

- diographic studies of stented fascia lata grafts in the mitral position. *Circulation* **49**: 237, 1974
6. Matsumoto H, Hasegawa T, Fuse K, Yamamoto M, Saigusa M: A new vascular prosthesis for a small caliber artery. *Surgery* **74**: 519, 1973
 7. Campbell CD, Goldfarb D, Roe R: A small arterial substitute: Expanded microporous polytetrafluoroethylene: Patency versus porosity. *Ann Surg* **182**: 138, 1975
 8. Smith DE, Hammon J, Anane-Sefah J, Richardson RS, Trimble C: Segmental venous replacement: A comparison of biological and synthetic substitutes. *J Thorac Cardiovasc Surg* **69**: 589, 1975
 9. Fujiwara Y, Cohn LH, Adams D, Collins JJ Jr: Use of Gortex grafts for replacement of the superior and inferior venae cavae. *J Thorac Cardiovasc Surg* **67**: 774, 1974
 10. Beer FP, Johnston ER: *Mechanics for Engineers: Statistics and Dynamics*, ed 2. New York, McGraw-Hill Book Company, 1962
 11. Mundth ED, Wright FEC, Austen WG: Development of a method for stress/strain analysis of cardiac valvular tissue. *Curr Top Surg Res* **3**: 67, 1971
 12. Johnson AD, Daily PO, Peterson KL, LeWinter M, DiDonna GJ, Blair G, Niwayama G: Functional evaluation of the porcine heterograft in the mitral position. *Circulation* **51** & **52** (suppl 1): I-40, 1975
 13. Bellhouse B, Bellhouse F: Fluid mechanics of model normal and stenosed aortic valves. *Circ Res* **25**: 693, 1969
 14. Davila JC, Amongero F, Sethi RS, Rincon NL, Palmer TE, Lautsch EV: The prevention of thrombosis in artificial cardiac valves. *Ann Thorac Surg* **2**: 714, 1966

The Evolution of Peripartal Heart Failure in Zaria, Nigeria

Some Etiologic Factors

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SUMMARY The subsequent course of 173 women with severe congestive heart failure hospitalized within 6 months of delivery has been analyzed after 4 to 7 year follow-up periods. Forty-seven normotensive women and 50 women hypertensive only during the initial 48 hours have little long term morbidity. Thirty-six women with hypertension initially improved, but many are now showing enlarging cardiac silhouettes. Morbidity is increasing in this group. A similar, less severe pattern is developing in 36 women with intermittent hypertension.

The uniquely high incidence of this condition in Zaria is associated

with several locale factors. These Hausa-Fulani women eat large quantities of a local lake salt, kanwa, for 40 days postpartum. The syndrome is markedly more common in the hot rainy season, when evaporative water loss is less, than in the dry season. The first postpartum days are spent confined to bed in a small heated room. Once or twice daily the new mother is given hot baths with branches which have been dipped in boiling water.

The combination of excessive sodium intake and diminished evaporative water excretion seems to precipitate failure in both normotensive and hypertensive patients.

HEART FAILURE associated with the puerperium was initially described from New Orleans.¹ Subsequent series have been reported from Johannesburg,² Chicago,³ Ibadan,⁴ Rio de Janeiro,⁵ Jamaica⁶ and other cities.^{7, 8}

Features in common have included association with the nonwhite races and usually low socio-economic status. These series have differed somewhat in age, parity, and blood pressure. Dietary and environmental factors have not been suggested as etiologic contributors. Most studies do not provide long term prognostic perspective.

In Zaria, Nigeria, severe congestive heart failure following delivery is one of the most common causes of admission to the medical service. Between March of 1969 and February of 1972, over 250 patients were admitted to the Ahmadu Bello University Hospital within six months of delivery. These patients have subsequently been followed in a special weekly cardiac clinic. Their clinical course over this 4-7 year period and some unique environmental factors form the basis for this report.

Patients

To avoid confusion, patients 1) with infections requiring antibiotics, 2) with hemoglobins below 6 g per 100 ml, 3) with murmurs which have persisted and are presumed organic, and 4) those in whom only a few follow-up visits are available are not included in this report. The remaining patients were grouped as follows: 1) 47 patients had a normal blood pressure (85 mm Hg diastolic) while in hospital and throughout the follow-up period. They are considered normotensive. 2) 50 patients had blood pressure elevations up to 110 mm Hg diastolic on admission and during the initial 48 hours. No treatment for hypertension was given, no evidence of hypertensive vascular disease was detected on initial physical examination, and all 50 of these patients have remained normotensive subsequent to this initial hypertension. 3) A third group includes 36 women who were hypertensive in the hospital and on almost all subsequent occasions. 4) Group 4 consists of 36 patients in whom blood pressure has been intermittently elevated; 5) and finally, in group 5 are four patients who were initially normotensive but have developed hypertension during this 4-7 year surveillance period. The clinical characteristics of these five groups are given in table 1. The clinical presentation was remarkably uniform, with jugular venous distension, bilateral pulmonary rales, cardiomegaly with loud gallop, tense ascites, and anasarca.

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TABLE 1. *Clinical Profiles of 137 Women with Peripartal Cardiac Failure*

Group	Age (yr)	Parity	Diuretics (kg)	Delivery-Admission interval (mo)	Hemoglobin (g/100 ml)
1 (N = 47)	25.44 ± 6.41	4.28 ± 2.36	11.34 ± 5.51 ⁴⁶	2.25 ± 1.73 ⁴⁷	10.13 ± 2.16 (47)
2 (N = 50)	26.86 ± 6.57	4.52 ± 2.88	11.74 ± 6.04 ⁴⁹	1.74 ± 1.4 ⁴⁹	10.33 ± 2.23 (48)
3 (N = 36)	29.97 ± 6.38	5.64 ± 2.98	10.07 ± 6.14 ³²	2.62 ± 1.78	11.25 ± 2.15 (32)
4 (N = 36)	26.69 ± 5.68	4.36 ± 2.39	12.35 ± 5.45 ³⁵	2.42 ± 1.31	10.48 ± 2.27 (33)
5 (N = 4)	24.75 ± 7.59	3.75 ± 2.75	10.67 ± 4.54	1.28 ± 0.76	10.07 ± 2.44

N = Number of patients unless otherwise indicated in parentheses.

The groups were clinically comparable except for the tendency of the hypertensive group to be slightly older. All of the women in this report were members of the Hausa-Fulani tribal grouping. All were admitted within six months after delivery. The treatment consisted of bed rest, digitalis, and diuretics. All had electrocardiograms, routine blood analysis, admission and discharge chest X-rays, and often an additional chest X-ray while in hospital. Patients were weighed daily. They were allowed routine hospital diets, except salt was excluded. No supplemental vitamins were given. Most nursing mothers were allowed to keep their infants with them on the wards and breast feeding was never stopped. These patients were usually free of all signs of failure within one week. They were all discharged on digoxin, 0.5 mg daily.

Following discharge, the patients were seen in a special clinic. The clinic team consisted of the physician, a nurse, a social worker, and two Hausa women, whose invaluable function was to trace and retrieve the patients from villages, sometimes deep in the bush, in order to maintain a high percentage of follow-up.

Patients were maintained on digoxin if their cardiac silhouette remained large. When patients failed to keep the clinic visits and then were traced and returned to clinic, they were started on folic acid or yeast tablets in order to maintain their interest in coming to clinic.

Results

We have distinguished between patients who responded to hospital treatment and then shortly thereafter relapsed, and those patients who made a full recovery, returned to normal activity, and were clinically well until a subsequent pregnancy led to a recurrence of the disease. The 47 normotensive

TABLE 2. *Subsequent Pregnancies Following an Episode of Peripartal Cardiac Failure*

Group	Uncomplicated	Recurrence (nonfatal)	Recurrence (fatal)	Total
1	31	4	—	35
2	32	1	3	36
3	15	—	4	19
4	22	11	—	33
5	5	—	—	5
Total pregnancies	105	16	7	128

patients had four relapses with four early deaths. They have had 35 subsequent pregnancies with four nonfatal recurrences (table 2). The deaths due to relapse, after initial recovery, are noted in table 3. Several of these were sudden but evidence to incriminate emboli, arrhythmias, digitalis toxicity or other causes is lacking.

Many of the recurrences were apparently due to repeating the practices which we believed led to the initial episodes, based on the anecdotal information obtained by the follow-up team.

Table 4 gives the cardiothoracic ratios in these patients. The cardiothoracic ratios, which were large on admission became normal with striking consistency; that is, 0.50 or less, and stayed normal with eight exceptions. Only four are greater than 0.55, but in all these the heart never did become normal. Twenty-four of the 42 in this group who are still living have been seen since January 1975. An additional eight have been seen since 1974.

The hypertensive group has presented a very different picture. They have had four relapses, three of which were fatal. There have also been four fatal recurrences. Two additional patients in this group have died suddenly without obvious explanation. There have been only 19 subsequent pregnancies. The cardiothoracic ratios initially returned to normal but soon began to enlarge. Eighteen of the 21 patients in whom long-term follow-up chest X-rays are available, have cardiothoracic ratios greater than 0.50 and these are enlarging

TABLE 3. *Early and Late Fatalities in 193 Patients with Peripartal Cardiac Failure*

Group	Relapse terminating initial occurrence	Fatal recurrence after subsequent pregnancies	Noncardiac deaths	Total
1 (N = 47)	4	—	1	5
2 (N = 50)	2	3	—	5
3 (N = 36)	4	4	3	11
4 (N = 36)	1	—	3	4
5 (N = 4)	—	—	—	—
Total fatalities	11	7	7	25

TABLE 4. *Serial Cardiothoracic Ratios Following Peripartal Cardiac Failure*

Group	Admission	Discharge	1 year	2-3 years	4-6 years
1	0.618 \pm 0.076	0.543 \pm 0.075	0.498 \pm 0.055	0.489 \pm 0.04	0.51 \pm 0.069
2	0.61 \pm 0.074	0.524 \pm 0.063	0.476 \pm 0.04	0.472 \pm 0.05	0.485 \pm 0.40
3	0.635 \pm 0.074	0.536 \pm 0.05	0.546 \pm 0.065	0.547 \pm 0.066	0.55 \pm 0.038
4	0.631 \pm 0.097	0.544 \pm 0.56	0.501 \pm 0.04	0.507 \pm 0.045	0.517 \pm 0.054
5	0.65 \pm 0.09	0.50 \pm 0.045	0.52 \pm 0.055	0.51 \pm 0.047	0.53 \pm 0.035

each year (table 5). Twelve of these 21 have ratios of 0.55 or greater. The morbidity in this group seems to be increasing each year. Seventeen of the 25 not known to have died have been seen since January 1975 and seven additional patients were seen during 1974.

The 36 labile hypertensives are doing somewhat better than the persistent hypertensives. There was one fatal and one nonfatal relapse. They have had 33 subsequent pregnancies with 11 nonfatal recurrences. Two have died suddenly from what seemed to be cerebrovascular accidents. Twenty-five of these patients have had chest X-rays more than four years after delivery. Eight have had cardiothoracic ratios of less than 0.50, ten have had ratios between 0.50 and 0.55, and seven are greater than 0.55. Twenty-one of the 32 not known to have died, have been seen since January of 1975. Eight additional patients were last seen in 1974.

During the seven years of observing this large series, only four patients have been noted to develop hypertension. They have had five subsequent pregnancies without difficulty. There have been no recurrences and no relapses. Five year follow-up films are available on three of them, and the cardiothoracic ratios are greater than 0.50. All four have been seen during 1975, and are doing well clinically.

Electrocardiographic analysis has not been particularly helpful. There have been no arrhythmias requiring specific therapy and routine electrocardiograms have not revealed significant difference between the groups and have not provided prognostic information.

Discussion

Occurrence of cardiac failure following approximately 1% of Hausa-Fulani pregnancies is probably higher than anywhere else in the world. This has provided a unique opportunity to study the natural history of this disease. The study has been enhanced by the highly efficient retrieval and follow-up team, which has sometimes walked miles to remote bush villages to bring women in for clinic visits.

Several things stand out in reviewing our series. Advanced age and multiparity do not seem to increase the incidence. In fact, there seems to be a relative sparing of second pregnancy mothers. The patients respond within a few days to digitalis and diuretics in modest doses. The vast majority

return soon after discharge from hospital to their normal household duties without ill effects. None has received prolonged bed rest. Most of the nonhypertensives do not have trouble with subsequent pregnancies. The incidence of arrhythmias is quite small. These features are all uncommon in other series.

It is interesting to note that several patients in groups 1 and 2 have shown progressively enlarged cardiac silhouettes despite normal blood pressures. This suggests that hypertension, per se, is not essential to develop the syndrome of heart failure and cardiomegaly following pregnancy. This is in contrast to Brockington's⁴ findings among Yoruba women in southern Nigeria and lends some support to the concept that postpartum muscle disease is a definite entity. Continued follow-up of these particular patients will be fascinating.

It is not surprising that the patients with persistent (group 3) and labile (group 4) hypertension have done less well than the two normotensive groups. The interrelationship between hypertension and the peripartal failure is impossible to unravel, but it is quite clear that hypertension, whether caused by or in association with the peripartal failure, exacerbates the clinical course.

There are some interesting environmental factors which may contribute to this disease. The birth frequency in this culture does not vary appreciably throughout the year. Nonetheless, the incidence of this disease is remarkably higher in the hot, humid rainy season (June through October) of the savanna. In fact, no patient in group 1 was delivered during December or January (dry season) of any of the years examined.

The Hausa-Fulani women, especially in the Zaria area, practice certain customs which one would predict to impose extra burdens on the cardiovascular system. Firstly, and perhaps most importantly, the folk belief is that eating large quantities of the local lake salt, known as natron or kanwa (primarily a mixture of sodium salts), increases the flow of breast milk and perhaps has a protective role against puerperal sepsis. Women ingest a small handful of the sodium salts twice each day for 40 or more days following delivery. Occasionally, one runs across an enthusiast who began to eat the salt even prior to delivery.

In addition, it is customary for these women to be confined on a mud bed in a small, almost sauna-like room, with a small fire beneath the bed, for 40 days postpartum. This practice is also intended to keep away the "cold," (despite an ambient temperature of over 85°F). Daily, or twice daily, the woman is given a bath with nearly scalding water. Indeed one woman was excluded from the series because her failure was severely complicated by infected third degree burns on her thighs as a result of these baths.

As noted above, there is a marked seasonal variation, especially for the normotensive patients. Evaporative water

TABLE 5. *Distribution of Cardiothoracic Ratios on 4-6 Year Follow-up Films*

Group	0.50	0.50-0.54	0.55+	Total*
1	9	5	3	17
2	19	10	1	30
3	2	5	12	19
4	8	10	7	25
5	0	2	1	3

*Total = number of films available.

loss is less in the hot humid season which parallels the time of peak incidence, compared to the greater cutaneous water loss of the dry season.

It is our postulate that many of our patients develop failure through a combination of the hot, humid weather aggravated by the high sodium intake, the prolonged heating, and the repeated hot baths. These probably operate synergistically to promote fluid retention. Why this small percentage of the women retain sodium to such an enormous extent and how they differ metabolically from the majority of their peers is unknown. Hypertension may be a predisposing factor in the minority of patients. On the other hand, some normotensive women eventually develop cardiomegaly.

The group 2 patients may have the initial transient hypertension as a response to fluid overload or to anxiety due to their initial encounter with a hospital.

One wonders if patients in other series have indulged in practices that are similar to the ones mentioned above including the ingestion of the kanwa and the 40 days of heated bedrest.

There is no evidence in our series of an infectious etiology. There is no practice among the Hausa-Fulani similar to the burial customs in New Guinea which propagate the problem of kuru. Occasional cases in our series occurred in the same living compound at different times and occasionally among relatives, but no pattern was noted, and perhaps these occurrences are due to especially zealous pursuit of the local practices.

The notion that the lake salt contains toxic trace elements is initially attractive as a parallel to the cobalt cardiomyopathy story.⁹ Spectrophotometric analysis of several samples has revealed a wide variety of elements including cobalt, but the clinical course with rapid recovery, few emboli, and rare arrhythmias, would seem to differ considerably from the cobalt cases. Further investigation may, however, incriminate some dietary factor more specific than the excessive sodium ingestion.

The women do not appear malnourished or vitamin deficient, and careful dietary historians have revealed no difference from the peer population. The rapid clinical recovery occurs without discernible dietary alteration except for sodium limitation. No supplemental vitamins have been needed.

In conclusion, we have reported 173 patients with heart failure following delivery. Differences in the subsequent clinical course have been noted between patients with normal and with elevated blood pressures. It is suggested that at least a portion of the normotensive patients, and perhaps many of the hypertensive patients, have intrinsic muscle disease. Aggravating factors to the development of the syndrome in Zaria probably include the custom of the high sodium ingestion, the occurrence of the syndrome in the hot, humid season, and the practice of prolonged use of a heated bed and of the hot baths. The similarities and differences between our large series and those reported by others have been mentioned. It is hoped that some of the factors we have discussed will aid in unravelling the etiology of this puzzling condition.

References

1. Hull E, Hafkesbrink E: "Toxic" postpartum heart disease. *New Orleans Med Surg J* **89**: 550, 1937
2. Seftel H, Susser M: Maternity and myocardial failure in African women. *Br Heart J* **23**: 43, 1961
3. Demakis JG, Rahimtoola SH, Sutton GC, Meadows WR, Szanto PB, Tobin JR, Gunnar RM: Natural course of peripartum cardiomyopathy. *Circulation* **44**: 1053, 1971
4. Brockington IF: Postpartum hypertensive heart failure. *Am Heart J* **27**: 650, 1971
5. Benchimol AB, Carneiro RD, Schlesinger P: Post-partum heart disease. *Br Heart J* **21**: 89, 1959
6. Stuart KL: Cardiomyopathy of pregnancy and the puerperium. *Quart J Med* **147**: 463, 1968
7. Johnson JB, Mir GH, Flores P, Mann M: Idiopathic heart disease associated with pregnancy and the puerperium. *Am Heart J* **72**: 809, 1968
8. Brown AK, Doukas N, Riding WD, Jones EW: Cardiomyopathy and pregnancy. *Br Heart J* **29**: 387, 1967
9. Mercier G: Quebec beer-drinkers' cardiomyopathy: clinical signs and symptoms. *Canad Med Assoc J* **97**: 884, 1967

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