APPENDICEL ENTEROBIASIS — ITS INCIDENCE AND RELATIONSHIPS TO APPENDICITIS

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Abstract. An evaluation was made of a biopic material (21,916 appendices recovered from 1965 to 1974), in order to disclose relationships of the incidence of Enterobius vermicularis and the origin of appendicitis. A separate evaluation was made of a set of appendectomies (10,619 cases — from 1961 to 1970) for the purpose of detecting changes in pin worm-infested appendices by means of histological methods (683 cases). E. vermicularis was found in 6.08 % of appendices. Included in our histological examination was a search for granulomas and eosinophile infiltrations. The former occurred in 1.14 % of pin worm-infested appendices, the latter in 1.74 % and in 0.15 %, or 2.18 % in pin worm non-infested appendices. The results indicated a statistically highly significant difference in the incidence of granulomas. The incidence of granulomas in the appendix was increased in the present of pin worms in the appendix, and seemed also to be responsible for further pathological changes in it.

The importance of the pin worm, Enterobius vermicularis (L., 1758), in the pathogenicity of appendicitis has been an object of study for more than 100 years. In the past, various authors (Still 1899, Metchnikoff 1901a, b, Galli Valerio 1903, Brumpt and Le Bègue 1909, Rheindorf 1912, 1914) suggested a mechanical transportation of pathogenic bacteria by the pin worm from the gut to the mucosa of the appendix. Later their suggestion was supported by Brumpt (1949) and Durán Jordà (1957). More recent observations of abscesses and granulomas with fragments of the pin worm in the appendiceal wall (Tesseraux and Viehmann 1952, Schenkken and Burns 1961, Sliaž and Štěrba 1975) confirmed the pathogenic effect of E. vermicularis.

On the other hand, numerous authors (Aschoff 1913, 1914, 1920, Hueck 1913, North 1933, Symmers 1950 etc.) inferred that the presence of E. vermicularis in the appendix was not directly responsible for the origin of appendiceal processes although they agreed in that the presence of pin worms in the appendix might bring about an irritation without histological signs of an inflammation (appendicopathia oxyurica or pseudoappendicitis ex oxyure — Hueck 1913, Aschoff 1913). But all in all, there is no firm evidence on the role played by the pin worm in the pathogenesis of appendicitis (Di Guarda and Pimpiglione 1972, Paždziorski et Burra 1973).

Our present study was intended to examine the incidence of pin worm in appendices, and to determine their possible etiological influence on the origin of appendicitis.

MATERIALS AND METHODS

A retrospective study, and an evaluation, was made of a standard biopic material of appendectomies deposited in the Pathological-Anatomical Institute, Hospital of the Medical School, Plzeň, Czechoslovakia. Our material consisted of appendices removed by surgery from 1955 to 1972 (21,916 cases, age group 0—84, both sexes). First, all appendices were fixed with 10 % formal, then three
RESULTS

*E. vermicularis* was found in 1,322 cases, i.e., in 6.0% of a total of 21,916 appendices (Table 1). The percentile representation of the worms in the appendices varied in the individual years, from 3.5% (1960) to 7.6% (1965). Štěrba et al. (1978) made a similar analysis of the findings arranged in age-sex groups. The incidence of *Trichuris trichiura* (L., 1771) was recorded seven times within the course of 20 years, i.e., in 0.08% of cases. Using histological methods, we traced the incidence of eosinophile infiltrations and granulomas. The presence of granulomas in the appendicular wall was found in 54 cases (0.20%). There, they occurred in all layers. About 50% of the granulomas were lodged either in the mucosa or the submucosa. They occurred in about equal numbers in the other, individual layers (i.e., the outer musculature, serous, mesentery, periappendicular space), but generally less frequently than in the mucosa and the submucosa. The content of the granulomas could not always be determined quite accurately. If we excluded granulomas of a different origin (TBC, etc.), the more frequent finding was that of a truly parasitic origin (*E. vermicularis*) and that of granulomas ensnaring foreign bodies (a hair, inorganic corpuscles, plant parts, calcified excrements, etc.). Less frequent were nodular granulomas of an unknown origin. A detailed evaluation of granulomas in appendices, and their differential diagnosis, will be the object of a further study.

We separated 1,322 pin worm-infested appendices from our total appendicular material for the purpose of detecting relationships between the incidence of the pin worm and the presence of eosinophile infiltrations and granulomas (Table 1). The remaining 20,594 appendices without worms were used as controls.

Table 1. Survey of the incidence of Enterobius vermicularis L. (E.v.), Trichuris trichiura L. (T.L.), eosinophile infiltrations and granulomas in appendices removed by surgery in the years 1965-1974

<table>
<thead>
<tr>
<th>Year</th>
<th>Total no. of appendices examined</th>
<th>Granuloma</th>
<th>Eosinophile infiltr.</th>
<th>E.v.</th>
<th>E.v. + granuloma</th>
<th>E.v. + eosinophile infiltr.</th>
<th>E.v. + eosinophile infiltr. + granuloma</th>
<th>T.L.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1965</td>
<td>906</td>
<td>2</td>
<td>25</td>
<td>56</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
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<tr>
<td>1966</td>
<td>1,047</td>
<td>4</td>
<td>19</td>
<td>69</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
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<tr>
<td>1967</td>
<td>1,352</td>
<td>2</td>
<td>21</td>
<td>111</td>
<td>4</td>
<td>2</td>
<td>2</td>
<td></td>
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<tr>
<td>1968</td>
<td>1,821</td>
<td>2</td>
<td>8</td>
<td>79</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
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<tr>
<td>1969</td>
<td>1,087</td>
<td>4</td>
<td>16</td>
<td>38</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
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<tr>
<td>1970</td>
<td>1,083</td>
<td>2</td>
<td>6</td>
<td>81</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
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<tr>
<td>1971</td>
<td>1,090</td>
<td>4</td>
<td>16</td>
<td>55</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
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<tr>
<td>1972</td>
<td>962</td>
<td>1</td>
<td>18</td>
<td>57</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
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<tr>
<td>1973</td>
<td>1,008</td>
<td>1</td>
<td>18</td>
<td>60</td>
<td>1</td>
<td>1</td>
<td>1</td>
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<tr>
<td>1974</td>
<td>1,467</td>
<td>3</td>
<td>31</td>
<td>123</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
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<tr>
<td>1975</td>
<td>998</td>
<td>1</td>
<td>30</td>
<td>72</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
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<tr>
<td>1976</td>
<td>956</td>
<td>1</td>
<td>30</td>
<td>72</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
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<tr>
<td>1977</td>
<td>936</td>
<td>1</td>
<td>44</td>
<td>73</td>
<td>1</td>
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<tr>
<td>1978</td>
<td>1,085</td>
<td>4</td>
<td>47</td>
<td>63</td>
<td>1</td>
<td>1</td>
<td>1</td>
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<tr>
<td>1979</td>
<td>1,036</td>
<td>2</td>
<td>33</td>
<td>61</td>
<td>1</td>
<td>1</td>
<td>1</td>
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<tr>
<td>1980</td>
<td>1,032</td>
<td>2</td>
<td>27</td>
<td>61</td>
<td>1</td>
<td>1</td>
<td>1</td>
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<tr>
<td>1981</td>
<td>1,397</td>
<td>2</td>
<td>40</td>
<td>60</td>
<td>1</td>
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<td>1</td>
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<tr>
<td>1982</td>
<td>932</td>
<td>2</td>
<td>3</td>
<td>37</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>1983</td>
<td>896</td>
<td>2</td>
<td>5</td>
<td>33</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

Σ 21,916 39 450 1,322 12 20 3 7

Fig. 1. Helminthological findings in appendices containing *E. vermicularis* in their lumina. Full line — appendices with parasites; dash-dotted line — appendiceal oesophagus; dashed line — so-called chronic appendicitis; dotted line — acute appendicitis; thin line — enterobiasis and appendiceal appendicitis (in the material from 1961—1970).

Granulomas were found in 15 cases of the group of pin worm-infested appendices, i.e., in 1.14%, eosinophile infiltrations of the appendicular wall in 23 cases, i.e., in 1.05%. In the control group without worms, granulomas occurred in 39 cases (0.19%), eosinophile infiltrations in 450 cases (2.18%).

As shown in Table 1, eosinophile infiltrations occurred both in pin worm-infested and in non-infested appendices, whereby the difference in their participation in the two groups was negligible. Using the testing method $x^2$, the values for eosinophile infiltrations were similar in both groups.

Interesting results were obtained from a comparison of the incidence of granulomas in pin worm-infested and worm-free appendices. Their participation in cases of the former group (1.14%) was sixteen times higher than that in the control group; the $x^2$ test confirmed a statistically highly significant difference ($P < 0.001$). Therefore, we might be correct in suggesting that the pin worms are capable of causing pathological changes in the appendix. Owing to a remarkably increased incidence of granulomas...
DISCUSSION

Although the problem of the incidence of \textit{E. vermicularis} in appendicitis, and its participation in the pathogenesis of appendicitis, has been investigated for several decades, the incidence of this pathogen in human appendicitis remains a matter of debate. The prevalence of \textit{E. vermicularis} in appendicitis varies significantly worldwide, with some studies reporting a high incidence while others report lower rates. However, the exact role of \textit{E. vermicularis} in the pathogenesis of appendicitis is still unclear. The presence of \textit{E. vermicularis} in appendicitis is often associated with other microorganisms, and the interaction between these microorganisms may play a role in the development of appendicitis.

In the present study, the incidence of \textit{E. vermicularis} was investigated in appendicitis, and the pathogen was found in several cases of appendicitis. The appendectomy specimens were examined for the presence of pinworm eggs and larvae. An average of 6.43% of the specimens contained pinworm eggs, and only in one case was the presence of \textit{E. vermicularis} confirmed.

The results of the present study are consistent with previous reports, which have shown that the incidence of \textit{E. vermicularis} in appendicitis is low. However, the presence of pinworm eggs and larvae in appendicitis may indicate a role of the pathogen in the pathogenesis of appendicitis. Further studies are needed to elucidate the exact role of \textit{E. vermicularis} in appendicitis.

### Table 2: Survey of the incidence of Enterobius vermicularis in appendiceal material as recorded by several authors (numerator = total number of appendectomies examined; denominator = number of positive cases)

<table>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Total no. of cases</td>
<td>26,051</td>
<td>2,344</td>
<td>138</td>
<td>2,317</td>
<td>1,016</td>
<td>601</td>
<td>1,806</td>
<td>2,439</td>
<td>919</td>
</tr>
<tr>
<td>Histological diagnosis</td>
<td>311</td>
<td>45</td>
<td>15</td>
<td>184</td>
<td>8</td>
<td>52</td>
<td>87</td>
<td>433</td>
<td>20</td>
</tr>
<tr>
<td>Acute catarrhal appendicitis</td>
<td>311</td>
<td>45</td>
<td>15</td>
<td>184</td>
<td>8</td>
<td>52</td>
<td>87</td>
<td>433</td>
<td>20</td>
</tr>
<tr>
<td>Inflammatory perforation</td>
<td>311</td>
<td>45</td>
<td>15</td>
<td>184</td>
<td>8</td>
<td>52</td>
<td>87</td>
<td>433</td>
<td>20</td>
</tr>
<tr>
<td>The so-called chronic appendicitis (+ coprostasis, coprokolon)</td>
<td>279</td>
<td>25</td>
<td>15</td>
<td>1,782</td>
<td>52</td>
<td>1,239</td>
<td>88</td>
<td>56</td>
<td>11</td>
</tr>
<tr>
<td>Ulcero-phlegmonous or gangrenous appendicitis</td>
<td>311</td>
<td>54</td>
<td>0</td>
<td>54</td>
<td>0</td>
<td>54</td>
<td>0</td>
<td>54</td>
<td>0</td>
</tr>
<tr>
<td>Appendicopathia oxyurica</td>
<td>311</td>
<td>54</td>
<td>0</td>
<td>54</td>
<td>0</td>
<td>54</td>
<td>0</td>
<td>54</td>
<td>0</td>
</tr>
<tr>
<td>Preventively removed appendix (without pathological changes)</td>
<td>45</td>
<td>65</td>
<td>6</td>
<td>65</td>
<td>6</td>
<td>65</td>
<td>6</td>
<td>65</td>
<td>6</td>
</tr>
</tbody>
</table>

* A histological diagnosis of pin worm infected appendixes
** The number also includes cases (736/22) of an acute appendicitis (empysemas, gangrene, gangrenes with phlegmons)
both in appendices without pathological changes and in those with various forms of an inflammation (Table 2). According to the majority of authors (Gordon 1933, etc.), the incidence of the pin worm in the so-called appendicitis is higher than that in appendices with an acute inflammation. Our results on this point are similar. On the other hand, a different situation has been observed by Duran Jorda (1867). The results of his study on appendicitis in children (0—16 years) indicate that E. vermicularis is present mainly in cases of acute inflammation. Having regard to the fact that all other authors have examined the problem in sets comprising all age groups (0—90 years), they might have failed to observe considerable differences in the incidence of the pin worm in the lowest age group.

The results obtained by Shubenko—Gabuzova (1965) are of a very different nature. The author did not report the presence of the pin worm in the case of the so-called chronic appendicitis, and recovered it solely from appendices showing various forms of an acute inflammation. In her opinion, the origin of a purulent inflammation in the presence of the pin worm in the appendix is associated with the individual properties of the organism of man, i.e., his resistance of the helmint. In these instances, the origin of an acute appendicitis requires certain "complementary" factors. The cited author suggests that the course of an inflammation of the appendix of a productive enterobiasis is frequently characterized by a genuine in the so-called chronic appendicitis. Since elements of a chronic, productive inflammation were always present in the appendices examined by the author, it is possible that her cases were those of the so-called chronic appendicitis with an acute exacerbation.

When examining the pathology of the appendix, one needs to have a clear and accurate understanding of its normal, histological structure, however, this is an extremely difficult undertaking because, as stated by a number of authors (e.g., Zavarsin and Rumyanstev 1968 — ex Shubenko—Gabuzova 1965), the appendix is continuously subjected to numerous processes which bring forth larger or lesser changes. This accounts for inaccuracies in the diagnosis of appendicopathia oxyurica and hence, for a considerable subjectivity in the determination of this diagnosis.

When solving the problem of the etiological influence of E. vermicularis on the pathology of the appendix, one always has to bear in mind that differences in the degree of an infestation of the appendix with the pin worm which have been detected with histological methods is no firm evidence on the etiological influence of the helminth. In this respect, a direct confirmation that the parasite can exist in a pathologically changed appendix.

The presence of the parasite in the organism might bring forth also an eosinophil infiltration of the tissues. This point has been examined by a number of authors (Innes and Campbell 1914—1915, Fischer 1923, Eastwood 1924 — ex Gordon 1935, Bell 1939, Brumpt 1949, Duran Jorda 1957, Richmond and Guthrie 1964, Goldblatt 1967, and Pampiglioni 1972, Sztib et al. 1973, Stéb 1982) who all found an eosinophil infiltration in pin worm-infected appendices. On the other hand, similar infiltrations occur also in worm-free appendices. Therefore, the presence of an eosinophil infiltration should not be regarded as the sole response to the presence of the parasite.

Another point of interest is the presence of granulomas in the appendicular wall. Most of the earlier authors have studied the morphology only of these granulomas (Galli-Valiero 1903, Huckle 1913, Matsuoka 1915—1916, Léven and Reinhard 1919, Gordon 1933, Symmers 1950, Lembre 1951, Schemzter 1957), more recent authors (Stark 1958, Slais 1962, Richmond and Guthrie 1964, Goldblatt 1967, Peterffy 1959, Tennstedt and Ockert 1972, Slais and Stéb 1975, Stéb 1982) have investigated also their content. Although fragments of E. vermicularis have been found in the granulomas, there is no firm evidence that the presence of the parasite in the lumen of the appendix is associated with that of the granulomas. Our results suggest that the pin worm might cause pathological changes in the appendix. The number of granulomas in pin worm-infested appendices surpasses by far that in the control group. The presence of granulomas in appendices is extremely rare, they are not observed in our material for as little as 0.8 % (0.2 % in our material) of cases. However, as pointed out by Goldblatt (1967), about 30 times more granulomas can be detected with a histotopographical examination of a complete series of sections as compared with the 0.4 % of a routine examination. This indicates that the impact of granulomas on the pathology of appendices is apparently considerably higher than anticipated so far on the basis of a routine examination which fails to disclose the presence. Because the presence of isolated granulomas in appendices without any other inflammatory forms might escape disclosure in a routine examination, this might be one of the reasons for an inaccurate diagnosis of, e.g., appendicopathia oxyurica owing to an absence of pathological changes in the appendix. However, an increased incidence of granulomas might confirm the fact that pin worms parasitize in the appendix bring about pathological changes. We believe, that new and important results will be obtained from further, detailed studies on this problem.

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ЭНТЕРОБИОЗ АППЕНДИКСА — ЕГО ВСТРЕЧАЕМОСТЬ И СВЯЗЬ С АППЕНДИЦИТОМ Я. Шторба и М. Вачек

Резюме. Обследова биотипичний матеріал (21916 аппендицисів), отриманий у 1955—1974 рр., з висновком відбулася зв'язок між зараженням гельмінтами Enteroxes vermicularis і патологією в організмі. Основними методами були: традиційні методи оцінювання гельмінтів; огляд 12 місць за 1967—1970 pp., і в припущеннях гістологічних методів зустрічалися в 683 аппендицисах, заражених цим паразитом. E. vermicularis виявлений в 6,03 % аппаратців. При гістологічному описі локалізували також відсутність гранулом і інфілтрацію зонофіл. У групі аппаратців, що відсутні грануломи, грануломи були відмічені у 1,14 % і інфілтрація зонофіл у 1,74 %, і в контролі, безвідмовних аппендицисах, грануломи відсутні у 0,19 % і інфілтрація зонофіл у 2,19 %. Обережні відверні в відношенні гранулом мають статистичне значення. Парацентези в аппендицисах неможливо оцінити на основі числа гранулом і, вероятно, також не інші патологічні зміни.

REFERENCES


ASHBURN L., Appendical oxyuris. Its


GOLDBURT N. N., Granulomas of the wall of the appendices and their relation to the so-called eosinophilic appendicitis. Arch. Path. (Moskva) 29: 89—93, 1967. (In Russian.)


—, ŠTĚRBA J., Previous findings of parasites in liver and lungs. All-state Congress of Czechoslovak Pathologist, Prague, 28th—29th September 1975, Suppl. (In Czech.)

ŠTĚRBA J., Histological detection of some helminths in appendix. Conference of pathologists of South-Bohemian region, Strakonice, 27. 5. 1982. (In Czech.)


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