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THE OCCURRENCE OF SUBEPITHELIAL GINGIVAL
BLOOD VESSELS IN PATIENTS WITH MORBUS
CAERULEUS (TETRALOGY OF FALLOT)

by

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An investigation was made on subjects with a congenital heart disease, named the tetralogy of Fallot. In these subjects there are (i) a pulmonic stenosis, (ii) a ventricular septal defect just below the aorta, (iii) an aorta which overrides both right and left ventricles, and (iv) hypertrophy of the right ventricle. Thus the whole blood volume does not pass through the lungs for oxygen saturation. Part of the venous blood is directly shunted to the arterial systemic vessels. The peripheral vessels then contain a poorly oxygenated blood. A compensatory increase in the number of erythrocytes and capillaries develops. With aid of thoracic surgery using hypothermia and heart-lung machines it is possible to give some of these patients a much better oxygen saturation in their blood.

From a medical and especially from a parodontological point of view it is in this disease of interest to investigate the occurrence of the subepithelial capillaries in the gingiva. Most cases of this heart disease have usually a markedly affected marginal periodontium. In the present investigation, however, only patients were selected with clinically healthy gingivae. The blood vessels of the gingiva represent a peripheral circulation which should

undergo changes according to the variation in the oxygen saturation. In spite of the relatively high operative mortality an attempt was made to follow the variation of the number of the capillaries per unit area before and after thoracic surgery.

METHOD

In an earlier publication (*Forslund, 1959*) the writer has developed a method for stereoscopic photomicrography *in vivo* of subepithelial blood vessels in the gingival margin in man. With this method it is possible, *inter alios*, to determine the number of blood vessels per square millimeter in the gingiva. A 36×36 mm square reticule is placed on enlarged pictures, with a combined magnification of 36×, over the interpapillary marginal zone and the adjacent parts of the submarginal zone. The blood vessels visible through the reticule are counted. The same region can be investigated stereoscopically on photographs taken on different occasions.

The heart disease in the patients was verified, *inter alios*, through radiographic heart cateterisation, and the oxygen saturation was examined before and after the operations.

MATERIAL AND RESULTS

Clinically healthy gingiva (the colour being slightly blue because of the cyanosis) was examined in twelve subjects (6 women, 6 men) suffering from the tetralogy of Fallot. The number of vessels per square millimeter ranged from 42 to 91 with a mean of 64 (S.D. of mean = 4.3; Table 1).

Eight of these patients were operated upon but four died during the operations or a few days later. Re-examinations were made on the other four, 2 women and 2 men. As can be seen from Table 2 the number of the capillaries decreased in all cases after surgery. The vessels per square millimeter before the operation ranged between 58 and 91 with a mean of 73 (S.D. of mean = 6.5), and after the operation the number had decreased to a mean of 50 (S.D. of mean = 3.5), the range being 42 to 59 vessels per

Table 1
Number of vessels per square millimeter in clinically healthy gingiva in morbus caeruleus (tetralogy of Fallot).

Subject	Sex	Age	Stereo-pair	No. of vessels per mm ²	Region	Comments
E.J.	Female	23	1483	72	1	Operated
J.S.	Female	8	1506	70	1	Operated
A.P.	Female	26	1510	43	2	Op. Died
A.J.	Female	20	1526	65	1	
S.E.	Female	32	1549	47	2	
G.E.	Female	24	1551	82	2	
A.A.	Male	34	1080	91	1	Operated
U.V.	Male	18	1401	42	1	Op. Died
Å.E.	Male	26	1407	61	1	
S.B.	Male	12	1479	58	1	Operated
B.B.	Male	16	1485	65	1	Op. Died
S.W.	Male	35	1517	70	1	Op. Died
Mean				63.8		
S.D. of the mean				4.3		

square millimeter. This decrease in number of vessels amounts to 23 vessels per square millimeter as a mean. The decrease in percentage was between 26 and 37 with a mean of 31.5.

The decrease could be seen as early as 2—3 weeks after surgery (Table 2).

Table 2
Number of vessels per square millimeter in clinically healthy gingiva before and after heart operations in morbus caeruleus (tetralogy of Fallot).

Subject	Sex	Age	Stereo-pair before/after	Number of vessels per mm ²		Decrease in		Days between examinations
				before	after	num-ber	percent-age	
E.J.	Female	23	1483/1503	72	53	19	26	15
J.S.	Female	8	1506/1514	70	47	23	37	14
A.A.	Male	34	1080/1085	91	59	32	35	21
S.B.	Male	12	1479/1499	58	42	16	28	165
Mean				72.7	50.2	22.5	31.5	
S.D. of the mean				6.5	3.5			

DISCUSSION

Earlier, the writer estimated the average number of vessels per square millimeter to 46 (S.D. of mean = 3.3) in clinically healthy gingiva (six subjects in good health). The results in the present investigation show significantly higher values in patients with the tetralogy of Fallot. It is interesting to compare these high numbers of vessels with the number 21 (S.D. of mean = 2.2) found in subjects in good health but suffering from marginal periodontal disease. (*Forsslund*, 1959, 1960).

In the previous studies by the present writer the *constancy* of the subepithelial vascular pattern was investigated. When there is full constancy, all vessels should be possible to identify on all pictures taken on different occasions. From the number of vessels that disappear and the number that can be identified for full constancy it is possible to compute the disappearance percentage during any particular period. The disappearance percentage can be regarded as an expression of the degree of constancy of the vascular bed. Two different time schedules were used in the investigation of this constancy in two groups of experimental subjects: In the first group the examination was performed in one continuous period of about one hour, and in the second group the constancy of the vascular bed was investigated on different days. There were only a few (0—3) vessels in each subject which disappeared, and the disappearance percentage was calculated to 0.31 and 0.61 respectively. Accordingly, the constancy of the individual vessels seemed to be high in normal cases.

From Table 2 can be seen that the individual patient showed a disappearance of vessels which is significantly greater than for normal cases. Patients subjected to successful heart operations thus showed a decrease in number of vessels. It seems natural to ascribe this phenomenon to the increased oxygen saturation in the peripheral blood. It seems unreasonable that other factors such as anesthesia or surgical trauma could have such an effect.

SUMMARY

Clinically healthy gingiva was examined in twelve subjects with the tetralogy of Fallot. The writer used his own method of counting the number of subepithelial blood vessels per square

millimeter (stereoscopic photomicrography). The number of vessels per square millimeter ranged from 42 to 91 with a mean of 64 (S.D. of mean = 4.3; Table 1). This result was significantly higher than the values for subjects in good health who had a mean of 46 (S.D. of mean = 3.3). (*Forsslund*, 1959, 1960).

Eight of the patients underwent thoracic surgery and four of them survived showing normalized values of the oxygen saturation of their blood. From a mean of 73 (S.D. of mean = 6.5) vessels per square millimeter in the gingiva before the operation, the number decreased to a mean of 50 (S.D. of mean = 3.5) after the operation (Table 2). With reference to the high constancy of the individual vessels in the gingiva in subjects with good health, the decrease in number in each patient in the present investigation will be highly significant. The decrease could be seen as early as the patients were in a condition to be examined, i.e. 2—3 weeks after the operations.

RÉSUMÉ

NOMBRE DE VAISSEAUX SANGUINS SOUS-ÉPITHÉLIAUX CHEZ LES PATIENTS ATTEINTS DE MALADIE BLEUE (TÉTRALOGIE DE FALLOT)

Chez douze sujets présentant la tétralogie de Fallot, un examen de la gencive cliniquement saine a été fait en utilisant une méthode propre à l'auteur pour compter le nombre de vaisseaux sanguins sous-épithéiaux par millimètre carré (microphotographie stéréoscopique). Le nombre de vaisseaux par millimètre carré allait de 42 à 91, avec une moyenne de 64 (écart-type de la moyenne = 4,3. Tableau 1). Ce résultat était significativement plus élevé que la valeur chez les sujets en bonne santé; Moyenne = 46, écart-type de la moyenne = 3,3. (*Forsslund*, 1959, 1960).

Huit des patients ont été traités par chirurgie thoracique et quatre d'entre eux ont survécu, leurs valeurs de saturation du sang en oxygène étant ramenées à la normale. D'une moyenne de 73 (écart-type de la moyenne = 6,5) avant l'opération, le nombre des vaisseaux par millimètre carré dans la gencive est descendu à une moyenne de 50 (écart-type de la moyenne = 3,5) après l'opération (Tableau 2). En considération de la grande constance des valeurs individuelles pour les vaisseaux de la gencive de sujets en bonne santé, la diminution de valeur trouvée pour

chacun des patients dans la présente étude est hautement significative. La diminution a pu être constatée dès que les patients ont été en état d'être examinés, c'est-à-dire 2—3 semaines après l'opération.

ZUSAMMENFASSUNG

DAS VERHALTEN DER SUBEPITHELIALEN BLUTGEFÄSSE IM ZAHNFLEISCH BEI PATIENTEN MIT MORBUS CAERULEUS (FALLOT'SCHER TETRALOGIE)

Klinisch gesundes Zahnfleisch wurde bei 12 Personen mit Fallot'scher Tetralogie untersucht. Der Verfasser benutzte sein eigenes Verfahren (stereoskopische Mikrophotographie) zum Zählen der je mm² vorkommenden subepithelialen Blutgefäße. Die festgestellten Anzahlen schwankten zwischen 42 und 91 mit einem Mittelwert von 64 (mittlere Fehler vom Mittelwert = 4,3, Tafel 1). Diese Werte waren signifikant höher als das bei gesunden Personen festgestellte Ergebnis: Mittel = 46, mittlere Fehler vom Mittelwert = 3,3 (*Forsslund*, 1959, 1960).

8 der Patienten wurden einer Brustoperation unterworfen; davon überlebten die vier und zeigten normalisierte Werte in der Sauerstoffsättigung des Blutes. Von einem Mittelwert von 73 (mittlere Fehler vom Mittelwert = 6,5) Gefäße pro mm² im Zahnfleisch vor der Operation ging die Anzahl auf einen Mittelwert von 60 (mittlere Fehler vom Mittelwert = 3,5) nach der Operation zurück (Tafel 2). Mit Rücksicht auf die hohe Konstanz der einzelnen Blutgefäße im Zahnfleisch bei gesunden Personen muss die Senkung in der Anzahl bei jedem der hier untersuchten Patienten als äusserst signifikant angesehen werden. Diese Senkung konnte festgestellt werden, sobald der Zustand der Patienten eine Untersuchung gestattete, d.h. 2 bis 3 Wochen nach der Operation.

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