unknown. (After J. C. M. Browne, 1963, Amer. J. Obstet. Gynae., Vol. 85).

The above table shows that there is little difference in the birth-weights of perinatal deaths in mature and postmature pregnancies. Hence, it is apparent from the above, that it is fallacious to infer that, because the dead foetus is of average size, it could not be a postmature death.

TABLE V

Relationship of Foetal Distress to Foetal maturity and Toxaemia

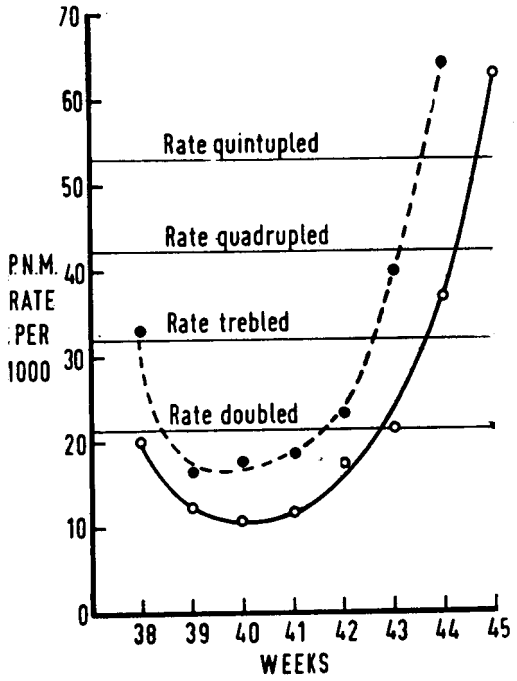


Effect of length of pregnancy on incidence of Foetal Distress. Dotted line, no toxaemia. Solid line, toxaemia present.
(After J. C. M. Browne, 1963, Amer. J. Obstet. Gynae., Vol. 85).

The above table clearly shows that the incidence of foetal distress rises very sharply in the postmature pregnancy ,and this is especially marked, if there is co-existing toxaemia of pregnancy.

TABLE VI

Relationship of Perinatal Mortality to Foetal Maturity and Toxaemia



Comparison of Perinatal Mortality Rates in prolonged pregnancy with and without Toxaemia. Solid line, no Toxaemia; dotted line, Toxaemia. After J. C. M. Browne, 1963, Amer. J. Obstet. Gynae., Vol. 85).

The above table clearly shows that there is a steep increase in the perinatal mortality rates in pregnancies prolonged beyond the 42nd week of gestation, and this feature is more marked when there is co-existent toxaemia of pregnancy.

2. Pre-Eclampsia/Eclampsia Syndrome

The above combination represents the true toxaemia of pregnancy, and there is little doubts that toxaemia of pregnancy predisposes to the placental insufficiency syndrome, and its concommitant hazards. Gross placental degenerative changes is a constant feature of moderate and severe toxaemia of pregnancy. Tables V and VI from Browne's (1963) paper clearly indicate that toxaemia of pregnancy predisposes to a higher incidence of foetal distress and perinatal mortality, and this is more so, when there is co-existent postmaturity.

3. Chronic Hypertensive Vascular Disease

It is a well accepted fact that chronic hypertension, in the pregant mother, predisposes to the severe forms of placental insufficiency syndrome, either directly by precipitating placental infarctions, or indirectly by predisposing to toxaemia of pregnancy. Both Townsend (1963), and Bourne and Williams (1962) have drawn our attention to this problem.

4. Pyelonephritis

Chronic pyelonephritis is almost always associated with secondary hypertension, which in turn can predispose to the placental insufficiency syndrome as stated above. The high perinatal mortality rates that co-exists with chronic pyelonephritis is only partly due to placental insufficiency; prematurity and hyperpyrexia also contribute to the perinatal mortality in this condition.

5. Diabetes Mellitus

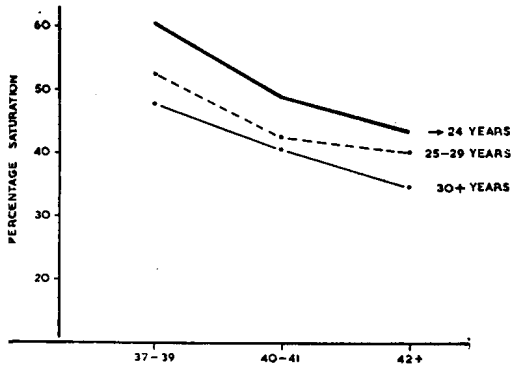
There is some degree of controversy as to whether placental insufficiency is a feature of diabetic pregnancies. Professor Scott Russell (1963), Robertson and Maxwell (1963), and Eddie (1963) have all found that, in the pregnant diabetic patient, the estimation of oestriol and pregnanediol excretion is seldom of any guide in the detection or management of placental insufficiency state. Russell (1963) categorically stated that in the diabetic pregnancy, the placenta, although often large, was inadequate to meet foetal requirements of oxygen and nutrition, or to protect the foetus from its mother's illness. He further stated that presumably, the risk to the foetus in maternal diabetes was metabolic, and not hormonal, and was, therefore, not reflected in altered hormonal excretions. It is also well known that pregnant diabetic patients are very highly susceptible to toxaemia of pregnancy and accidental haemorrhage, both of which aggravate the state of placental insufficiency.

6. Elderly Primigravida

Turnbull and Baird (1957) conducted a carefully controlled scientific studies on the oxygen content of venous and arterial blood from the umbilical vessels of 100 primigravid deliveries. The pregnancy in all these 100 primigravidae had been clinically normal.

TABLE VII

Relationship of Maternal age to Foetal Blood Oxygen Saturation



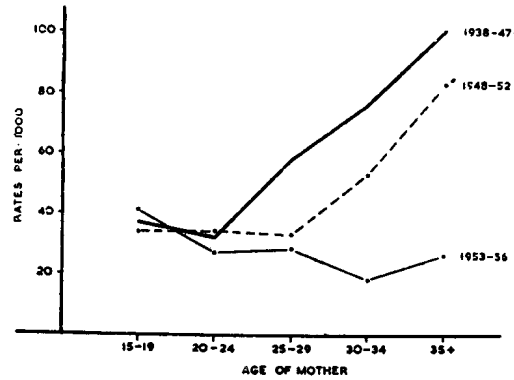
Average Oxygen saturation of blood in the Umbilical vein at various stages of pregnancy, by maternal age.
(After Turnbull, E.P.N. and Baird, D. (1957): Brit. Med. Journal Vol. 2).

They found that the average oxygen saturation became less as maternal age and the length of gestation increased and was sometimes dangerously low, especially in primparae, aged 30 or more, delivered after the 41st week of pregnancy. They then postulated that the relatively high rate of perinatal mortality in the elderly primigravidae—often clinically unexplained and accompanied by post mortem evidence of foetal asphyxia—is due in part to inadequate foetal oxygenation after term, following a state of placental insufficiency.

In the light of their findings as stated above, Professor Dugald Baird, in 1953, implemented a policy at the Aberdeen Maternity Hospital, whereby labour has been induced routinely by artificial rupture of the membranes in primigravidae aged 25 or more and who are undelivered before the end of the 41st week, and Caesarean Section has been used more frequently if there are signs of foetal distress, especially meconium in the liquor amnii.

TABLE VIII

Falling Perinatal Mortality Rates with Policy of Surgical Induction



Perinatal Mortality Rates (Stillbirths plus 1st week deaths per 1,000 births and still births), in Aberdeen Maternity Hospital, booked primigradiva, by age, in 1938 — 1947, 1948 — 1952, and 1953 — 1956.

(After Turnbull, E.P.N. and Baird, D. (1957): Brit. Med. J. Vol. 2).

The above table (Table VIII) clearly shows that as a result of the above policy, there was a steep fall in the perinatal mortality rates in the elderly primigravidae, during the years 1953-6, to such an extent as to eliminate the excess of perinatal deaths.

TABLE IX

Aetiology of Minor Degrees of Placental Insufficiency Syndrome

1. Unexplained Past Perinatal Death.
2. Habitual Abortion (Unexplained).
3. Prolonged Involuntary Infertility.
4. Threatened Abortion/Antepartum Haemorrhage.
5. Multiple Pregnancy.
6. Previous Uterine Scar { L.S.C.S. / C.C.S. / Myomectomy

b) MINOR AETIOLOGICAL FACTORS

1. Unexplained Past Perinatal Death:

It is a commonly accepted belief by most authorities that certain types of women are poor obstetric performers, and that

certain forms of obstetric mishaps tend to recur in particular types of patients. This being so, it is widely accepted by most authorities that patients who have had a past perinatal death of unexplained aetiology, are more susceptible to have a recurrence of this status, and it is most probable that placental insufficiency, of unexplained basis, may be the underlying factor.

2. Unexplained Habitual Abortions:

Similar to the previous aetiological factor, those authorities, who are advocates of the placental insufficiency syndrome, do believe that patients who have had a past history of unexplained habitual abortions, have a greater tendency to develop a state of placental insufficiency in their subsequent pregnancies. It is possible that minor aberrations in the genes (sperm or ovum), which could lead to such cases of unexplained habitual abortions, could also be responsible for the production of defects in the state of placental function in the subsequent pregnancies. Just as in the previous minor aetiological factor, placental insufficiency status does not co-exist with every case of habitual abortion.

3. Prolonged Involuntary Infertility:

As in the previous two factors, patients who have prolonged involuntary infertility, are said to have a higher tendency to develop a state of placental insufficeincy syndrome. Statistical evidence from retrospective studies have shown that the above type of patients have a higher incidence of unexplained foetal distress and asphyxial perinatal deaths.

4. Threatened Abortions/Antepartum Haemorrhage:

It is a well accepted fact that patients who develop unexplained episodes of haemorrhage in any period of their pregnancy do tend to sustain varying degrees of placental damage, even though the pregnancy proceeds to full term. Again, as stated in the previous three causes, whether any individual case with this cause does sustain that degree of placental damage, so as to produce a state of placental insufficiency syndrome, is debatable. But there is little doubts that these types of patients will require closer vigilance in late prenancy and in labour.

5. Multiple Pregnancy:

Most authorities subscribing to the syndrome of placental insufficiency, do accept the fact that patients, with twins and other multiple pregnancy, do run a higher risk of developing the state of placental insufficiency as term approaches. In fact, Professor McClure Browne (1962) categorically states that the optimal duration for twin pregnancy is 38 weeks and not 40 weeks. He even goes so far as to advocate termination of uncomplicated twin pregnancies, soon after the 38th week of gestation, based upon his strong suspicions, which he has not been able to substantiate as yet. However, most authorities will be prepared to await the 40th week of gestation, before considering the termination of uncomplicated twin pregnancies.

6. Previous Uterine Scar:

Here again, the ardent advocates of the placental insufficiency syndrome postulate that patients who have a scar in the uterus, L.S.C.S., Classical C.S. or Myomectomy type, do run a higher risk of developing the placental insufficiency syndrome, in their subsequent pregnancies. Whilst there is some reason to believe that this may be so in those cases where the placenta becomes implanted over the site of uterine scar, and hence become impaired in blood supply, this condition may not be a constant cause of placental insufficiency. Hence like all the other minor causes of placental insufficiency syndrome, each individual case should be assessed on its merits, as to whether there exists a state of placental insufficiency in that particular pregnancy.

Acknowledgements:

I wish to make official acknowledgements to the Editors of the undermentinoned Journals and the authors of their respective publications for the use of the following Tables from their publications, in this paper:-

TABLE		JOURNAL		AUTHORS
(*i*) Table I	-	Lancet, 1953, Vol. II	-	Walker, J. & Turnbull, E.P.N.
(*ii*) Table IV	-	Amer. J. Obstet. Gynae., 1963, Vol. 85	-	Browne, J.C.M.
(*iii*) Table V	-	,,	-	,,
(*iv*) Table VI	-	,,	-	,,
(*v*) Table VII	-	Brit. Med. J. (1957), Vol. II.	-	Turnbull, E.P.N. & Baird, D.
(*iv*) Table VIII	-	,,	-	,,

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