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ORIGINAL ARTICLE

Appraisal of Short- and Long-Term Outcomes of Partial Versus Complete HELLP Syndromes: A Retrospective Cohort Study

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Abstract To compare short-term outcomes at index and subsequent pregnancies, as well as the long-term medical complications encountered later than 5 years after index pregnancy incomplete and partial HELLP syndromes. Pregnancies complicated by partial HELLP or complete HELLP during a period of 19 years were identified. Searches were limited to cases before 2012 to ensure an adequate follow-up period. Data on index or subsequent pregnancies occurring at our center were extracted from the hospital database, while data pertaining to subsequent obstetric outcomes when deliveries occurred elsewhere together with current medical conditions were acquired by patient self-reporting. Complete HELLP was defined as the presence of the 3 components of the syndrome whereas partial HELLP was defined by the presence of 1 or 2 components. 100 pregnancies were included. At index pregnancy, there was a higher rate of composite adverse maternal outcome in complete HELLP when compared to partial HELLP (45.8% vs 21.1%, $p = 0.017$). Outcomes at subsequent pregnancies showed no difference between the two variants of HELLP syndrome. When examined years later, a higher frequency of "composite medical morbidity" in the complete HELLP group was observed, though this difference did not reach statistical significance (77.7% vs 61.9%, $p = 1.00$). Although partial HELLP is relatively less harmful, it can nonetheless cause serious maternal complications including ruptured liver hematoma, intracranial hemorrhage and even mortality. These two clinical entities represent a continuum of the same pathology, which implies that the approach at management should be uniform. Furthermore, the prognosis and long-term outcomes were not different between these 2 variants.

Keywords Complete HELLP · HELLP syndrome · Long-term outcome · Partial HELLP · Short-term outcome

Introduction

Preeclampsia is a multi-organ hypertensive disease affecting around 2–8% of pregnancies and is known to cause severe maternal and neonatal morbidity and mortality [1]. It has been suggested that complications of preeclampsia are not limited to pregnancy but can extend also to later stages of life and are considered to be an independent risk factor for the development of metabolic syndrome, cardiovascular disease, diabetes mellitus (DM), stroke, hypothyroidism, renal disorders and autoimmune diseases [2, 3]. HELLP syndrome is a hypertensive condition during pregnancy consisting of a constellation of Hemolysis, Elevated Liver Enzymes and Low Platelets [4]. Since 1982, this condition has been subject to several controversies [5]. While some authors consider HELLP syndrome to be a separate and independent entity, others believe it is one of the most dangerous preeclampsia variants [6, 7]. Furthermore, no unified definitive diagnostic criteria exist for HELLP syndrome [8, 9], especially for the incomplete type where patients develop only 1 or 2 of the 3 diagnostic criteria [10]. Few studies have compared the short-term

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outcomes of complete HELLP (c-HELLP) with those of partial HELLP (p-HELLP) syndrome [5, 10]. In contrast to the abundance of studies on long-term outcomes following the syndrome of preeclampsia, little is known about the long-term consequences of these two closely related hypertensive conditions, and available studies are limited to five years postpartum [6]. Furthermore, the absence of clinical guidelines for the management of p-HELLP syndrome is a major source of uncertainty.

The objectives of this study were to compare the short-term outcomes of c-HELLP versus p-HELLP at index and subsequent pregnancies in addition to the long-term medical outcome of the same cohort.

Materials and Methods

This was a retrospective cohort study that was started after obtaining the Institutional Review Board approval (Number: 01022018) on July 1st, 2018 and concluded on January 31st, 2019. The subjects were women who developed c-HELLP or p-HELLP syndrome during their index pregnancy, between January 1st, 1994 and December 31st, 2012, in our hospital. Subjects were identified using the hospital electronic medical record system. C-HELLP syndrome was defined by the presence of all of the following three laboratory criteria according to the Tennessee Classification System: (1) Hemolysis; defined as characteristic peripheral blood smear, serum lactate dehydrogenase $\geq$ 600 IU/L or total bilirubin $\geq$ 1.2 mg/dL; (2) Elevated Liver Enzymes; defined as aspartate aminotransferase (AST) $\geq$ 70 IU/L; and (3) Low Platelet Count ($<$ 100,000 μL) [8]. P-HELLP syndrome was defined as the presence of one or two features of c-HELLP [10]. Contacting women and interviews took place during the month of January 2019. Patients who consented to the study were interviewed either face-to-face or by phone. At the interview, a full past medical and obstetrical history was obtained together with an inquiry about current medical status and any medication intake.

Chart review was performed for extraction of relevant data, such as maternal age, parity, being indigent or referred, history of hypertensive disorder in previous pregnancies, and past medical history. Information pertaining to the index pregnancy included: symptoms at presentation, antepartum or postpartum occurrence, laboratory values and pertinent complications. The composite adverse maternal outcome during the index pregnancy included: eclampsia, intracranial hemorrhage, liver hematoma, pulmonary edema, placental abruption, intensive care unit (ICU) admission, acute kidney injury, disseminated intravascular coagulation (DIC), blood transfusion or maternal mortality. Outcome of subsequent pregnancies was obtained from the hospital system when deliveries occurred at our hospital, otherwise, it was obtained through patient self-report. Finally, the composite variable of long-term outcomes included: cerebrovascular accident (CVA), coronary artery disease (CAD), hypertension, dyslipidemia, chronic kidney disease (CKD), thyroid disorders, type 2 DM or mortality.

Data were analyzed with the SPSS 22 statistical software (IBM SPSS Statistics). Continuous variables were expressed as mean $\pm$ 1 standard deviation (SD), while categorical variables were expressed as number (frequency). We used the Kolmogorov–Smirnov test ($n > 50$) or Shapiro–Wilk test ($n < 50$) to test the normal distribution of continuous variables. Then we used either Student's t-test or the Mann–Whitney U test to compare means of continuous variables with normal distribution or means of continuous without normal distribution, respectively. Similarly, we used either Fisher's exact test or Pearson's Chi-square test to compare proportions of categorical variables in both groups of each level of the statistical analysis. Statistical significance was assumed when the p value was ≤ 0.05.

Results

A total of 100 women were identified at index pregnancy (24 cases with c-HELLP syndrome and 76 cases with p-HELLP). Of these, 40 women could be traced at an average of 16 years later (7–25 years). Three were outside the country, and 6 declined to participate, making the total attrition rate 69%. Thirty-one women agreed and provided written consent: 9 cases in the c-HELLP and 22 cases in the p-HELLP group (including the father of a deceased woman in this group). Twenty-two patients had one or more subsequent pregnancies for a total of 46 pregnancies (13 in c-HELLP and 33 in p-HELLP) (Fig. 1).

Around 50% of women in both groups were referred from remote hospitals. In both groups, there was no history of partial or complete HELLP syndrome during previous pregnancies. No between-group differences were observed in mean maternal age, rates of primiparity, multiple gestation, cesarean delivery and postpartum occurrence of HELLP syndrome (Table 1).

Right upper quadrant/epigastric pain and nausea/vomiting were significantly higher in the c-HELLP compared to the p-HELLP group (70.8% vs 23.7%, p value < 0.001, and 29.2% vs 5.3%, p value = 0.004, respectively). Laboratory values, except for uric acid, were significantly more disturbed in c-HELLP, whereas the difference in blood pressure parameters was not significant (Table 2).

During the index pregnancy, there was a significantly higher frequency of composite maternal adverse outcome

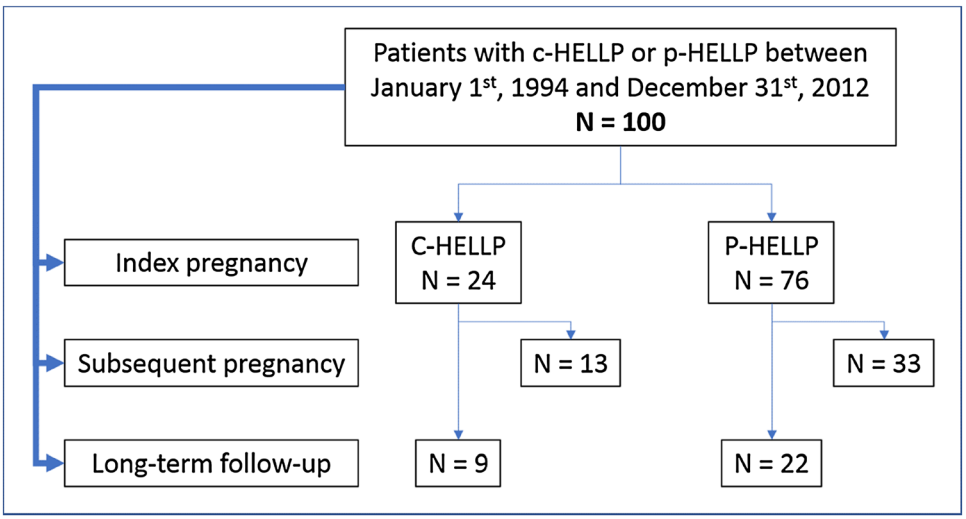

Fig. 1 Flow chart of the study population. Abbreviations: c-HELLP: complete HELLP syndrome; p-HELLP: partial HELLP syndrome

Table 1 Baseline characteristics of the study population at index pregnancy

	c-HELLP N = 24	p-HELLP N = 76	*p* value
Maternal age, years	30.6 ± 6.8	30.3 ± 6.5	0.86
Referred patients	12 (50%)	43 (56.6%)	0.64
Multiple gestation	3 (12.5%)	7 (9.2%)	0.70
Primiparity	11 (45.8%)	39 (51.3)%	0.64
Postpartum occurrence of HELLP	7 (29.2%)	15 (19.7%)	0.40
Cesarean delivery	14 (58.3%)	35 (46.1%)	0.35
Previous pregnancy-induced hypertensive disorders			
Gestational hypertension	1 (7.7%)	2 (5.4%)	1.00
Preeclampsia	4 (30.8%)	8 (21.6%)	0.71
HELLP syndrome	0 (0.0%)	0 (0.0%)	NA
Gestational age at termination/delivery			
Gestational age, weeks	32.9 ± 4.5	34.9 ± 4.6	0.06
< 28 weeks	3 (12.5%)	6 (7.9%)	0.31
< 34 weeks	10 (41.7%)	22 (28.9%)	

c-HELLP, complete HELLP syndrome; NA, not applicable; p-HELLP, partial HELLP syndrome

in c-HELLP in comparison to p-HELLP (45.8% vs 21.1%, *p* value = 0.017) while individual maternal morbidities displayed higher rates in the c-HELLP group, except for placental abruption which was more frequent in the p-HELLP group. These between-group differences did not reach statistical significance. There was one case of maternal mortality in the c-HELLP group due to intracranial hemorrhage. Rates of intrauterine fetal demise (IUFD) and neonatal intensive care unit (NICU) admission did not differ between the groups, while mean newborn weight was significantly lower in the c-HELLP group compared to the p-HELLP group (1680.8 ± 824.5 g vs 2230.0 ± 957.2, *p* value = 0.01) (Table 3).

In subsequent pregnancies, pregnancy-induced hypertensive disorders were noted in 69.2% of c-HELLP group patients versus 57.6% of p-HELLP group patients; this difference was not statistically significant. Similarly, there was no between-group difference in the rates of each individual entity such as gestational hypertension, preeclampsia, and p-HELLP. C-HELLP recurred in one patient with previous c-HELLP, whereas no patients with previous p-HELLP developed c-HELLP in subsequent pregnancies (Table 4).

The mean maternal age at the time of interview was 46.4 years in the c-HELLP group and 43.3 years in the p-HELLP group. The mean time between the interview and

Table 2 Clinical presentation of patients with c-HELLP and p-HELLP during the index pregnancy

	c-HELLP N = 24	p-HELLP N = 76	*p* value
Presenting symptoms			
Headache	9 (37.5%)	23 (30.3%)	0.62
Epigastric pain	17 (70.8%)	18 (23.7%)	< 0.001
Nausea and vomiting	7 (29.2%)	4 (5.3%)	0.004
Visual disturbance	6 (25.0%)	11 (14.5%)	0.23
BP and laboratory findings at admission			
Systolic BP, mmHg	174.4 ± 31.2	165.4 ± 25.8	0.26
Diastolic BP, mmHg	109.2 ± 18.4	102.4 ± 12.6	0.17
$MgSO_4$ use	24 (100.0%)	69 (90.8%)	0.19
Platelets, $\times 10^9$/L	54.3 ± 21.8	155.7 ± 68.5	< 0.001
LDH, IU/L	2005.3 ± 1606.6	808.8 ± 392.2	< 0.001
AST, IU/L	619.9 ± 1086.2	90.2 ± 142.9	< 0.001
Uric acid, mg/dL	7.8 ± 2.5	7.1 ± 1.9	0.51
Creatinine, mg/dL	1.4 ± 1.9	0.8 ± 0.2	0.02
Absence of proteinuria	1 (4.2%)	12 (15.8%)	0.18

AST, aspartate aminotransferase; BP, blood pressure; GA, gestational age; IU, international units; LDH, lactate dehydrogenase; $MgSO_4$, magnesium sulfate

Table 3 Outcomes of patients with c-HELLP and p-HELLP during the index pregnancy

	c-HELLP N = 24	p-HELLP N = 76	*p* value
Maternal outcomes			
Composite adverse outcome	11 (45.8%)	17 (21.1%)	0.017
Eclampsia	3 (12.5%)	4 (5.3%)	0.35
Placental abruption	1 (4.2%)	6 (7.9%)	1.00
Need for blood transfusion	6 (25.0%)	8 (10.5%)	0.09
Intracranial hemorrhage	1 (4.2%)	0 (0.0%)	0.24
Liver hematoma	1 (4.2%)	1 (1.3%)	0.42
Pulmonary edema	1 (4.2%)	1 (1.3%)	0.42
Acute kidney injury (requiring dialysis)	1 (4.2%)	0 (0.0%)	0.24
DIC	2 (8.3%)	2 (2.6%)	0.24
ICU Admission	2 (8.3%)	1 (1.3%)	0.14
Cesarean delivery	14 (58.3%)	35 (46.1%)	0.35
Mortality	1 (4.2%)	0 (0.0%)	0.24
Total hospital stay, days	6.9 ± 5.3	5.9 ± 3.3	0.25
Neonatal outcomes			
Weight, grams	1680.8 ± 824.5	2230.0 ± 957.2	0.01
NICU Admission	15 (62.5%)	33 (43.4%)	0.16
IUFD	4 (16.7%)	9 (11.8%)	0.51

c-HELLP, complete HELLP syndrome; DIC, disseminated intravascular coagulation; IUFD, intrauterine fetal death; ICU, intensive care unit, NICU, neonatal intensive care unit; p-HELLP, partial HELLP syndrome

the index pregnancy was 16 years (range 7–25 years). Six patients (66.7%) in the c-HELLP group and 17 (77.2%) in the p-HELLP group reported delay in subsequent pregnancy due to the fear of the recurrence of HELLP. Only one case of maternal mortality was reported 12 years post-pregnancy complicated by p-HELLP due to a CVA, otherwise, there were similar rates in both groups of dyslipidemia, type 2 DM, obesity, CAD, and autoimmune diseases such as hypothyroidism. Psychosocial disorders requiring medication, such as depression, were reported in

Table 4 Outcomes of subsequent pregnancies during the follow-up of patients with previous c-HELLP and p-HELLP

	c-HELLP N = 13	p-HELLP N = 33	*p* value
Inter-pregnancy interval, years	2.3 ± 0.8	4.3 ± 3.2	0.10
Any hypertensive disorder	9 (69.2%)	19 (57.6%)	0.52
Gestational hypertension	1 (7.7%)	4 (12.1%)	1.00
Pre-eclampsia	4 (30.7%)	10 (30.3%)	1.00
Partial HELLP syndrome	3 (23.0%)	5 (15.2%)	0.67
Complete HELLP syndrome	1 (7.7%)	0 (0.0%)	0.28

c-HELLP, complete HELLP syndrome; p-HELLP, partial HELLP syndrome

44.4% of c-HELLP patients and 27.3% of p-HELLP patients, and this affected the marital life of these patients leading to divorce in some cases (Table 5).

Discussion

Principal Findings

This was a retrospective cohort observational study in which the outcomes of women with c-HELLP were compared to another group contracting p-HELLP at index and subsequent pregnancies. The same groups were then followed up for a long period of time to examine the occurrence of medical complications. C-HELLP was associated with more serious short-term adverse outcomes at index pregnancy compared to partial HELLP, yet both forms had similar long-term obstetric and medical outcomes.

Interpretation

At index pregnancy, the risk for development of any complication was significantly higher among patients with c-HELLP syndrome when compared with p-HELLP, as substantiated by an earlier gestational age at delivery, higher frequency of right upper quadrant/epigastric pain and nausea/vomiting in c-HELLP versus p-HELLP and by higher abnormalities of laboratory values. Individual complications at index pregnancy were relatively more frequent in c-HELLP, probably reflecting greater comorbidity, albeit not reaching statistical significance. Different clinical presenting features and laboratory values that reflect the magnitude of end-organ damage were shown to be higher among patients with c-HELLP compared to p-HELLP [11]. A similar observation was made by Kaddour et al. who found that although c-HELLP carried a significantly worse outcome, p-HELLP was associated with a high frequency of major morbid events, including 15% mortality [11]. This view was contradicted by Abbade et al. who suggested that aggressive procedures adopted for patients with p-HELLP resulting in immediate interruption of pregnancy, with elevated cesarean delivery rates and preterm delivery need to be reviewed [12]. Individual components of partial or complete HELLP are regarded as markers of end-organ damage and are also considered as features of severity when present in patients with preeclampsia [1]. Once severe preeclampsia has manifested, remarkable end-organ involvement, adverse renal, central nervous system, and pulmonary complications can

Table 5 Long-Term Outcome of patients with previous c-HELLP and p-HELLP

	c-HELLP N = 9	p-HELLP N = 22	*p* value
Composite adverse medical outcome	7 (77.7%)	13 (61.9%)	1.00
Hypertension	5 (55.5%)	9 (40.9%)	1.00
Cerebrovascular accident	0 (0.0%)	2 (9.5%)	1.00
Coronary artery disease	2 (22.2%)	1 (4.8%)	0.23
Dyslipidemia	2 (22.2%)	3 (14.3%)	1.00
Type 2 diabetes mellitus	1 (11.1%)	4 (19.0%)	1.00
Thyroid problems	2 (22.2%)	4 (19.0%)	1.00
Chronic kidney disease	1 (11.1%)	0 (0.0%)	0.32
Chronic medication use	7 (77.7%)	10 (47.6%)	0.23
Obesity (BMI > 30 kg/m^2)	5 (55.5%)	6 (28.6%)	0.22
Depression	4 (44.4%)	6 (27.2%)	0.68
Marital problems (divorce)	1 (11.1%)	1 (4.5%)	1.00
Delay in subsequent pregnancy due to fear of recurrence of HELLP	6 (66.6%)	17 (77.2%)	0.64
Mortality	0 (0.0%)	1 (4.5%)	1.00

BMI, body mass index; c-HELLP, complete HELLP syndrome; p-HELLP, partial HELLP syndrome

arise and should be anticipated [13, 14]. In severe preeclampsia, with or without evidence of features related to HELLP syndrome, optimal management remains primarily termination of pregnancy [1]. One case of maternal mortality (4.2%) due to intracranial hemorrhage was encountered in the c-HELLP group, but none in the p-HELLP group. Although there is universal agreement on a clear association between c-HELLP syndrome and maternal mortality, 1.1% as reported by Sibai et al. [15], this can vary widely depending on the population studied, the diagnostic terms used and the presence of associated pre-existing medical conditions [16]. Maternal mortality rate ranged between 0.0 and 35.4% [5, 10, 11, 17, 18]. This variance in maternal mortality and other complications might reflect differences in prenatal care, hospital accessibility, inappropriate diagnostic and management protocols applied to these patients, such factors being more frequent in developing countries [16]. Similarly, all short-term complications seen with severe preeclampsia can also affect partial or complete HELLP, with a greater predilection for the latter. Maternal mortality is more prevalent in, but not limited to, patients with c-HELLP. Individual studies have reported 2.2%, 6.25% and 15.3% maternal mortality among patients with p-HELLP, which bears witness to the hazards that can complicate p-HELLP [11, 17, 18]. As in c-HELLP syndrome, all kinds of catastrophic morbidities can occur, including intracranial hemorrhage and liver hematoma, albeit at a lower frequency. Kaddour et al. reiterated this observation and indicated that although it is relevant to distinguish between partial and complete HELLP, mortality among patients admitted to an ICU was not seen with c-HELLP (40.0%) alone, but with complicated p-HELLP as well (15.0%). Mortality in p-HELLP was still very elevated, which argues for aggressive management as in c-HELLP [11]. Conservative management pending the development of c-HELLP might prove hazardous, as p-HELLP already carries increased risks for morbidity and even mortality. We noted also that vaginal delivery, NICU admission rate, prevalence of IUFD and lower mean birth weight tended to be higher in the group with c-HELLP syndrome. This pattern was also seen in other studies [5, 10, 17–19]. This might indicate that c-HELLP tends to be more severe and affects the uteroplacental blood supply more, thus mandating delivery at an earlier gestational age. The only difference in neonatal outcome was lower birthweight among newborn infants delivered to women with c-HELLP syndrome, which could be attributed to earlier termination of pregnancy (32.9 weeks vs 34.9 weeks).

Recurrence of hypertensive complications in a subsequent pregnancy was comparable in c-HELLP and p-HELLP (69.2% vs 57.6%), frequencies analogous to those reported in subsequent pregnancies following preeclampsia [20, 21]. The reported recurrence rate of HELLP syndrome ranges between 2 and 24.5% [10, 22–26]. Only Aydin et al. have provided information for comparison, in reporting a rate of 7.1% for preeclampsia and 3.6% for HELLP syndrome in patients with a history of c-HELLP, compared to 34.6% for preeclampsia and 15.4% for HELLP syndrome in patients with a history of p-HELLP syndrome. Unfortunately, no information was provided on the recurrence rate of p-HELLP in the two groups in this study [5]. Interestingly, we observed that patients with a history of c-HELLP developed all types of hypertensive disease in their subsequent pregnancies, but those with a history of p-HELLP did not develop c-HELLP, though they did develop the remaining hypertensive conditions. Whether or not this observation was due to the small sample size can only be demonstrated by larger studies.

Several studies have indicated that women with a history of preeclampsia are at increased risk for the development of cardiovascular diseases (hypertension, congestive heart failure and myocardial infarction), CVA, and many autoimmune diseases later in life [27, 28]. The risks are highest in patients with a history of severe or early preeclampsia [29]. On the other hand, data on the long-term consequences of HELLP syndrome in its two forms are limited and, when available, are confined to c-HELLP and limited to a maximum of 5 years of follow-up [6, 19, 22, 23]. This bestows merit on our study for filling this informational gap, with a mean of 16 years of follow-up (range 7–25 years). We observed that both groups showed an increased risk for new-onset hypertension (55.6% for c-HELLP vs 40.9% for p-HELLP), albeit with no significant difference between the groups. Van Pampus et al. reported an 8% frequency of new-onset hypertension 3 years after c-HELLP syndrome, while Habli et al. reported a 33% frequency of new-onset hypertension 5 years after a pregnancy complicated by c-HELLP, whereas Hupuczi et al. reported a 24% frequency of new-onset hypertension immediately after a previous pregnancy complicated by c-HELLP syndrome (a three-fold increase) [2, 6, 25]. Comparison between c-HELLP and p-HELLP was only reported by Aydin et al., who observed that hypertension occurred at a rate of 22.4% for c-HELLP versus 23.4% for p-HELLP syndrome 5 years post index pregnancy [5].

Patients in both groups in our study developed CAD (22.2% in c-HELLP vs 4.5% in p-HELLP). This might be linked to a higher frequency of several components linked to metabolic syndrome among patients with a history of HELLP, such as dyslipidemia (22.2% for c-HELLP vs 13.6% for p-HELLP), type 2 DM (11.1% for c-HELLP vs 18.2% for p-HELLP) and obesity (50% for c-HELLP vs 33.3% for p-HELLP). Similar percentages were not

reported in other studies [5, 6], which could be attributed to the difference in populations or to the limitation of a 5-year interval. Our patients also had an increased risk of thyroid problems (mainly hypothyroidism): 22.2% for c-HELLP and 18.2% for p-HELLP. Only one case of mortality due to CVA was observed in the p-HELLP syndrome group 12 years post index pregnancy. Other studies have not reported such a finding.

Several studies have reported an increased incidence of depression among HELLP patients. Habli et al. reported that depression affected 32%, anxiety 26% and marital problems such as divorce 19% of patients with HELLP [6]. Van Pampus et al. pointed also to the need for psychological treatment in 18% of HELLP patients [30]. Aydin et al. reported increased early termination of pregnancy and attributed these psychological problems to neonatal mortality and long hospital/ICU stay [5]. In our study population, depression requiring medical treatment was noted in 44.4% of patients with c-HELLP and 27.3% of patients with p-HELLP, while 11.1% of c-HELLP patients and 4.5% of p-HELLP patients divorced after the index pregnancy. Moreover, fear of the recurrence of HELLP together with a delay in subsequent pregnancy was found to affect 66.7% of the c-HELLP patients and 77.2% of the p-HELLP patients. The same was also noted by Habli et al. who considered that fear of recurrence was the main issue affecting the psychology of HELLP patients in the postpartum period and required intervention and close follow-up, while Van Pampus et al. noted that 34% of c-HELLP patients abstained from further pregnancies because of a fear of recurrence [6, 22]. Interestingly, in our study, patients who agreed to an interview belonged to the early period of the study (1994–2000), after which they probably had overcome the stress inflicted by HELLP syndrome in its two varieties, a condition defined by Van Pampus et al.as post-traumatic stress disorder [30].

Implications for Clinical Practice

When compared to p-HELLP, c-HELLP syndrome was associated with higher rates of maternal and neonatal morbidity and mortality. Nevertheless, the same approach should apply to the management of both syndromes. Waiting for p-HELLP to progress to the complete form is ill-advised. Although p-HELLP is less harmful, it can nonetheless initiate major morbid events, including 15% mortality [11]. Nevertheless, both types have similar sequelae in subsequent pregnancies and later life and, as such, both can be regarded as a "continuum in the natural evolution of the same disease" [5]. Therefore, adequate detailed documentation for patients presenting with c-HELLP or p-HELLP should be done because this may affect future pregnancies and long-term maternal health. Clinical observations exploring the pathophysiology and the molecular and angiogenic similarity between HELLP syndrome and preeclampsia indicate a growing conviction that both complete and partial HELLP types are variants of preeclampsia syndrome [31–34]. Nowadays, there is a shift of preeclampsia screening towards the first trimester. The combination of maternal history, blood pressure measurements, serum biomarkers, and measurements of uterine arteries pulsatility index identify the population at risk who may benefit from prophylactic low-dose aspirin before 16 weeks of gestation. Such screening is advisable in patients with a history of preeclampsia, c-HELLP, and p-HELLP [35, 36].

Strengths and Limitations

To our knowledge, this is the only study to report long-term medical outcomes of patients with the 2 varieties of HELLP syndrome, an average of 16 years (7–25 years) after the index pregnancy. Another advantage was that we followed up with the same individuals so as to describe the outcomes of subsequent pregnancies and their medical condition years later. Small sample size was the major limitation of the study. Another limitation was the high (60%) attrition rate, which might be explained by "loss to follow-up" due to the long study period and the refusal of several women to participate because of their unpleasant experiences. This high rate though is not uncommon when compared to other long-term follow-up studies. In a 15-year population-based longitudinal study by Gustavson et al., the attrition rate was 17% after one year and reached 56% at the conclusion of the study [37].

In summary, like preeclampsia, partial and complete HELLP can predispose patients to life-threatening serious medical morbidities over the long term, so all healthcare providers need to provide similar and appropriate follow-up for close monitoring of medical morbidities and to investigate the benefits of lifestyle changes and some potential prophylactic measures.

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Declarations

Conflict of interest The authors report no conflict of interest.

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