

## Mast Cell Density of the Human Umbilical Cord

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*Mast cells are the most constant components of the connective tissue and their presence in human placenta and umbilical cord has been described. The biological functions of mast cells in the human placenta and umbilical cord have not been well understood. The aim of the present study is to evaluate the number of mast cells of the umbilical cord in complicated and uncomplicated pregnancies. Umbilical cords obtained from 38 patients with either complicated (premature rupture of the membranes, pregnancy induced hypertension, fetal distress) or uncomplicated term pregnancies were collected immediately after spontaneous vaginal delivery or cesarean section. The mean number of mast cells from the different portion of umbilical cord were similar in all samples. There was no significant increase in the mean number of mast cells of the umbilical cord collected from uncomplicated term pregnancies delivered spontaneously compared to cesarean section. Any significant correlation was not detected in the mean number of mast cells of the umbilical cord collected from complicated pregnancies. The number of mast cells of the umbilical cord were not seemed to be affected from pregnancy complications. [Journal of Turgut Özal Medical Center 1998;5(1):43-46]*

**Key Words:** Mast cells, umbilical cord

### İnsan göbek kordonundaki mast hücre yoğunluğu

*Vücuttaki bağ dokularında bulunan mast hücrelerinin insan plasentası ve göbek kordonundaki varlığı gösterilmiş olmakla birlikte buradaki biyolojik fonksiyonları yeterince anlayamamıştır. Bu çalışmada komplike olan veya olmayan gebeliklerdeki göbek kordonlarında ortalama mast hücre sayılarının karşılaştırılması yoluyla bu konunun aydınlatılması amaçlanmıştır. Bu amaçla toplam 38 vakada göbek kordonunun fetal, orta ve maternal bölgelerindeki ortalama mast hücresi sayıları hesaplanmıştır. Yapılan istatistiksel karşılaştırmada ortalama mast hücresi sayıları göbek kordonunun değişik bölgelerinde benzer bulunmuştur. Ayrıca göbek kordonlarının içerdikleri ortalama mast hücre sayıları gebeliğin komplikasyonlu olup olmamasına ve doğum şekline göre de birbirleriyle karşılaştırılmış ve aralarında istatistiksel yönden anlamlı bir farklılığa rastlanamamıştır. [Turgut Özal Tıp Merkezi Dergisi 1998;5(1):43-46]*

**Anahtar Kelimeler:** Mast hücresi, göbek kordonu

The mast cells are known for their participation in inflammatory reactions, allergic and immunological diseases (1,2). In the last century, the mast cells were

identified in various organs such as human placenta and umbilical cord (3,4). The mast cells were found to be located predominantly around the vessels in the

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Wharton's jelly of umbilical cord (5) and mesenchymal stroma of placenta in several studies (6,7). The number of the mast cells in human umbilical cord was reported to be less than the other adult tissues such as gastrointestinal tract and skin (5). This anatomic distribution and the number of the mast cells are functionally important and point out the role of the mast cells in response to various stimuli. The main function of the mast cell is to produce and release several products that can affect connective tissue stromal cells, epithelial and endothelial cells, and smooth muscle cells and nerves both locally and systemically (8). Although the mast cells and their products are best known for their role in allergic or hypersensitivity states, they have also been implicated in a variety of nonimmunological functions, including maintenance of tissue homeostasis (9) and promoting of nonspecific inflammatory reactions (2). Moreover, alterations in the number of mast cells in response to physiological and pathological conditions have been documented in humans and other species (2,8,10,11).

The present study was designed to investigate whether the number of mast cells of the umbilical cord are affected from the complicated and uncomplicated pregnancies and the mode of delivery.

## MATERIALS AND METHODS

Umbilical cords were obtained from 38 term parturients immediately either after spontaneous vaginal delivery or cesarian section. One-centimeter segments were taken from fetal, central and maternal portions of each umbilical cord, flushed with saline solution and fixed in neutral buffered formaline. After 36-hour fixation, umbilical cord samples were routinely dehydrated and embedded into paraffin blocks. Three sections (5 µm) were taken from each sample via the step serial section method with a 50 µm interval to prevent the possibility of including the same mast cells in different sections. Sections were stained with prolonged (5 days long) toluidine blue technique to maximize the number of mast cells which were stained (12). Umbilical cord mast cells were identified according to the following criteria;

1. Mast cells are containing numerous granules that overlying almost whole nucleus located centrally or slightly eccentric.

2. Mast cell granules are stained dark blue and other tissue elements are practically unstained.

Counting of the mast cells was examined on an Olympus Microscope equipped with a square grid in the ocular. The mast cells were identified and counted with a magnification of x400. All of the mast cells were counted in each section. The mean number of fields of vision investigated per section was 370 (range 135-785). In each section, mean value of the mast cells which counted per grid area were calculated. The results were expressed as number of mast cells per mm<sup>2</sup>. The values are compared with each other for all three different parts of umbilical cord. Additionally, in order to understand whether number of mast cells of the umbilical cord are affected from mode of delivery and pregnancy complications, the values are compared according to different case groups. One-way Anova and Mann-Whitney U tests were used to evaluate the statistical analyses. A value of p<0.05 was used to denote significance statistically.

## RESULTS

Seventeen of the 38 umbilical cords were collected from uncomplicated term pregnancies after spontaneous vaginal delivery. Six uncomplicated term pregnancies were terminated by cesarean section. Five of 15 complicated pregnancies were premature rupture of the membranes, the other 5 were pregnancy-induced hypertension and the last 5 were fetal distress. Six of 15 complicated pregnancies were terminated by cesarean section and the others were terminated by vaginal delivery (Table 1).

The mean number of the mast cells per mm<sup>2</sup> was 4.6 (range 3-7.11) and was found to be similar in all samples taken from different parts of the umbilical cord (Table 2). The mean value of mast cells of the umbilical cord samples obtained from central portions was significantly higher in uncomplicated pregnancies terminated by spontaneous vaginal delivery compared

**Table 1.** Distribution of the cases.

Case	Mode of delivery		Total
	Vaginal	Cesarean	
Uncomplicated	17	6	23
PROM	4	1	5
PIH	4	1	5
FD	1	4	5
Total	26	12	38

Uncomplicated: Normal term pregnancies

PROM: Premature rupture of membranes

PIH: Pregnancy induced hypertension

FD: Fetal distress

**Table 2.** Mean umbilical cord mast cell counts per mm<sup>2</sup> in normal and complicated pregnancies after vaginal and abdominal delivery.

Case	n	Fetal end		Central portion		Maternal end	
		Mean	SD	Mean	SD	Mean	SD
UVD	17	5.160	1.240	4.841	0.935	4.750	0.764
UCS	6	4.449	0.986	3.945	0.806	4.350	1.220
PROM	5	5.008	0.786	4.960	1.260	4.552	0.479
PIH	5	4.713	0.789	4.561	0.724	4.410	1.200
FD	5	4.360	1.180	3.914	0.544	4.290	1.340

UVD: Uncomplicated term pregnancies terminated by vaginal delivery

UCS: Uncomplicated term pregnancies terminated by cesarean section

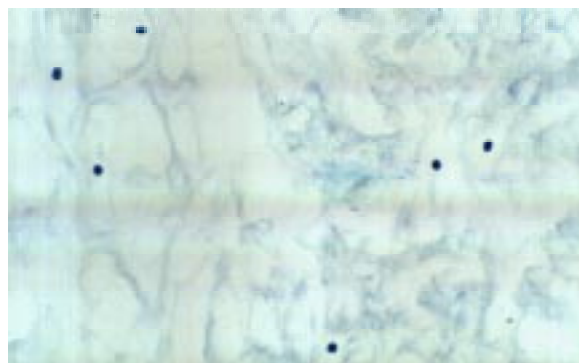
PROM: Premature rupture of membranes

PIH: Pregnancy induced hypertension

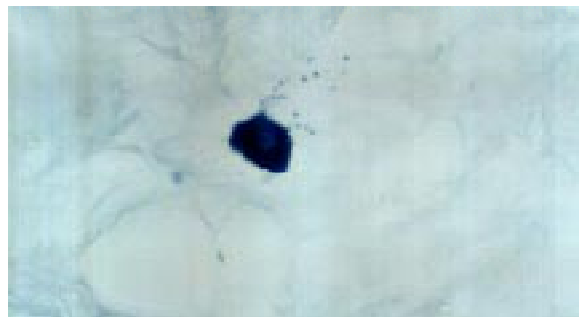
FD: Fetal distress

to the uncomplicated pregnancies delivered by cesarean section ( $p < 0.05$ ). But, it was not found to be statistically significant in the samples obtained from the other parts of umbilical cord. The number of the mast cells was not found to be affected by the pregnancy complications such as premature rupture of the membranes, pregnancy-induced hypertension, and fetal distress.

The mast cells tended to be concentrated around the umbilical vessels in the Wharton jelly (Figure 1,2). But, they were also located adjacent to amnion epithelium in a few samples.



**Figure 1.** Mast cells in the Wharton jelly. *Toluidine blue X100.*



**Figure 2.** Degranulated mast cell in the human umbilical cord. *Toluidine blue X400.*

## DISCUSSION

The umbilical cord mast cell has been described in various studies, but the biological functions and the relation with the complicated pregnancies has been remained unknown (3-5,13,14). Several pathological situations can cause mast cell proliferation (2,8). The mean number of mast cells of the umbilical cord has been reported with a wide range in various studies (5,13,14). Engberg Damsgaard et al., estimated that the mean number of the mast cell was 180/mm<sup>3</sup> (range 58-265/mm<sup>3</sup>) in the umbilical cord by using a stereological method (5). On the other hand, Sunderberg et al., concluded that mast cells were present in "considerable numbers" by counting the mast cells per low power field of vision (13). Durst-Zivkovic found that mast cells were more abundant in the umbilical cord and present in "smaller numbers" in the placenta (14). The mean number of mast cells of the umbilical cord were found 4.6/mm<sup>2</sup> (range 3-7.11/mm<sup>2</sup>) in the present study. The main concern with the estimation of the mean value of the mast cells of the umbilical cord is the methodology. Engberg Damsgaard was the only author estimating the numerical value of the mast cells in the umbilical cord. It is thought that the significant difference between Engberg Damsgaard's results and this study is directly related to the methods.

No regional variations have been described in the distribution of the number of mast cell in the umbilical cord itself (5). Results of present study supported the previous reports. The mean number of the mast cells were found to be similar in all samples of umbilical cords in this study.

Mast cells were found to be concentrated around the vessels (5). We also detected the mast cells in close proximity to the blood vessels in the umbilical cord. This localization may be attributed to the biological function of these cells.

The number of mast cells of the human placenta collected after spontaneous vaginal delivery and cesarian section were reported to be similar (15). In this study, no significant increase in the number of mast cells of the umbilical cords following a vaginal delivery compared to cesarian section was detected in uncomplicated pregnancies.

It can be speculated that, the umbilical cord mast cells may play some role in elevation of amniotic fluid cytokines and prostaglandin levels during the labor. Opsjon et al., concluded that there were no major differences in concentrations of interleukin-1, interleukin-6 and tumor necrosis factor in amniotic fluid at delivery with preeclamptic disorders compared to uncomplicated pregnancies (16). The number of the mast cells were not found to be related to the pregnancy complications in this study.

To the best of our knowledge; this is the first study designed to evaluate the difference in the number of the mast cells in complicated and uncomplicated pregnancies. Although age and environmental alterations were documented in other species (17), variability in the number and distribution of mast cells in various organs in human has not been well known. The sources of this variability have not been understood yet. Moreover, heterogeneity and the exact role of the mast cells in the human organs are still a debatable issue.

In conclusion; the number of mast cells of the umbilical cord were not seemed to be affected from mode of delivery and pregnancy complications.

## REFERENCES

1. Kaliner M, Lemanske R. Inflammatory responses to mast cell granules. *Fed Proc* 1984;43:2846-51.
2. Parwadesh MR, Horny H-P, Lennert K. Tissue mast cells in health and disease. *Path Res Pract* 1985;179:439-61.
3. Pagani C. I mastociti della placenta e del cordone ombelicale umani in condizioni fisiologiche. *Ann Obstet Gyn* 1952;74:429-42.
4. Lehner J. Das mastzellen problem und die metachromasie-Frage. *Ergebn Entwickl Gesch* 1924;25:67-184.
5. Engberg Damsgaard TM, Windelborg Nielsen B, Sorensen FB, Henriques U, Schiotz PO. Estimation of the total number of mast cells in the human umbilical cord. *APMIS* 1992;100:845-50.
6. Latta JS, Beber CR. Cells with metachromatic cytoplasmic granules in the stroma of the human chorionic villi. *Science* 1953;117:498-9.
7. Pescetto G. Sulla presenza di elementi granulati basofili metacromatici nella placenta fetale umana. *Biol Lat* 1957;2:744-57.
8. Longley J, Duffy TP, Kohn S. The mast cell and mast cell disease. *J Am Acad Dermatol* 1995;32:4,545-61.
9. Lewis RA, Austen KF. Mediation of local homeostasis and inflammation by leukotriens and other mast cell-dependent compounds. *Nature* 1981;293:103-8.
10. Gaytan F, Aceitero J, Bellido C, Sanchez-Criado JE, Aguilar E. Estrous cycle-related changes in mast cell numbers in several ovarian compartments in the rat. *Biol Reprod* 1991;45:27-33.
11. Silver R, Silverman A-J, Vitkovic L, Lederhendler II. Mast cells in the brain: evidence and functional significance. *Trends Neurosci* 1996;19:25-31.
12. Wingren U, Enerback L. Mucosal mast cells of rat intestine: a reevaluation of fixation and staining properties, with special reference to protein blocking and solubility of the granular glycosaminoglycan. *Histochem J* 1983;15:571-82.
13. Sunderberg RD, Schaar FE, Powell MJS, Denboer D. Tissue mast cells in human umbilical cord. *Anat Rec* 1954;118:35-56.
14. Durst-Zivkovic B. Das vorkommen der mastzellen in der nachgeburt. *Anat Anz* 1973;134:225-9.
15. Purcell WM, Hanahoe THP. 1.Histamine release from mast cells and basophils. A novel source of mast cells: The human placenta. *Agents Actions* 1991;33-1/2:8-12.
16. Opsjon SL, Austgulen R, Waage A. Interleukin-1, interleukin-6 and tumor necrosis factor at delivery in preeclamptic disorders. *Acta Obstet Gynecol Scand* 1995;74(1):19-26.
17. Hough LB. Cellular localization and possible functions for brain histamine; recent progress. *Prog Neurobiol* 1988;30(6): 469-505.

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