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## Morula Forms of E Rosettes: Distribution, Specific Inhibition, and Enhancement

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### Extract

Rosette-forming cells (RFC) with more than 10 sheep red blood cells (SRBC's) per cell defined as morula-forming cells (MFC) were studied in human lymphoid organs and in the peripheral blood (PBL). MFC are most common in the thymus (more than 50%) and the frequency is much less in peripheral lymphoid tissues and in the blood (29.8% in those less than 5 years old; 14.9% in adults). There is very slight decrease in total RFC in PBL over age 5, but the changes in MFC are quite striking. Treatment with anti-human thymus antiserum (ATS) and with anti-human lymphoblastic antiserum (ATL) resulted in significant inhibition of total rosette and morula rosette formation. No inhibition was seen using normal brain antiserum, anti-IgM antiserum, or anti-L chain antiserum. In two patients with chronic lymphocytic leukemia and in some cases of thymic deficiency the ratio of MFC to total RFC was unusually high. After culture with phytohemagglutinin (PHA) and conversion to blast forms or after surface perturbation by papain or freeze-thaw treatment, MFC numbers were increased.

### Speculation

The reason that T cells bind SRBC without prior sensitization remains a mystery. Nevertheless, the reaction serves as a reliable detector of a special class of immunologically competent lymphocytes. Subpopulations within the two major classes of human lymphocytes (B and T cells) are now known. We speculate that an analysis of surface markers may help to detect these subclasses. We suggest that the more primitive T cells may show the phenomenon of morula formation. It is postulated that the increase in MFC's might be due to the exposure of hidden sites or alteration of pre-existing surface receptors.

Thymus-derived human peripheral blood lymphocytes are known to form rosettes spontaneously with SRBC (4-7, 11, 15, 16, 18, 25-27). The highest number of RFC are found in thymuses (11,

15, 18, 25, 27), and significantly low RFC have been reported among patients with defective T cell immunity (4, 9, 15, 21, 25, 26).

In studying human lymphoid cells, we have observed some rosettes with extremely large numbers of surrounding SRBC. If those cells with more than 10 SRBC adherent are enumerated separately, different patterns of distribution in various lymphoid organs as well as in disease states are observed. We have termed the cells which have clusters of many surrounding SRBC the MFC. The number 10 was chosen since 10 SRBC's will usually completely surround a lymphocyte. It was the purpose of this study to further characterize the morula phenomenon by noting distribution patterns in age and disease, by ultrastructural studies, and by observing the effect on morula formation of prior cell treatment with various antisera, PHA, papain, freezing and thawing, hypotonic treatment, or short term *in vitro* culture.

### MATERIALS AND METHODS

#### FORMATION OF ROSETTES

The method was essentially that of Jondal *et al.* (15) with minor modifications. Peripheral blood mononuclear leukocytes were isolated from heparinized venous blood by Ficoll-Hypaque gradient centrifugation. Lymphocytes from tonsils, lymph nodes, livers, spleens, and thymuses were prepared by gentle teasing of fresh tissues and suspension in minimum essential medium (MEM) (29) with Hank's salts. The source of lymphoid tissue was fetal (30) or surgical specimens; all specimens were normal histologically. Rosettes were prepared by adding 0.2 ml leukocyte suspension in MEM ( $4 \times 10^6$ /ml) to 0.25 ml of 0.5% SRBC in MEM. Cells were mixed thoroughly and incubated at 37° for 5 min. The mixture was then centrifuged at  $200 \times g$  for 5 min at room temperature and incubated at 4° for 1-2 hr. The cell pellet was resuspended very gently by rocking the tubes. Ten microliters of 0.1% eosin dye were added to the final cell suspension. At least 200 lymphocytes were counted in a hemocytometer and all lymphocytes binding more than three SRBC were considered to be rosettes. The rosettes were further classified as low binding if less than 10 SRBC adhered to a

lymphocyte, and high binding or morula (MFC) if more than 10 SRBC clustered around a single lymphocyte.

#### SURFACE IMMUNOGLOBULIN STAINING

Mixed with 0.1 ml fluorescein conjugated heavy or light chain antisera (1) and incubated at 4° for 30 min were  $1-2 \times 10^6$  cells/0.1 ml MEM. All antisera were spun at  $1,500 \times g$  just before use. After three washes in cold MEM cells were examined by fluorescence microscopy.

#### BLOCKING OF ROSETTE FORMATION WITH ANTISERA

Antisera studies included anti-B<sub>2</sub>-microglobulin, anti-human brain (12, 31), anti-human thymocyte (32), anti-IgM, anti-human L-chain, and antilymphoblast antisera. All antisera had been previously heat-inactivated and exhaustively absorbed with equal volumes of packed SRBC until no agglutination was demonstrable. Antisera (0.1 ml) was incubated with 0.1 ml lymphocyte suspension ( $4 \times 10^6$ /ml) for 1 hr. The cells were then washed three times with MEM before being mixed with SRBC for rosette formation in the usual way. Viability was determined by eosin dye exclusion.

#### EFFECTS OF *IN VITRO* TREATMENTS ON ROSETTE FORMATION

Blast cells after PHA stimulation: PBL were stimulated with PHA for 72 hr. The cells were collected and rosette formations of blast cells were estimated. These results were compared with rosette formation by unstimulated cells cultured simultaneously with PHA.

*Hypotonic Treatment and Freezing of PBL.* To 0.5 ml whole blood were added 9 ml distilled water. Within 30 sec 1 ml 10 times phosphate-buffered saline (PBS) was added and the sample mixed thoroughly. Leukocytes recovered from the cell pellet after centrifugation were tested for rosette formation.

Frozen cells prepared by freezing in 10% dimethylsulfoxide, were thawed carefully at 37°, washed in MEM three times, and then tested for rosette formation.

*Papain Treatment.* PBL were treated with papain (0.06 mg/ml) and cysteine (2.5 mM) in MEM containing 5% normal human serum as described previously by Chapel (6). After incubation at 37° for 1 hr, cells were washed and resuspended for rosette formation.

#### CAP FORMATION OF ROSETTE-FORMING CELLS

After the estimation of rosette formation on PBL, cells were subsequently incubated at 37° without agitation. The cells were then removed 1, 2, and 4 hr later to study the redistribution of SRBC on the surface of lymphocytes.

#### TISSUE PREPARATIONS FOR SCANNING (SEM) AND TRANSMISSION ELECTRON MICROSCOPY (TEM)

*TEM.* Suspensions of rosette and cap forming cells were initially fixed in 1% glutaraldehyde in 0.1 M Soronson's phosphate buffer. Secondary fixation was in 1% OsO<sub>4</sub> in 0.1 M S-collidine followed by rinsing in acetate-barbital buffer. After exposure to traditional resin mixtures, cells were placed in full strength catalyzed Epon 812 in conical-tipped polyethylene capsules and centrifuged. The resin was then placed in a 60° oven for 48 hr to allow polymerization. Ultrathin sections of selected cells were cut on a LKB 8800 Ultratome III, stained with lead citrate and uranyl acetate, and observed in a Philips EM-300 electron microscope with a 30- $\mu$ m objective aperture at 60 KV.

*SEM.* A drop of unfixed cells in Hank's balanced salt solution was allowed to adhere to acid-cleaned circular glass covers at 4° for 15 min. Cells were then fixed in 1% phosphate-buffered glutaraldehyde with an osmolarity sufficient to cause distension of SRBC in an effort to observe the site of cell attachment. After washing with 0.1 M phosphate-buffer, cells were dehydrated in alcohol and dried using amyl acetate as an intermediate solvent according to the method of Anderson (2). Cells were coated with 200 Å gold-palladium by vacuum evaporation and observed at 25 KV in a JEOL JSM-U 3 scanning electron microscope.

Table 1. Percentage and total number of rosette-forming cells (RFC) and morula-forming cells (MFC)

		RFC		MFC	
		Range (%) <sup>1</sup> (mean $\pm$ SD)	Number/mm <sup>3</sup> (mean $\pm$ SD)	Range (%) <sup>2</sup> (mean $\pm$ SD)	Number/mm <sup>3</sup> (mean $\pm$ SD)
PBL					
Adult	25 <sup>3</sup>	53-79 (64.8 $\pm$ 6.4)	708-2,208 (1352 $\pm$ 373)	13-32 (19.4 $\pm$ 8.3)	182-304 (251 $\pm$ 28) <sup>4</sup>
<5 yr of age	8	21-59 (46.8 $\pm$ 12.8)	1,184-2,924 (1,731 $\pm$ 592)	22-36 (29.8 $\pm$ 5.5)	261-740 (517 $\pm$ 180) <sup>4</sup>
Thymus					
Prenatal	5	93-98 (95.1 $\pm$ 1.7)		31-65 (50.4 $\pm$ 14.5)	
Postnatal	9	86-96 (92.7 $\pm$ 2.7)		38-65 (51.0 $\pm$ 7.3)	
Lymph node	4	56-70 (63 $\pm$ 5.7)		8-47 (26.2 $\pm$ 17.2)	
Spleen	3	40, 15, 68		25, 28, 75	
Tonsil	3	51, 58, 59		15, 29, 18	
Liver	3	10, 17, 25		0, 0, 7	
Bone marrow	6	29-46 (36.3 $\pm$ 8.0)		31-51 (40.8 $\pm$ 10.2)	

<sup>1</sup> Percentage of RFC in cell population.

<sup>2</sup> Percentage of RFC classified as MFC.

<sup>3</sup> Number of samples tested.

<sup>4</sup> Difference between these means significant ( $P < 0.05$ ).

## RESULTS

## DISTRIBUTION AND FREQUENCY OF ROSETTE-FORMING CELLS

The numbers of RFC and MFC in lymphoid organs and PBL are listed in Table 1. The major differences noted are that the number of MFC in the peripheral blood decreases after 5 years of age. Tissue distribution cannot be fully assessed because of sample size, but in the four lymph node samples tested, total and mean MFC counts were about one-half those of five other lymphoid organs examined. Table 2 illustrates the changes in percentage and numbers of peripheral blood RFC and of MFC in those 5 years of age or less. At age 5, the means of samples tested approached the adult mean.

Table 3 shows the distribution of RFC and MFC in a number of immunodeficient states. In patients with chronic lymphatic leukemia the total number of lymphocytes is markedly increased. As reported previously by others, most of these lymphocytes are B lymphocytes; we found from 57–80% of the lymphocytes were surface immunoglobulin-bearing cells. However, additionally, we

Table 2. Percentage and total number of rosette-forming cells (RFC) and morula-forming cells (MFC) in peripheral blood (donors 5 years of age or less)

Age	% <sup>1</sup>	No./mm <sup>3</sup>	% <sup>2</sup>	No./mm <sup>3</sup>
15 wk <sup>3</sup>	21	1,750	36	630
25 wk <sup>3</sup>	35	1,714	36	617
3 mo	46	2,242	33	740
7 mo	53	2,924	24	702
1.5 yr	53	1,376	30	412
3 yr	59	1,423	33	470
5 yr	54	1,236	22	272
5 yr	54	1,184	25	296
Mean ± SD		1731 ± 592		517 ± 180

<sup>1</sup> Percentage of RFC in cell population.

<sup>2</sup> Percentage of RFC classified as MFC.

<sup>3</sup> Gestational age.

Table 3. Rosette-forming cells (RFC) and morula-forming cells (MFC) in peripheral blood of immunodeficient patients<sup>1</sup>

Case	Age, yr	Diagnosis	Lymphocytes		RFC		MFC		B cells (%)		
			Total WBC	%	No./mm <sup>3</sup>	%	No./mm <sup>3</sup>	%	No./mm <sup>3</sup>	Ig+	EAC
DW	35	CLL	36,300	97	35,211	5	1,761	35	616	80	
VG	42	CLL	18,700	79	14,773	8	1,182	30	355	66	
TS	50	CLL	14,900	84	12,516	10	1,252	27	338	65	8.5
KK	52	CLL	71,200	80	56,960	11	6,265	50	3,133	57	21
HW	54	CLL	35,200	75	26,400	13	3,432	45	1,544	73	37
AW	57	CLL	18,500	76	14,060	10	1,406	30	422	60	
DC	2	SCID	3,500	32	1,120	31	347	16	56	16	16
AK	3	SCID	1,700	11	187	32	60	15	9	8	3
TB	2	SCID	4,200	30	1,260	7	88	11	10	15	10
RR	19	Chronic mucocutaneous candidiasis	2,500	10	250	22	55	58	32	25	22
VH	4	Cartilage hair hypoplasia <sup>2</sup>	6,400	30	1,920	14	269	36	97	20	8
DG	9	Hypogammaglobulinemia, common variable	7,000	47	3,290	44	1,448	35	507	46	24
DS	12	Cyclic neutropenia	4,500	60	2,700	75	2,025	36	729	28	12
KK	28	Sarcoid, inactive	5,500	20	1,100	70	770	20	154	18	15
JF	11	Selective IgA deficiency	7,300	30	2,190	50	1,095	15	164	30	25
SA	13	Selective IgA deficiency	6,730	35	2,356	48	1,131	18	204	22	10
DA	12	Selective IgA deficiency	3,960	52	2,059	60	1,236	25	309	15	8

<sup>1</sup> CLL: chronic lymphocytic leukemia; SCID: severe combined immunodeficiency.

<sup>2</sup> Isolated T cell deficiency.

noted that two of the patients showed a disproportionate increase of MFC (KK and HW), both relatively and absolutely. Conversely, among patients with combined immunodeficiency, not only was there the expected decrease in total lymphocytes of those lymphocytes present, there were only about one-half the expected number of MFC's. Finally, in two patients with primarily T cell deficiency (RR and VH), there was a striking increase in the proportion of MFC. Absolute and percentage increases of MFC were noted in common variable deficiency (DG) and cyclic neutropenia (DS).

## INHIBITION OF ROSETTE FORMATION BY ANTISERA

Table 4 illustrates changes in rosette formation after PBL were treated *in vitro* with various antisera. Normal human and goat sera were used as controls. Only treatment with ATS and ALS caused significant reduction of RFC. The heat-inactivated antisera were not cytotoxic to normal PBL as judged by eosin dye exclusion.

OBSERVATION OF EFFECT OF ENHANCEMENT ON MORULA FORMATION AFTER *IN VITRO* TREATMENT

Hypotonic treatment and short term culture did not change the total numbers of RFC, but increased the number of morula forms significantly as compared with untreated cells (Table 5). As judged by dye exclusion, there was no deleterious effect on PBL after such treatment. Many blast cells had nearly 100 surrounding SRBC (Fig. 1), and it was clear that some SRBC were not attached to lymphocytes directly; rather they formed a series of layers (Fig. 1a and 2a). Treatment with papain, phytohemagglutinin, and freeze-thaw procedures increased both the numbers of RFC and the relative percentage of MFC.

## CAP FORMATION OF MFC

Figures 1b and 2b illustrate the shifting of SRBC to a polar distribution; in Figure 3 the SRBC seem to be detaching continuously from the polar area. An interesting observation by TEM was that of the apparent relation of the cell's Golgi apparatus position to the polar areas of cell were "caps" formed (Fig. 3 and 4). Table 6 shows the sequence or events in six separate samples

Table 4. *Rosette inhibition tests*<sup>1</sup>

Antisera	Specimen no.									
	1		2		4		4		5	
	R <sup>2</sup>	M <sup>3</sup>	R	M	R	M	R	M	R	M
No serum	60	20	64	25	61	18	67	21	61	23
Normal goat serum	68	23	69	27	68	26	66	30	63	17
Normal human serum	51	18	64	22	57	20	60	24	67	19
Anti- $\beta_2$ -microglobulin <sup>4</sup>	58	20	43	23	53	16	54	19	58	18
Anti-brain Ab <sup>4</sup>	54	24	65	26	53	19	60	20	58	20
Anti-IgM	68	22	71	20	60	21	63	19	65	19
Anit-L-chain	63	19	62	22	62	20	58	23	61	21
Antilymphoblast antiserum	33	0.5	38	0.3	35	5	37	0.2	30	2
Antithymocyte antiserum <sup>4</sup>	0.9	0.0	0.7	0.0	3	0.0	0.3	0.0	2	0.0

<sup>1</sup> At least 300 lymphocytes were counted for each experiment. All tests were performed simultaneously.

<sup>2</sup> Percentage of rosette-forming cells in cell population.

<sup>3</sup> Percentage of rosette-forming cells classified as morula-forming cells.

<sup>4</sup> See text.

Table 5. *Change of rosette-forming cells (RFC) and morula form after in vitro physical or chemical treatment of peripheral blood from normal subjects*

	Specimen no.											
	1		2		3		4		5		6	
	R <sup>a</sup>	M <sup>b</sup>	R	M	R	M	R	M	R	M	R	M
No treatment	69	14	62	13	56	17	54	12	56	11	69	30
Hypotonic treatment	64	34	73	50	76	36	71	37	61	50	66	55
3 days' culture	60	28	53	31	63	13	66	21	60	24	74	41
Phytohemagglutinin and 3 days' culture <sup>3</sup>	81	60	70	59	87	74	88	62	89	83	93	78
Papain treatment	91	77	96	78	86	90	86	40	83	41	84	58
Frozen and thawed	86	58	88	62	86	29	82	33	83	39	76	41

<sup>1</sup> Percentage of RFC in cell population.

<sup>2</sup> Percentage of RFC classified as morula-forming cells.

<sup>3</sup> Only blast cells were counted.

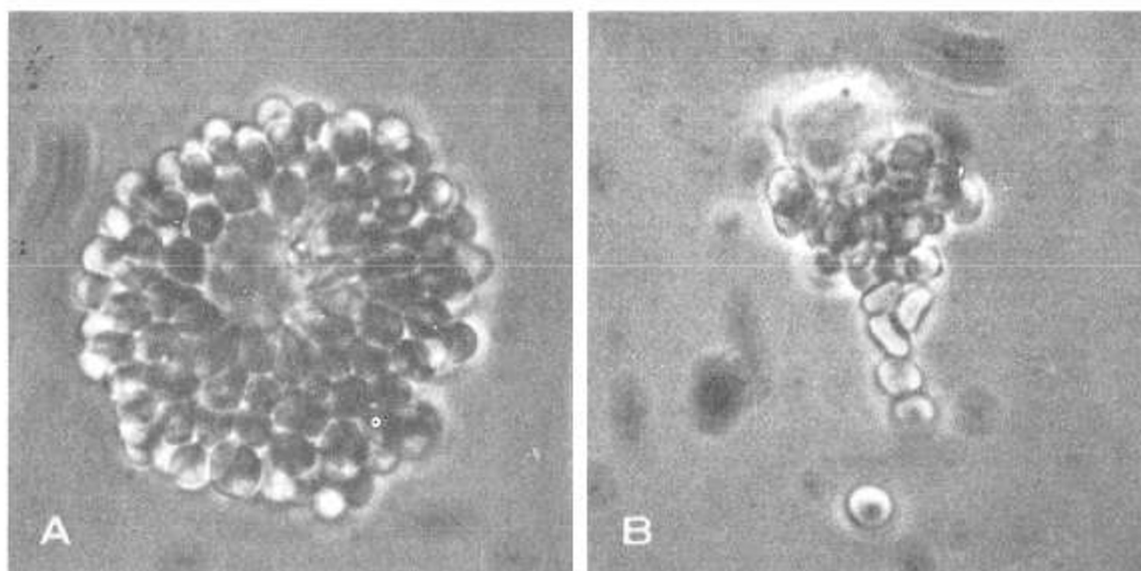


Fig. 1. *A*: morula form of sheep cell rosette seen after 3-day incubation of normal human lymphocytes with phytohemagglutinin (original magnification  $\times 400$ ); *B*: shifting of erythrocytes to polar distribution with beginning detachment ( $\times 400$ ).

which were studied. At zero time, *i.e.*, when the fully formed rosettes were first examined, all SRBC are either arranged as complete multilayer structures (morulas) or with less than 10 peripheral SRBC all touching the central lymphocyte. With time, a "capping" phenomenon occurs where multilayering is seen, but not occupying the entire circumference. The percentage of both MFC and RFC types of rosettes observed in this form is recorded in Table 6. Approximately one-third of the rosettes show capping at 2 hr and 80% at 4 hr.

#### MORPHOLOGY OF RFC BY TEM AND SEM

Thymic-derived lymphocytes observed during the course of study were characteristically of a 9–15  $\mu\text{m}$  diameter with low to moderate numbers of surface microvilli and invaginations, a reniform nucleus with condensed chromatin, moderate numbers of mitochondria and polysomal particles, scant endoplasmic reticulum, and often fairly well-developed Golgi profiles (Fig. 4). Red cells were occasionally seen adhering to lymphocytes by microspikes or elongated cell processes. Occasionally, zones of intercellular contact were seen to be made up of discontinuous electron-dense areas "bridges" between cells instead of a uniform electron-dense band (Fig. 4).

#### DISCUSSION

For normal adults our study revealed a range of  $64.8 \pm 6.8\%$  RFC (Table 1) which is in agreement with the work of others (4, 6, 15, 21). The discrepancy between our data and those of some others (18, 25) is probably due to different techniques employed involving differences in cell concentrations and conditions of incubation. After age 5 there may be some slight diminution of total RFC but statistically significant changes are seen only in MFC which are approximately 50% less in other individuals.

Observations of lymphoid tissue showed that more than one half of thymocytes were MFC; the distribution was the same in prenatal or postnatal specimens (Table 1). In other organs, distribution of total RFC and MFC varied but the portion of RFC which are morulas is less than within the thymus.

Rosette formation could be inhibited almost completely by ATS while inhibition by ALS was 50%; however, there were virtually no morula form rosettes visible after ALS treatment. Inhibition of RFC by ALS was also reported by Brain *et al.* (5) and Wortis *et al.* (28). Coombs *et al.* (7) and Jondal *et al.* (15) have shown that anti-immunoglobulin antisera would not inhibit rosette formation. Our studies using anti-human IgM or anti L-chain antiserum are in agreement with theirs but contrary to the observation of Wybran *et al.* (25). The reason for this discrepancy is not clear. The inability of anti-brain or anti- $\beta_2$ -microglobulin antisera to inhibit rosette formation is of interest. The antisera were capable of coating appropriate lymphocytes for, by indirect fluorescent techniques, all T cells were shown to be coated by the anti-brain antiserum. Furthermore,  $\beta_2$ -microglobulin has been observed on all lymphoid cells (19), although a previous study (10) has suggested this surface receptor is restricted to T cells. The failure to inhibit SRBC binding by these antisera as contrasted to antilymphoblast or antithymocyte antibodies is of interest in view of the demonstration that antiserum to  $\beta_2$ -microglobulin has profound inhibitory effects on *in vitro* lymphocyte stimulation by PHA, allogeneic cells, and antigen despite its lack of effect upon formation of rosettes (3). The disparity suggests that the rosette forming site is located far from sites important in initiating *in vitro* proliferation. The  $\beta_2$  site and the rosette forming site may have markedly different densities which account for the disparate antibody response. None of the antiserum used were cytotoxic as defined by eosin dye exclusion capability.

As shown by others, immunodeficient cases who had primary T cell defects showed low percentages of RFC (Table 3) (21, 25, 26). However, an increase of the MFC/RFC ratio was seen in cases RR and VH. Absolute increases, as well, were seen in nonlymphopenic host defense abnormalities: one patient with common

variable immunodeficiency and one with cyclic neutropenia. Two patients with chronic lymphocytic leukemia showed 50% and 45% MFC, respectively, indicating a disproportionate number of the morula form. No normal adult studied by us had more than 32% MFC's. An increase in the ratio of MFC/RFC was also observed in a case of common variable immunodeficiency. Thus, variations in total numbers of RFC's do not always show parallel and proportionate changes in morulas. It might be that morula forms denote a subpopulation of T cells. The higher proportion among nonperipheralized thymic cells, among "blast" cells produced by PHA stimulation and in younger individuals suggests that perhaps the morula form is a less mature rosette cell. If so, its increase in deficiency states might represent a state of maturation arrest.

Concomitant TEM and SEM studies confirmed that rosettes were almost exclusively formed by lymphocytes. Our results are consistent with the findings of others (13, 17), who showed that binding sites in rosettes vary in size from small pointlike areas to broader zone contact.

The morphology of the MFC is quite unique as compared with the other forms of the RFC's. The fact that no direct contact of red cells in the outer layers with the central lymphocyte was observed

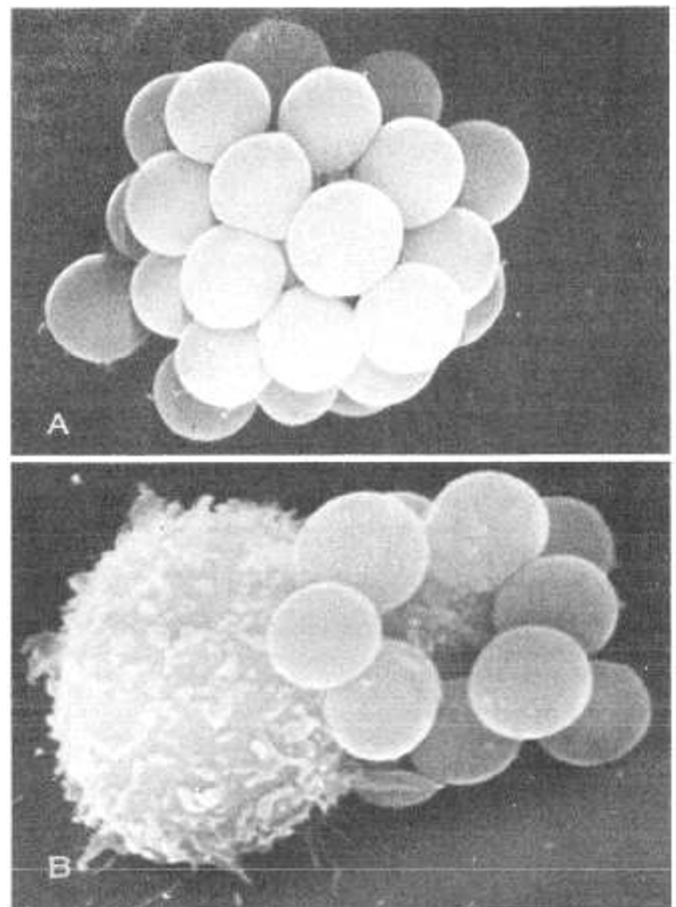


Fig. 2. A: scanning electron micrograph of morula ( $\times 12,350$ ); B: scanning electron micrograph of "capped" rosette-forming cell ( $\times 17,800$ ).

Table 6. Percentage of capping at various times

No.	0 hr	1 hr	2 hr	4 hr
1	0	10	30	80
2	0	8	35	75
3	0	5	33	75
4	0	20	38	80
5	0	15	35	75
6	0	25	40	80

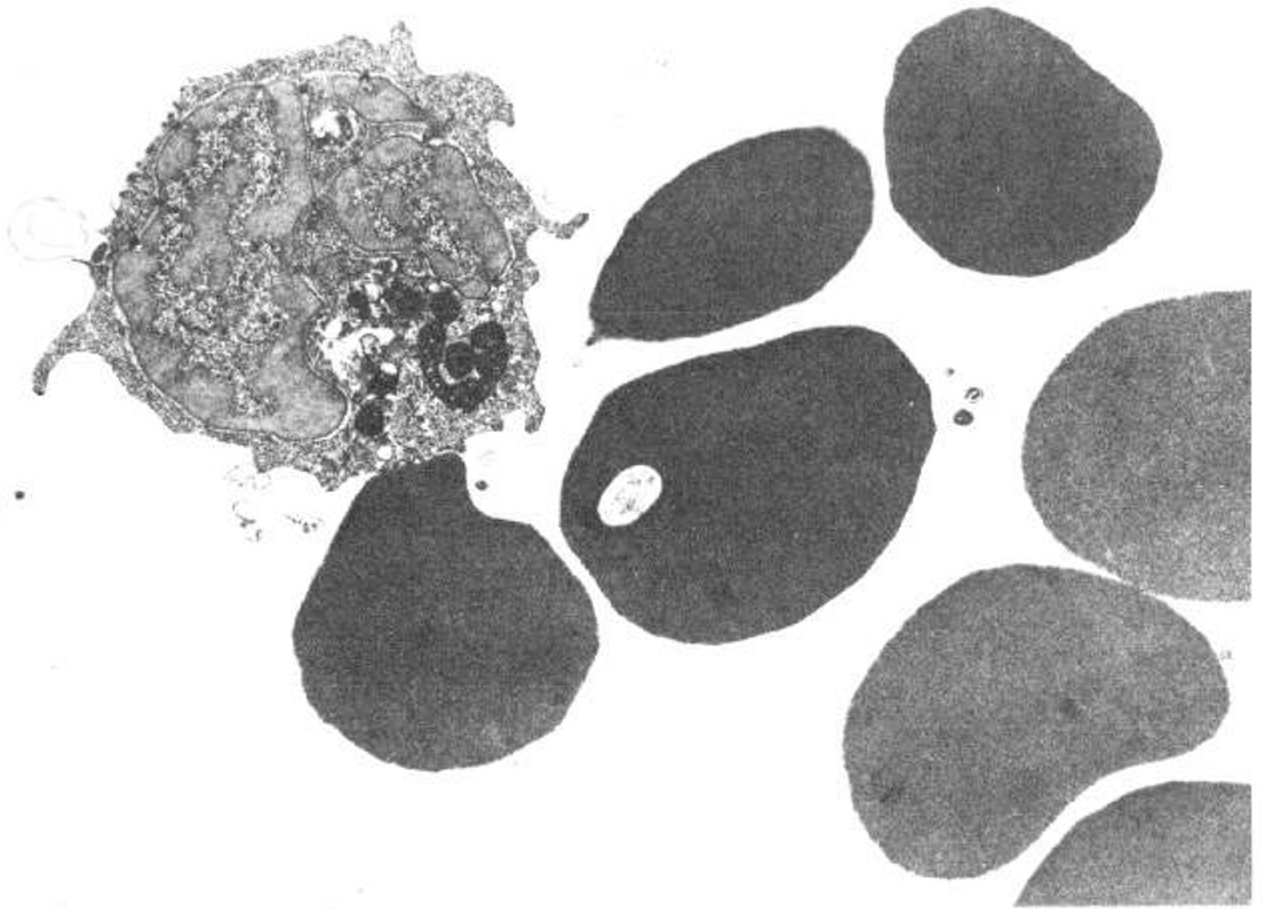


Fig. 3. Capped rosette-forming cell. Intracytoplasmic vesicles of the lymphocyte are visible at the point of attachment of an erythrocyte ( $\times 11,650$ ). Lead stain.

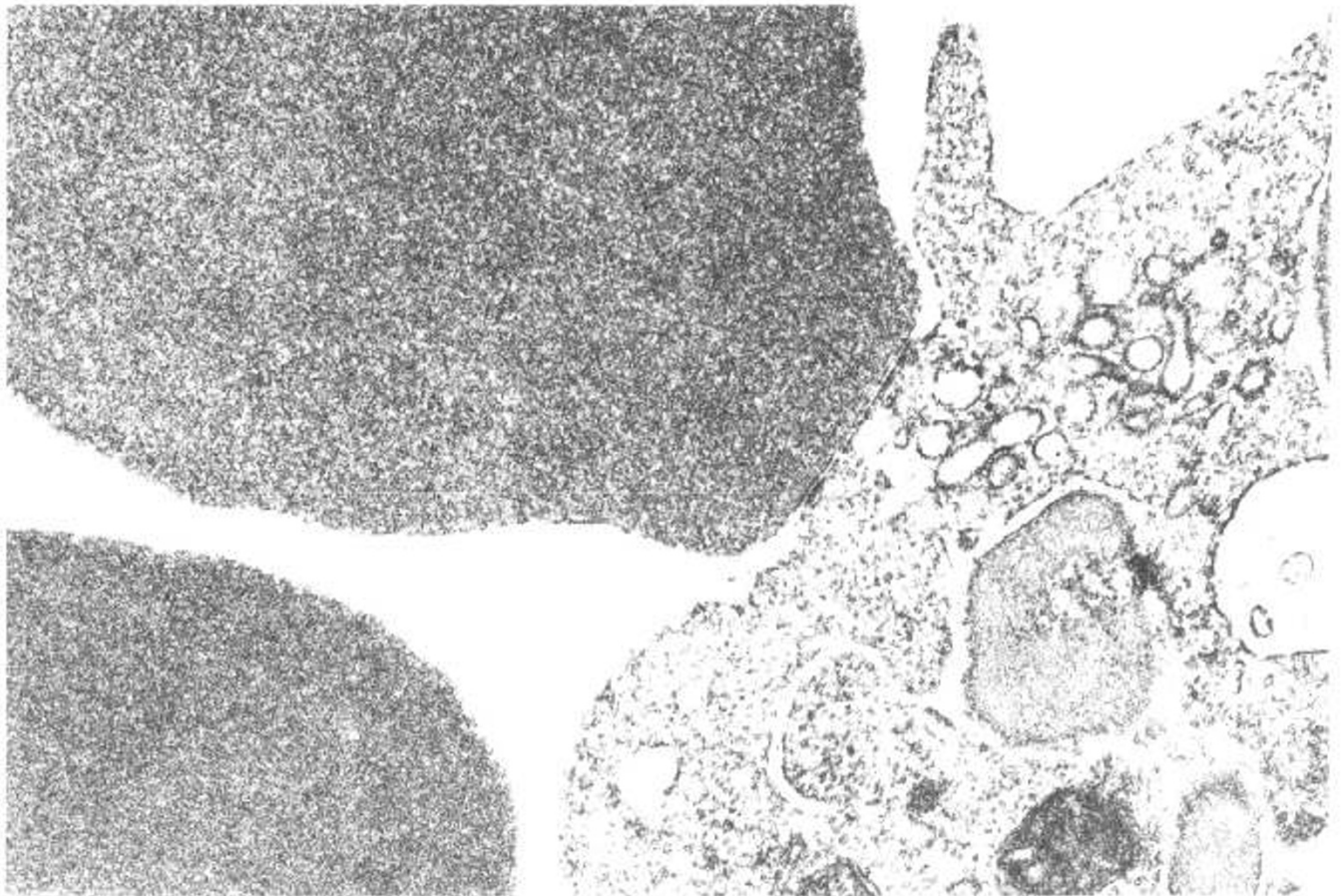


Fig. 4. Higher magnification of capped T lymphocyte showing approximation of cell Golgi vesicles to site of red cell adherence ( $\times 68,450$ ). Lead and uranyl acetate stain.

by SEM indicated the possibility that at least some of the erythrocyte binding was due to other mechanisms. MFC's may be "secretors", as suggested by Duffus and Allan (8) in their observation of large RFC's; however, whether a hemagglutinin was released to cause binding of sheep red cells on outer layers is at present unknown. Haskill *et al.* (14) classified mouse lymphoid cell populations by their ability to bind few or many sheep red cells and found a shift of population either after animals were thymectomized or cells were treated with anti- $\theta$  serum. Multilayered RFC's seemed to be equivalent to secretory cells or plaque forming cells in their experiments. In man, however, spontaneous rosette-forming cells derived from untreated lymphocytes are exclusively T cells. Nevertheless, some human B cells may be induced to reveal receptors for SRBC, as was suggested by Chapel (6) and Bentwich *et al.* (4) on the basis of studies utilizing cells treated with papain or neuraminidase. The numbers of RFC's we observed after papain treatment would require B cell conversion to rosette formers. There was also a marked increase in the ratio of morula cells, so that it is probable that B cells also were involved in morula formation.

Of interest was the ability of SRBC's to induce cap formation after the cells were incubated at 37°. The process was found to be time dependent. This phenomenon was quite similar to redistribution of surface immunoglobulin molecules induced by anti-immunoglobulin antibody on B cells observed by Taylor *et al.* (24) and described for surface molecules of other cells as well (23). It appears that movement of membrane receptors is a basic process of cells. The role of this phenomenon in antigen processing and the initiation of immunoglobulin synthesis and secretion is unknown, but it appears to be a necessary early event (20). Whether the SRBC receptor of T cells is associated with or part of the surface systems which interacts with antigens is at present unknown, but further studies of its distribution and its variant, the MFC, may prove helpful in evaluating and understanding T cell function.

#### SUMMARY

A rosette-forming T lymphocyte characterized by a plethora of binding sites is found in increased numbers in the thymus gland, early in ontogeny and in certain disease states. It may represent a primitive T lymphocyte.

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