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Blood Group Cartography (ABO, RHESUS, KELL and DUFFY) and Hemogram of Icteric Newborn in Sendwe Hospital, Lubumbashi/D.R.C

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Abstract: Background: Allo immunization jaundice is a common cause of neonatal jaundice. According to racial group the concerned blood group may not be the same. In our Country people are exposed to high transfusionnal risk because of malaria and sicklanemia and the blood group research in laboratory include only ABO/D. Objective: Our objective was to establish a blood group cartography of this icteric newborn population and their mother; the frequency of rare blood group and the compatibility level between mother and newborn. Our interest was also to study hemogram of this population. Methodology: We studied blood group ABO/D; RH/Kell and Duffy of 56 newborn whom developped an indirect bilirubin and their mothers. We performed bilrubin level and hemogram. Results: The frequency of icteric newborn was 17.17%. The mother blood mapping was O (60.71%), RhD positive (83.9%), C negative (91.07%) E negative (89.29%) c positive (91.07%), epositive (92.86%), kell negative (100%) and duffy null (100%). The most common phenotype was ccDee (67.9%) Neonatal was ex aequo O and B (37.50% respectivly), RH D positive (87.50%), RhC negative (87.50%), Rh E negative (89.29%), Rhc positive (96.43%), Rh e positive (96.43%), Kell negative (98.21%) and duffy null (100%), 75% of newborn had the phenotype ccDee. We noticed 9% of extremely rare blood group in maternal population. Mean level of bilirubin was 11.48 mg% at H48. Analyse of hemogram reveal a normocytic and normochromic anemia. Conclusions: Mapping blood group of this population reveal the importance of extended blood grouping in icteric newborn and their mother. Our population presents a blood group that is widely open to allo immunization in all studied blood group.

Key words: Blood group, ABO/D, RH/Kell, Duffy, icteric newborn, allo immunization.

1. Background

Foeto maternel allo immunisation jaundice is the second leading cause of neonatal jaundice after physiological jaundice. [1-3] This free bilirubin jaundice can have serious consequences on the psychomotor fate of the newborn [1, 3].

Maternal fetal allo immunization is a cosmopolitan phenomenon, it is found in all countries, however the blood groups involved vary from one region of the world to another [1, 3, 4].

The most immunogenic blood groups are classified differently; In terms of Frequency ABO is the first; in terms of severity, Rhesus D is in the lead. [2, 3, 5, 6] Severe cases of newborn hemolytic disease are described in blood groups that had not been focused. Some authors also describe cases of multi-antigen allo immunization [5-11].

Just as the distribution of blood groups is not homogeneous between breeds, grouping techniques and the number of blood groups routinely requested

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vary from hospital to hospital and continent to continent [12-18].

African ABO distributions are mostly Around O 50%; followed by A and B, which are almost equal, the AB group is the rarest.

For the RH D group 5% of the African population is devoid of rhesus trait while in the Caucasian population the proportion is 15% [19, 20].

The most common rhesus phenotype also varies by breed; and even at the same continent and country level, distributions are not homogeneous. In Africans, the most common phenotype is Dccee; while in the world population, the DCcee phenotype is the most found [19, 20].

In common practice in Africa in general, and in the DRC in particular, routine blood grouping involves ABO D; other blood groups are not usually sought after. All transfusions performed only respect these two compatibilities [15, 21-23].

This practice in a country placed in the belt of malaria and sicklanemia, which are two pathologies providing anemia and therefore high transfusion can be the cause of allo immunization to several antigens. Authors have examined the frequency of allo immunizations in these populations and found multi-antigen allo immunizations [13, 14, 24-26].

Our interest focused on the mother- newborn couple in a Newborn population that developed indirect bilirubin jaundice. We performed a systematic blood grouping in ABO-D; Rh-Kell and Duffy and a hemogram.

1.1 Objectives

The aim of this study was:

- Mapping blood groups in the population of icteric infants;
- Define the proportion of rare blood groups and perfect compatibility in this population of icteric newborns;
- Compare bilirubin and hemogram constants to classically known constants in newborns.

2. Methodology

Our study was conducted in the neonatology department of Sendwe Hospital from March 01, 2015 to December 1, 2015. It was a descriptive cross-sectional study. The sample was of convenience.

It included all infants admitted for jaundice or who had jaundice during hospitalization with complete records. Jaundice was first clinically diagnosed by yellow coloration of the mucous membranes and/or teguments. A paraclinical examination of bilirubin was then performed to classify indirect bilirubin and conjugate bilirubin jaundice.

All icteric infants whose mothers had agreed to the sample were retained. Non-icteric infants and those with incomplete records were excluded from the study. We took blood from the EDTA tube from the mother and performed extensive blood grouping.

In newborns, a blood grouping and hemogram and an anti-coagulant sample for bilirubin were taken.

The tests that have been carried out are the ABO-D and the RH-Kell systematically in the mother and newborn.

A complete hemogram and bilirubin on venous blood in the newborn had been performed. The bilirubin was collected during laboratory hours: from 7:30 a.m. to 11 a.m. from Monday to Friday and from 7:30 a.m. to 10 a.m. on Saturday. The statistical analysis was carried out with the Software epi info and Excel. The confidence interval was 95%.

3. Results

3.1 Frequency

During the 10 months of our study, 316 newborns were hospitalized in neonatology on 1,603 live births, representing 19.71%.

Of the 316 hospitalized infants 96 developed jaundice during hospitalization, a frequency of 30.37%. However, only 56 complete files were selected for the study, representing a frequency of 17.72%.

3.2 Maternal Profile

As shown in Table 1.

3.3 Immunization Pathway

As shown in Table 2.

3.4 Bilirubin Profile

As shown in Figure 1 and Table 3.

3.5 Blood Group Cartography

Knowledge of blood group (as shown inTable 4).

In our population 64.26% knew the father blood group and 67.86% their own blood group.

The ccDee phenotype was the most found either in maternal and newborn population (as shown in Table 5 and Table 6).

3.6 Compatibility

In this study, 62.50% couple mother/newborn was not perfectly compatible according to one of the blood group of interest for our study (Fig 2).

The ABO group was the most involved 41% and in the Duffy one mother and newborn had exactly the same profile of Duffy null (Fig 3).

3.7 Hemogram

As shown in Table 7.

Table 1 Maternal Profile.

Median age	25 ans (21-30)
Profession	Housewife 66.07%
Commune	Kampemba 28.57%
Province	Katanga 58.93%
Level of instruction	Secondaire 58.93%
Parity	2 (1-4) ; dans 30.36% des cas dès le premier accouchement
Gestity	3 (1-4.5)
Miscarriage/Abortion	30.26%
Neonatal death	21.40%

Table 2 Immunization Pathway.

Curetage	25%
Prior blood transfusion	14.55%
Jaundice in siblings	16.07%
Anemia in siblings	3.57%

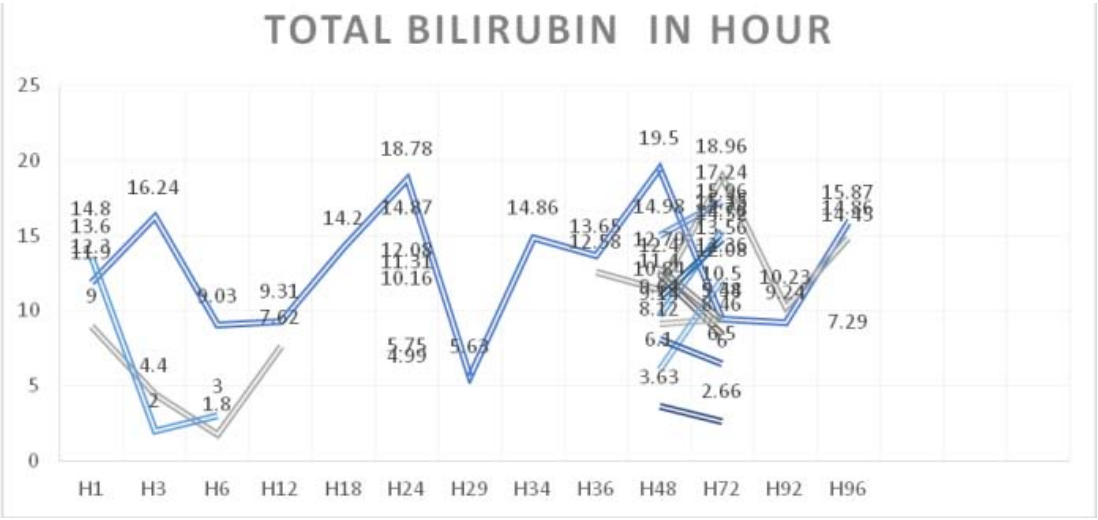

Fig. 1 Bilirubine in hour.

Table 3 Bilirubine Level According to Jaundice Apparition in Hour.

	Minimum	P25	Médianne	P75	Maximum
BT mg%	2	9	11.99	14	19.5

Table 4 Mother and Newborn Blood Group Mapping.

Blood Group	Maternal	Newborn
	ABO	
A	7/12.50%	12/21.4%
O	34/60.71%	21/37.5%
B	15/26.79%	21/37.5%
AB	0	2/3.6%
	RHESUS D	
NEGATIF	9/7.1%	7/12.5%
POSITIF	47/83.9%	49/87.5%
	RHESUS C	
NEGATIF	51/91%	49/87.5%
POSITIF	5/9%	7/12.5%
	RHESUS E	
NEGATIF	50/89.3%	50/89.3%
POSITIF	6/10.7%	6/10.7%
	RHESUS c	
NEGATIF	5/9%	2/3.6%
POSITIF	51/91%	54/96.4%
	RHESUS e	
NEGATIF	4/7.1%	2/3.6%
POSITIF	52/92.9%	54/96.4%
	KELL	
NEGATIF	56/100%	55/98.2%
POSITIF	0	1/1.8%
	DUFFY	
NEGATIF(Fya(-) Fyb(-)	56/100%	56/100%
POSITIF	0	0

Table 5 Maternal Extended Phenotype.

Maternal Phenotypes	Frequency	Percent
ccDee	38	67.9
cc-ee	7	12.5
ccDEe	4	7
--Dee	2	3.6
CcDee	2	3.6
Cc-ee	1	1.8
ccDEE	1	1.8
CC---	1	1.8
Total	56	100%

Table 6 Newborn Extended Phenotype.

Newborn Phénotypes	Frequency	Percent
ccDee	42	75%
cc-ee	6	11.3%
CcDee	4	5.6%
CcDEe	2	3.8%
ccDEe	1	1.8%
---ee	1	1.8%
Total	56	100%

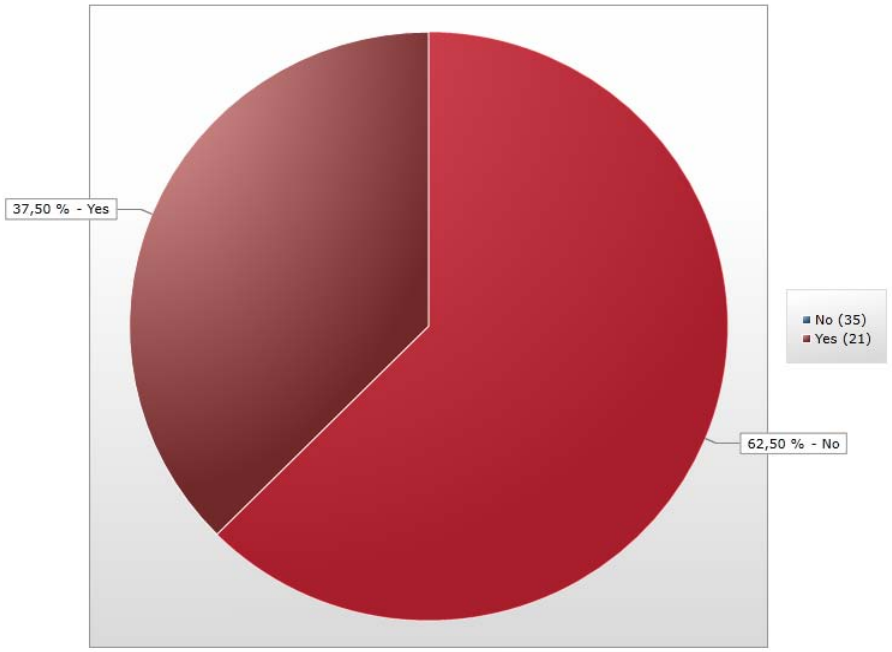

Fig. 2 62.50% couple mother/newborn was not perfectly compatible according to one of the blood group of interest for our study.

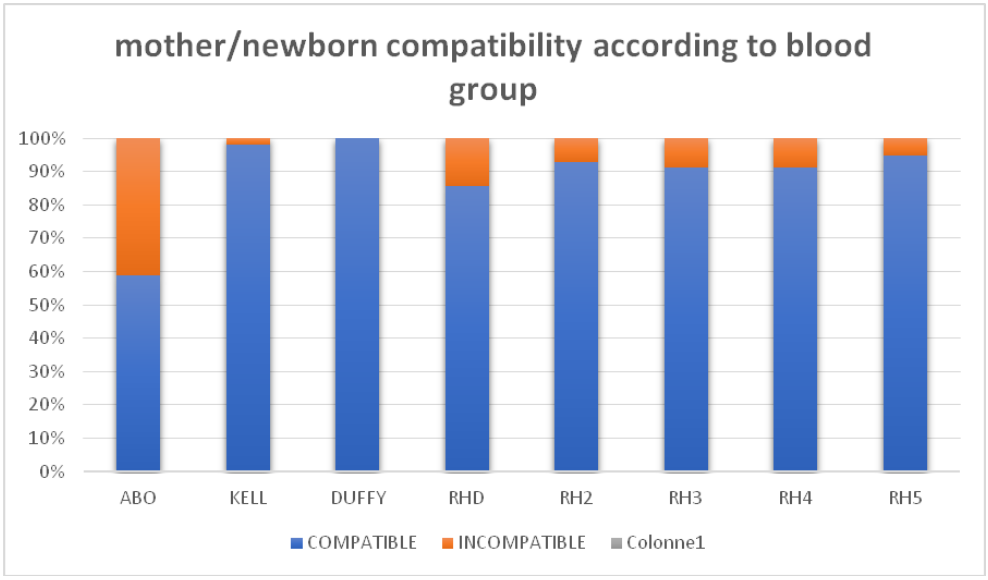

Fig. 3 The ABO group was the most involved 41% and in the Duffy one; mother and newborn had exactly the same profile of Duffy null.

Table 7 Newborn hemogram.

Variables	Frequency	Interpretation
Hemoglobin	14.98 g% ± 2.7975	low for age
Hématocrit	47.71% ± 9.9	low for age
Red blood cells	4.829 T/L ± 1.106	low for age
MCV	99.30 fL ± 11.36	Normocytaire
MCHC	30.65 g/dl ± 2.23	Normochrome

We noticed a normochrom and normocytic anemia in our population.

4. Discussion

➢ Frequency

We had a frequency of 17.72% in our study; this frequency is close to that of Ghomari et al in Algeria 18% [27]. It is lower than that found in the Study of Barkat et al in Morocco 26% [28] and significantly higher than in Benin 11% [29].

➢ Maternal Profile

• A median maternal age of 25 years (21-30.5); these values are close to other authors: Ngo sack et al in Cameroon in their study of allo immunization in women of childbearing age in Yaounde found 49.87 per cent of women between the ages of 21 and 30 [30] and Assumani et al in the DRC found middle-aged pregnant 29.9 ± 5.7 years [31]. It is in this age group that reproductive activity is highest on the continent.

• The household profession at 66%; our proportions are slightly higher than that of Assumani, who found 63.3%. It is a reflection of the African population where women do not work.

• The births of the study resided in the commune Kampemba in 29% of cases; it is one of the municipalities adjacent to the hospital; which explains its strong representation.

• The province of origin was Katanga for 59%; our study took place in this province, hence its strong representation; Assumani et al also found a predominance of mothers from Katanga 55.8% [31].

• Secondary education level was predominant 58.93%; the same is true in the study of Assumani 80% [31].

4.1 Obstetrical History

More than a quarter of our population had a primigeste mother 28.57%; for a median gestity of 3. With regard to jaundice by incompatibility; only the ABO group can justify jaundice from the first pregnancy [1-3, 32, 33]. Naimi and Assumani's studies found a higher proportion of multigestes [18, 31].

Pregnancy is a route of immunization, the risk of alloimmunization increases with the number of pregnancies [1, 2, 34].

In our study, jaundice was more pre-manifested in pare 2 mothers followed by pare 1; they account for 62% of the subjects. In his study of icteric infants Boudjelloul and Bouneb in Algeria, for their part, a majority of primiparous 55% [35]. The damage in blood groups other than ABO, usually occurs from the third pregnancy in the absence of prior immunization [1, 4, 36, 37].

A history of miscarriage has been reported in 30% of births, this percentage is almost double that of Assumani et al in a general population of Lushoises births 15.6%. It appears that our population has experienced more miscarriages; it should be noted that a history of abortion is both a possible route of immunization and a manifestation of maternal foeto allo immunization [3, 36, 38].

Our subjects had a history of early neonatal death of 26%; this rate is 3 times higher than that of Assumani in a population of normal-term newborn mothers 8% [31]. The history of our births makes the case for the immunological origin of jaundice, so it would be wise for the extensive blood grouping to be carried out systematically in case of jaundice.

➢ Immunization Pathway

One third of our sample, or 33%, had already

undergone a curetage, and 14.55% had a transfusion that constitutes probable immunization pathways. These figures are lower than those found by Ngo Sack in Yaounde in its population of women of childbearing age 34% of transfusion history [30]; however, transfusions in sub-Saharan Africa only comply with ABO/D compatibility and any transfusion poses a high risk of allo-immunization [15, 21, 22].

- Blood Group Knowledge

The blood group knowledge rate in our study was 67.86%; however, no subject had a blood type card because they were not issued in Congo. This is almost the same at Barkat in Morocco, 68% [28].

This rate is significantly lower than that of Naimi et al, in whom all the gestantes knew their blood groups and had their blood type cards [18].

- Bilirubin Rate

The median bilirubin rate in our study was 11.9 mg%; it is significantly lower than the rates noted in Algeria by Boudjelloul and Bouneb by 23 mg% [35]. In their study all jaundices were pathological. This difference is probably related to the techniques used and the time it takes to collect. We had has a constraint the opening hours of the laboratory for the samples (Monday to Friday from 8 am to 11:00 am and Saturday from 8 am to 10:00 am), some samples were taken up to two days after the clinical diagnosis of jaundice.

The thresholds we found were above the average for age which is 8.5 mg% at the forty-eighth hour.

- Maternal Blood Group Cartography

Our population of gestantes has a blood group distribution frankly different from the known averages for the breed in a general population; all blood groups combined.

4.2 ABO

In ABO, there is a clear predominance of O 60.71%, followed by B 26.79% and A 12.50%, no mother was AB (Table 8).

These three blood groups are most implicated in jaundice by ABO maternal foeto incompatibility; and Group O more than the others. This incompatibility is more frequent and severe in black subjects [11, 42-44].

It should be noted that AB subjects are naturally devoid of antibodies so a jaundice by incompatibility if it is to exist develops less quickly and more rarely [2, 19, 20] .

Our distribution is an echo of these assumptions.

4.3 Rhesus D

For Rhesus group D, the percentage of our negative RhD births is 4 times higher than the region rate and is double the known averages for the black race (Table 9) [19, 39, 45].

Our frequency in this population is almost equal to Caucasian distributions. [19]

This finding suggests that incompatibility jaundice is really to be monitored since negative RhD is the group that causes the most severe forms. [1-3, 46]

Knowledge of maternal blood type in an icteric newborn population is very crucial.

4.4 Extened Rhesus

Mothers of our icteric subjects express Less Rh2 and Rh3 than most Negroid subjects (Table 10) [19, 47].

There are no data for these blood groups in the Congolese population, so a comparison is not feasible.

Table 8 In ABO, there is a clear predominance of O 60.71%, followed by B 26.79% and A 12.50%, no mother was AB.

ABO	Our Study	Black [19]	Congo [39]	India [40]	White [19]	American Indian [19]	Nigeria [41]	Maghreb [26]	Moroco [35]
O%	60.71	49	61.5	29.27	44	100	58.1	42.5	47
A%	12.50	27	18.5	29.42	43	0	18.7	35	34
B%	26.79	20	17.5	20.03	9	0	17.6	15.66	11
AB%	0	4	2.5	22.24	4	0	5.6	5	8

Table 9 The percentage of our negative RhD births is 4 times higher than the region rate and is double the known averages for the black race.

Rhesus	Our Study	Black [19]	RDC [39]	India [40]	White [19]	American Indian [19]	Nigeria [41]	Algeria [26]	Zambie [42]	Moroco [35]
Positif	83.93		97	84.67			95.5	87	91	89
Négatif	16.07	5-7.8	3	15.33	16.5	1	4.5	13	9	11

Table 10 Mothers of our icteric subjects express Rh2, Rh3, Rh4 and Rh5.

Extended Rhesus	Our Study	American Black [19]	Ivorians [47]	Indians [26]	Caucasians [19]
Rh2 C %	8.93	27	17.9	67	68
Rh3 E %	10.71	22	17.9	18	29
Rh4 c %	91.07	96	82.10	65	80
Rh5 e %	92.86	98	82.10	36	98

Table 11 The most common phenotype in the Congolese population is a phenotype considered rare worldwide.

	ccDee %	cc-ee %	CcDEe %	--Dee %	CcDee %	Cc-ee %	CcDEE %	CC—-%
Our study	67.9	12.5	7	3.6	3.6	1.8	1.8	1.8
American black [19]	44	26	11	0	17	2	0	0
Caucasians [19]	4	37	14	0	44	2	0	0
Congo Belge [48]	76.61	2.37	9.83	0	9.15	0.34	0	0
Ivorians [47]	50.3	7.6	17.6	0	17.2	2.8	1.4	0
Cameroonian [30]	50.45	2.44	19.3	0	24.8	0	0.61	0
World mean and phenotype classification [19]	2% Rare	15%	12%	Less than 1% very rare	35% Most frequent phenotype	Less than 1% Rare	Less than 1% rare	Less than 1% Very rare

Rh3 and Rh2 IFMEs are to be feared in this population.

Rh4 and Rh5 are expressed by the vast majority of mothers; however our rates in this population remain below the known averages for the black race [19].

4.5 Extended Phenotype

From a phenotypic point of view, our distribution is clearly different from all known frequencies, even Congolese. In this distribution, 9% of the population has a rare blood type and therefore has significant immunological potential [19, 47].

The most common phenotype in the Congolese population is a phenotype considered rare worldwide; only 2% express it (Table 11) [2, 19, 49].

The phenotypes of all our mothers have the potential for allo immunization. Sub-Saharan Africa and the DRC in particular should therefore incorporate these groupings into routine transfusion surveillance.

Our subjects did not express the Kell at all; these constants are slightly higher than the known averages for the black population (Table 12) [19, 30, 47].

Our population was similar to that of the Orientals and therefore had greater potential to induce allo immunization in Kell than the general population.

4.6 Duffy

The Duffy null gene is the one found in the majority of our gestantes, these results are similar to the known averages for Sub-Saharan Africa; but are well above the averages of the black race. It should be noted that Duffy null is a rare blood type in other breeds (Table 13).

There are a high proportion of rare blood groups in our maternal population; the profile that emerges is strongly exposed to allo immunizations [2].

Table 12 Our subjects did not express the Kell.

Blood group	Our study	Blacks [19]	Caucasians [19]	Maghrebins Naimi [18]	Cameroonians [30]	Ivorians [47]	Arab [19]	Iranian jew [19]	Oriental [19]
Kell neg %	100	98	91	98	98.5	97.9	75	88	≈100

Table 13 Duffy null is a rare blood type in other breeds.

Blood group	Our study	Blacks [19]	Caucasians [19]	Indians [50, 51]	Algérians [49, 52, 53]	Zairian (&) (congolese) [53]	Nigérians(&) [53]
Fya- Fyb- Duffy null %	100%	68	0.1	0	5 9.523 37.7	97,1	100

Table 14 Neonatal map.

ABO	Our study	Morocco [35]	Lubumbashi /RDC [31]	Zambia [42]	Kalemie /RDC [45]	Blacks [19]	Caucasians [19]	Asians [19]
O %	37.50	52	55	51	60.5	49	44	43
A %	21.43	38	23.3	24.6	21.6	27	43	27
B %	37.50	5	17.7	20.1	15.4	20	9	25
AB %	3.57	5	4	4.3	2.5	4	4	5

Table 15 Rhesus D.

RHD	Our study	Assumani [31]	Kabemab [45]	Kapasa [42]	Black [19]	Abdelhamid [35]	Caucasians [19]
POSITIF	87.50					86	
NEGATIF	12.50	2.3	1.6	9	5-7,8	14	16,5

- Neonatal map (Table 14)

Our icteric newborns have a lower percentage of subjects O than the known averages for city and race [19, 31, 39, 42]. Group O is even lower than Caucasians and Asians.

This low representation brings us back to the pathogenesis of jaundice by incompatibility in ABO, no ABO antibodies (Anti-A and Anti-B) can be directed at red blood cells O [2, 11, 32, 42, 54].

Our distribution is frankly different from that of Abdelhamid who worked on a population of icteric newborns in Morocco in 2015; it is probably related to the race [35].

On the other hand, our Group B subjects are:

- Almost twice as high as the known Congolese averages (Assumani and Kabemba) the former worked on a full-term newborn population and the second on blood donors.
- Well above the averages of the breed, and the Asian frequencies.

This distribution is in favour of known data on ABO incompatibility that is more common in blacks and more severe in O/B couple according to several studies. [11, 32, 42, 44, 55-57]

4.7 Rhesus D

We note a high proportion of negative RhD subjects in our newborns which are almost an echo of the high proportions noted in the maternal population (Table 15).

Our results are very similar to those of Boudjelloul and Bouneb in Algeria who also worked on a population of icteric newborns, [35] and Caucasians [19]. Our icteric subjects rank in frankly different distributions to known averages for race.

4.8 Extended Rhesus

Our icteric subjects have more expressed Rh4 and Rh5 and this on an equal footing; their expression of Rh2 and Rh3 is the weakest of all races as shown in this Table 16.

It should be noted that Rh2 is much more expressed in newborns than in their mothers.

The phenotypes we have listed in our icteric newborn population are almost similar to those found by Hiernaux at the time of the Belgian Congo where it was already noted that three quarters of the subjects were ccDee (Table 17) [48]. For the other phenotypes, the difference is marked; we note two phenotypes that he had not found in the general Congolese population of the time.

One of our subjects presented a rare phenotype that is not found in any distribution.

These findings should lead clinicians to carefully perform extensive blood clusters in any icteric newborn in order to identify rare blood groups and plan their management in transfusion medicine.

In our population of icteric newborns, there was one kell positive subject (Table 18). Our distribution reflects the known percentages for the breed [19].

4.9 Newborn Distribution of Duffy

As for the Duffy group our subjects were all Duffy null as the maternal population, for this blood group we had noted a perfect compatibility that would suggest that duffy incompatibility is not a problem in a population black-race subjects.

- Compatibility

Incompatible mother/newborn couples accounted for 62.50%, this frequency is higher than that reported in studies in general infant populations.

Monica Kapasa et al. in Zambia in her study of aBO-type hemolytic disease found an incompatibility rate of 49% [42]; it should be noted that all the mothers in his study were in Group O and that rhésus D was the only additional group examined. Referring only to the ABO group, our incompatibility rate was 41% for this blood group alone. In other breeds this rate of incompatibility is lower; 14% among Czechs, 16% in Venezuela and 28.3% in Puerto Rico.

One study found that the black race was 2 to 3 times more exposed to ABO incompatibility than Caucasians, this finding corroborates our findings.

- Hemogram (Table 19)

Our average hemoglobin level was 14.98 g% ± 2.7975 at forty-eighth hour of life, these constants were low for age 18.5 g% between 0 and 3 days [1].

Table 16 Extended Rhesus.

	Our study	Ivory coast [47]	Black [19]	Caucasians [19]	Pakistan [58]	Inde [59]
Rh2 C	12.50	17.9	27	68	87	87.55
Rh3 E	10.71	17.9	22	29	19	26.55
Rh4 c	96.43	82.10	96	80	57	51.06
Rh5 e	96.43	82.10	98	98	99	98.42

Table 17 The phenotypes we have listed in our icteric newborn population are almost similar to those found by Hiernaux at the time of the Belgian Congo where it was already noted that three quarters of the subjects were ccDee.

	Our study	Congo Bashung [48]	Congo Twa [48]	Ivory coast [47]	Cameroon [30]	Black [19]	Caucasians [19]
ccDee	75	71.39	76.61	51.8	50.45	44	4
cc-ee	11.3	5.15	2.37	7.6	2.44	26	37
CcDee	5.6	9.54	9.15	17.2	24.8	17	42
CcDEe	3.8	1.55	0.68	2.8	1.8	0	0
ccDEe	1.8	0	0	17.6	19.3	11	2
---ee	1.8	0	0	0	0	0	0

Table 18 One kell positive subject.

Blood group	Our study	Black [19]	Caucasians [19]	Algérians [18]	Cameroonian [30]	Ivoirians [47]	Arab [47]	Iran jew [47]	Oriental [47]
Kell neg %	98.2	98	91	98	98.5	97.9	75	88	≈100

Table 19 Hemogram.

	Our study	Assumani [31] Valeur normale N-né Lubumbashi	Laugier [1] Valeur normale N-né moyenne mondiale 0-3jrs	Schaisson et al 1979 In Armari C [60]
Hemoglobin g%	14.98 ± 2.7975	17.97 ± 2.39	18.5	17-20
Hematocrit %	47.71 ± 9.9	56.14 ± 7.64	56	
Red blood cells T/L	4.829 ± 1.106	6.07 ± 3.34		4-5.7
MCV fL	99.30 ± 11.36	96.59 ± 8.69	108	90-120
MCHC g/dl	30.65 ± 2.23	31.91 ± 1.78		

The hematocrite rate of our subjects was 47.71 ± 9.9 this value is well below the average for the age of 56 [1].The red blood cell count of the subjects in our study 4.829 ± 1.106 on average was on the minimum for age which is 4.5-5.5 between 2 and 7 days.

The mean corpuscular volum (MCV) revealed a normal size of red blood cells 99.30 ± 11.36 which corresponded to the averages for age; 90-120 between 0 and 7 days [60].

This low hemoglobin, haematocrit, red blood cell and increased MCV configuration was found in the Assumani study in a normal term newborn population blood count study [31]. However our values are all much lower than his, except the mean corpuscular volum (MCV). The explanation could be found in our study population which is different from his; it includes:

- Premature newborns;
- All our subjects developed a jaundice;
- Newborns from incompatible mother/newborn couples in a blood group (more than half of the subjects). The most affected blood type is ABO. Incompatibility may expose these newborns to normocytyc normochrome anaemia.
- In his study on neonatal jaundice in Algeria, Boudjelloul noted only anemia without further disruption of the blood count [35].

5. Conclusions

By its frequency of 17.72%, jaundice is still a public health problem in our community.

This study allowed us to highlight the presence of rare blood types in our population of jaundice infants and even more in the maternal population.

We were able to map blood groups not studied in the Congo; the most common blood group is O ccDee Kell- Fya-Fyb-group; this group is quite common in the black race, but globally it is a rare blood group. We have established that from colonial times to the present day for Rh Kell; there have not been many notable changes. However, our population has more blood types with high immunological potential.

The blood type mapping is very different from the one known for the breed; it corresponds mainly in ABO to the blood types able to induce an allo immunization.

The ABO system is the one with the most incompatible mother/newborn pairs, which confirms its greater frequency in the black race.

Rh-Kell blood types are usually not sought in common practice and yet can be responsible for severe allo immunizations. In our study, all of these groups show percentages of incompatible mother/baby couples.

A single blood group, Duffy, was not shown to have allo-immunization potential in our study due to the homogeneity of the study population. All subjects are Duffy null; however one must fear the appearance of allo immunization to the outcome of mixed marriage.

There is a disruption in the blood count in our newborn population, which argues for a hemolytic origin of jaundice.

These findings open the door to further studies that would look at other blood types not studied here.

Declarations

This study has the ethical consent of our ethical comitee of Lubumbashi number UNILU/CEM/2018.

We have no conflict of interest to declare.

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