blood transfusions and the possible acquisition of antibodies either transplacentally or from a postnatal infection. Nevertheless, serological findings suggested perinatal infection with the ToRCH agents in 61 of 192 cases (37%). The type of involvement associated with individual agents is presented in the table:

	Agent implicated			
	To	R	C	H
Total number of cases	11	16	22	12
Type of involvement*				
Central nervous system	4	9	10	7
Ocular	5	4	5	3
Growth retardation	1	5	2	1
Visceral organs	2	2	10	2
Other	2	1	1	2

* A single case may have shown more than one type of involvement.

Ecological contrasts between bacterial species commonly found in impetigo. ADNAN S. DAJANI, PATRICIO FERRIERI, and LEWIS W. WANNAMAKER. *Univ. of Minnesota Med. Sch., Minneapolis, Minn.*

An opportunity to study the interrelationships between and the significance of the two bacterial species commonly associated with impetigo was provided by intensive observations on 38 children in a population with endemic skin infections. Cultures of the respiratory tract, 3 normal skin sites and lesions (when present) were done 3 times weekly from July to October 1969. Impetigo developed in all children. Group A streptococci alone were recovered from 21% of 361 lesions, staphylococci alone from 14% and both from 62%. Lesions in early stages (before crusting) were more often pure streptococcal (34%) than staphylococcal (8%). Phage type 75 accounted for the majority of the staphylococcal isolates from all sites. 74 lesions were serially cultured at least 3× each (mean 4.9×) over a period of 6 days or longer (mean 12.6 days) until healing occurred. Of 17 initially pure streptococcal lesions 41% remained so, 59% became mixed and none became staphylococcal. Of 54 initially mixed lesions 69% remained so, 24% became streptococcal and only 7% became staphylococcal. Of the 3 initially pure staphylococcal lesions 2 became mixed. In 85% of the instances, the same streptococcal serotype was recovered repeatedly from a lesion. However, staphylococcal phage types changed in 57% of instances. In contrast to the sequence of spread of streptococci from normal skin sites to lesions to respiratory tract, staphylococci spread from the respiratory tract to normal skin to lesions. These studies reveal important differences in the migration of streptococci and staphylococci to various body sites and suggest a subsidiary role for staphylococci in impetiginous lesions yielding both organisms.

HEMATOLOGY

Irreversible oxidant injury in the erythrocytes of the newborn infant. FRANK A. OSKI and BERTRAM LUBIN. *Univ. Pennsylvania Sch. Med., Children's Hosp. of Philadelphia, Philadelphia, Pa.*

It is generally recognized that the red cells of the newborn are more susceptible to injury, i.e. the appearance of Heinz bodies and glutathione instability, upon exposure to oxidant compounds.

A more complete examination of the extent and nature of this injury was made. RBC's were incubated for 2 hours with and without glucose in the presence of acetylphenhydrazine (APH) or menadione (K_3) and then reincubated in glucose media. Red cell hexokinase, phosphofructokinase, and glyceraldehyde-3-phosphate dehydrogenase activity, all SH containing enzymes, were irreversibly lost in the cells of the newborn when incubated in APH or K_3 with no glucose in the medium. The cell's ability to consume glucose was reduced from 50 to 95%. The red cells of adults showed some fall in enzyme activity during drug exposure but full activity was restored and red cell glycolysis was unimpaired when reincubated in glucose. Incubation of the cells of the newborn in a carbon monoxide atmosphere during drug exposure prevented their adverse effects. In addition, in the presence of glucose, K_3 increased the rate of fatty acid incorporation into adult cells and depressed the rate in newborn cells. Oxidant drugs apparently through hydrogen peroxide generation, produced irreversible metabolic alterations in the cells of the newborn and their use in the neonatal period appears contraindicated.

Intracellular control of the 2,3-diphosphoglycerate (DPG) concentration in fetal red cells. ROBERT C. TRUEWORTHY and JAMES T. LOWMAN. *Univ. of Kansas Med. Ctr., Kansas City, Kan.*

The stress of anoxia produces an elevation of red cell DPG which results in a shift of the oxygen dissociation curve. The net result of these changes is to increase the oxygen delivered to the tissues. DPG occurs in the red cell in two pools: one, hemoglobin bound, and the other free or unbound. Major alterations of either pool can occur without altering the total red cell DPG content. Fetal hemoglobin (HbF) does not bind DPG. Therefore, in infants one of the mechanisms for preventing tissue anoxia is not operative. A review of the DPG cycle suggests that changes in the conc. of either of the DPG pools might alter the rate of reaction of the rate limiting enzymes 2,3-diphosphoglyceromutase (DPGm'ase) and 2,3-diphosphoglycerophosphatase (DPGp'ase). The complete DPG cycle was studied in cells with normal and altered DPG-Hb binding in order to delineate the factors controlling red cell DPG conc. Assays of hemolysates of 18 cord blood samples revealed the following: the mean HbF conc. was 51%, DPG levels = 13.5 μ M/mgHb (normal = 12.5), DPGp'ase activity = 0.111 μ M DPG/mg Hb/hr (normal = 0.055), DPGm'ase activity = 95 μ M DPG/mg Hb/hr (normal = 85). The DPG binding of cord blood was 33% of that bound by adult blood. The oxygen dissociation curves revealed a P-50 for cord blood samples of 29.5 mmHg (normal = 31.5). These studies of fetal cells with elevated unbound DPG demonstrate no inhibition of DPGm'ase. Product inhibition at this step has been postulated by other investigators. The significant elevation of DPGp'ase is in response to the increased unbound DPG. Therefore, DPGp'ase appears to be more important as a controlling mechanism for DPG conc. than does DPGm'ase.

Fetal erythrocyte deformability—physiologic, rheologic, and clinical considerations. GARY P. GROSS and WM. E. HATHAWAY. *Univ. of Colo. Med. Ctr., Denver, Colo.*

Investigation of fetal red blood cell (RBC) deformability by filtration and viscosimetry has shown that the fetal RBC varies significantly from the adult. Cord blood from 15 newborns was compared with 14 adults. Triple washed RBC's in Eagle's albumin buffer with a hematocrit of $10 \pm .5\%$ were passed through a polycarbonate filter with a $3 \mu \times 13.5 \mu$ cylindrical pore under

constant pressure. Flow velocity ($\mu\text{l}/\text{sec}$) was calculated. Cell suspensions were modified by adjusting temperature, pH and pO_2 prior to filtration. Mean corpuscular volume (MCV), reticulocyte count and fibrinogen were measured. Viscosity of whole blood, 40% cells in autologous plasma and 80% washed cells was determined.

Filterability, as a measure of RBC deformation, was markedly decreased in newborn samples. Mean flow velocity was $2.2 \mu\text{l}/\text{sec} \pm .6$ (S.D.) for newborns and $4.5 \mu\text{l}/\text{sec} \pm .8$ for adults ($p < .001$). Lowered pH or pO_2 in the prefiltrate resulted in significantly decreased filterability in newborn samples only. Filterability correlated poorly with MCV. Two infants with polycythemic hyperviscosity syndrome showed increased viscosity of whole blood, 80% cell suspension and markedly decreased filterability. An infant with pyknocytosis showed decreased filterability and elevated viscosity of an 80% suspension compared to normal newborns.

Decreased deformability of the fetal RBC may be related to shortened newborn RBC survival involving diminished ability to pass through the splenic microcirculation. The decreased fetal RBC deformability which can be aggravated by acidosis and hypoxia contributes to hyperviscosity in newborns with high hematocrits. The decrease in red cell survival and anemia in infantile pyknocytosis may also be related to altered RBC deformability.

Prediction of severity of disease in homozygous β thalassemia (β thal). YUET W. KAN and DAVID G. NATHAN. *Children's Hosp. Med. Ctr. and Harvard Med. Sch., Boston, Mass.*

The clinical consequences of homozygous β thal are variable. We have studied globin chain synthesis in the peripheral blood reticulocytes of the parents of patients with homozygous β thal to determine the likelihood of mild and severe β thal in families in which both parents have thal trait. Peripheral blood was incubated with $\text{U-}^{14}\text{C}$ leucine. The ratio of the specific activities of β and α chain separated by urea CMC chromatography (β/α ratio) was determined. The β/α ratios of 14 parents of patients with severe disease was compared to those of 10 parents of patients with mild disease. The mean β/α ratio in the former group of parents was 0.49 with a narrow standard deviation of 0.06. The mean ratio in the group of parents of patients with mild disease was 0.68 with a wider standard deviation of 0.21. Two patterns were observed in the milder group: (1) the ratio in one parent was close to 0.50, while the other parent had a significantly higher ratio (0.71 to 1.09), and (2) both parents had moderately elevated ratios (0.65). The higher ratios in the milder group may represent a milder β thal gene or the co-inheritance of an α thal gene, either one of which reduces the severity of homozygous β thal. We conclude that the study of peripheral blood globin chain synthesis in prospective parents with β thal trait may be extremely useful for estimating the potential severity of homozygous β thal in their offspring.

Phototherapy in ABO hemolytic disease of newborn. EUGENE KAPLAN, FRITZ HERZ, ELSIE SCHEYE, and LAWRENCE ROBINSON, JR. *Sinai Hosp. of Baltimore, Inc., Baltimore, Md.*

In hyperbilirubinemia of ABO hemolytic disease of newborn (ABO-HDN), phototherapy is less effective in lowering bilirubin concentrations than in hyperbilirubinemia of prematurity or nonhemolytic disorders of newborns. Nevertheless, phototherapy does alter patterns of serum bilirubin in ABO-HDN, as seen in a comparison of 29 treated infants with 144 untreated infants.

In ABO-HDN, recognizable patterns of serum bilirubin result

from variations in the severity of onset in the 1st day of life, and in the time, extent, and duration of maximum serum bilirubin concentrations. A severe onset is seen in $1/3$ of infants with ABO-HDN, serum bilirubin increasing at a rate of 0.5 mg/hr or greater. Peak bilirubin levels are noted on day 1 (10% of infants), day 2 (30%), day 3 (40%) and day 4 or 5 (20%). The peak bilirubin concentration is less than 16 mg% in $1/3$ of the infants; between 16 and 19 mg% in $1/3$ and exceeds 20 mg% in the remaining $1/3$. In $1/3$ of infants the maximum bilirubin concentration remains unchanged for at least 24 hrs. before decreasing.

On phototherapy, the bilirubin levels in 20% of infants with ABO-HDN continue to rise, remain unchanged in 40% and decrease in 40%. Light is least effective in infants with severe onset during the 1st day of life. However, in no infant on phototherapy does bilirubin reach its peak after the 3rd day of life and the maximum bilirubin concentration exceeds 20 mg% in only 10% of treated infants.

In-vitro chromosomal radiosensitivity in Fanconi's anemia. MAKOTO HIGURASHI and PATRICK E. CONEN (Intr. by Bernard Laski). *Univ. of Toronto and Hosp. for Sick Children, Toronto, Ont., Canada.*

Peripheral blood samples and fibroblast cultures from 5 children with Fanconi's anemia and 4 controls were irradiated with 10 and 100 rads; other controls were non-irradiated duplicate cultures. Blood cultures were harvested at 52 and 72 hours. Fibroblast cultures were irradiated 24 hours before fixation. Radiation break frequencies were calculated by subtracting figures for non-irradiated samples from those for irradiated samples. The number of chromosome-type breaks per cell per rad in irradiated controls was 0.0025 ± 0.0005 (52 hour cultures) and 0.0017 ± 0.005 (72 hour cultures) in lymphocytes, and 0.0059 ± 0.0016 in fibroblasts, and in irradiated cells from Fanconi's anemia was 0.0103 ± 0.0016 (52 hour cultures) and 0.0074 ± 0.0036 (72 hour cultures) in lymphocytes, and 0.0103 ± 0.0034 in fibroblasts. The number of dicentric and rings per cell was significantly greater in the Fanconi's anemia samples than controls at 100 rads. We concluded that, in-vitro, chromosomes of cells from children with Fanconi's anemia were significantly more radiosensitive than those of controls ($P < 0.01$).

Microlymphocyte transformation (MLT) determinations of peripheral blood and marrow aspirates from children with acute lymphocytic leukemia. DAVID M. MUMFORD, JORDAN R. WILBUR, RACHID A. CHEEMA, CAROLYN A. BOUTTE, and DONNA L. RAUMAKER. *M. D. Anderson Hosp. and Tumor Institute, and Baylor Coll. of Med., Houston, Tex.* (Intr. by George W. Clayton).

Utilizing an 0.1 cc whole blood in vitro microlymphocyte transformation technique (MLT) previously described (Mumford, *Fed. Proc.* 29: 369, 1970), human peripheral blood white cells from acute lymphocytic leukemic (ALL) patients have been tested for immune responsiveness (triplicate runs) in 30 children during various stages and treatment of their disease. A mitogen (PHA) and selected common specific antigens were employed. Concurrent MLT runs (duplicate) on bone marrow aspirates taken at the same time were performed. While some MLT kinetics differ slightly from "macro" lymphocyte transformation studies (esp. optimum day of harvest), sensitivity approximates the "macro" test. Responses were considered positive when the ratio of positive stimulated cultures were greater than twice the control val-