A great deal of experimental work has been done seeking some specific relation between the various vitamins and malignant neoplasms. The literature is extensive, but the diverse information is not readily fitted into a unified or consistent pattern for it is impossible to make extensive generalizations from the effects obtained with one type of tumor when the opposite effect may prevail with others. There are, however, three general approaches to the problem and with these in mind the scattered literature may be divided into first, the relation of vitamins to the induction of tumors; second, the relation of vitamins to the growth of tumors; and third, the vitamin content of tumors as compared with that of normal tissues. Our investigations fit into the third category but differ from most of the previous work in that we are dealing with spontaneous human cancers, not an experimental type induced or transplanted in animals.

As vitamin B₆ plays an important part in the transamination process it was felt that the amount of this vitamin present in the neoplasm, compared with the amount present in the surrounding normal tissue, might serve as an indication of the amount of transamination taking place during neoplasia. In addition, the observation that the feeding of a diet low in pyridoxine caused the rats to be more resistant to the induction of cancer (9, 10) and also caused a reduction of growth of tumors already present (8, 9) prompted the study of the amount of vitamin B₆ present in various types of human neoplasms.

A few studies were made on the biotin content of neoplasms, for biotin also seems to be related to nitrogen metabolism as Winzler (12) has indicated in his work with yeast. Biotin has been reported to have a procarcinogenic effect on "butter yellow" induction of tumors (5, 7) and has been reported to affect the growth rate of tumors (3). In addition, the same assay method could be used, simplifying the experimental procedure.

EXPERIMENTAL

All human neoplasms were obtained through the cooperation of the Department of Surgical Pathology, Toronto General Hospital, and the Department of Pathology, Toronto Western Hospital. Sections of all tissues used for assay were made in these respective departments and microscopic examinations carried out. The diagnoses were received from these departments but no attempt was made to determine the density of stroma, the proportion of malignant to normal cells or the amount of necrosis present. All data represent the amounts of the vitamins present per gram of the entire tumor mass.

The tissue remaining after sections were made was available for assay and was prepared for determinations within six hours of removal in the case of surgical specimens and within six hours of death in the case of autopsy specimens. A preliminary experiment was carried out in which it was shown that there was no loss of vitamin B₆ during a six hour period following removal and thus the results represent the total amount of vitamin B₆ present in the tissue. Whenever possible vitamin estimations were carried out on surrounding normal tissue as well as on the neoplasm itself.

The vitamin B₆ and biotin content of the tumors was estimated microbiologically using the method of Atkin et al. (1) utilizing Saccharomyces carlsbergensis. For the assay of biotin, pyridoxine hydrochloride was substituted for biotin in the basal medium and a 0.3 milligram/cc. solution of crystalline biotin was used as a standard. With this method the vitamin B₆ content of 40 malignant tumors and 20 samples of normal tissue was determined as well as the biotin content of 22 malignant tumors and 9 samples of normal tissue.

RESULTS

The vitamin B₆ content of the neoplasms fell within a range of 0.33 to 1.35 mcgm./gm., while the values for surrounding normal tissue fell within a much wider range from 0.26 to 8.90 mcgm./gm. A similar situation was found with the biotin content.
values, where the range for the neoplasms was 0.02 to 0.16 mcgm./gm. Figures 1 and 2 depict the average values for the vitamin content of the various neoplasms and their host tissues.

DISCUSSION

An examination of these results indicates that a marked similarity of both vitamin B₆ and biotin content exists among all examined types of neoplasms, and that this similarity is not evident among the normal host tissues. Not only are the vitamin B₆ values within a narrow range but the values are similar to those for normal tissues having a low vitamin B₆ content, such as the mucosa of the gastro-intestinal tract. Other tissues having high values for their vitamin B₆ content, such as liver, kidney and muscle, act as hosts for neoplasms which have small amounts of vitamin B₆. In fact the vitamin B₆ content of all malignant tumors studied was found to have a standard deviation of 0.19 mcgm./gm., whereas the corresponding group of normal tissues varied over such a wide range that the standard deviation could not be determined. A similar observation was made when the biotin content of tumors and of normal tissues was considered.

The standard deviation may be considered to be too high to be of significance, but there are not only a large number of different types of tumors, but these tumors, even those of the same type, may vary considerably in the degree to which they resemble or depart from the characteristics of normal tissue. In human neoplasms particularly, there are elaborate gradations of malignancy and it has been said that the greater the degree of malignancy the greater is the departure from normal. Neoplasms are likely to be heterogeneous, being composed of both cellular and non-cellular elements in varying proportions and in addition having varying degrees of central necrosis which would effect the concentration values.

A chemical similarity has been previously demonstrated, the first indication being reported by Cori and Cori in 1925 (4) when they found that the lactic acid and sugar content of a sarcoma was very nearly the same as that of a carcinoma. Greenstein (6) has cited many instances where the nearly uniform metabolic pattern of neoplasms, of different etiology and histogenesis, have been reported. The similarity of the B vitamin content of neoplasms has been reported previously and our data, both quantitatively and with regard to uniformity in tumor tissue, are in general agreement with those found by Pollack, Taylor and Williams (11).

In several reports in the literature regarding the vitamin content of neoplasms the comparison between normal and neoplastic tissue has been made on a percentage basis. A determination of this sort can be misleading as the foregoing results show no relationship between the neoplasms and their tissues of origin. For example, if the vitamin B₆ content of bowel carcinoma were compared with that of normal bowel mucosa, it would be regarded as 102 per cent of normal, whereas if the value for liver carcinoma were compared with that of normal liver, it would be 11 per cent of normal. These are extreme examples but indicate the wide difference and the lack of quantitative relationship between normal and tumor tissues.
SUMMARY

The vitamin B₆ content of 40 human malignant tumors and 20 samples of human normal tissue was determined, as well as the biotin content of 22 malignant tumors and 9 samples of human normal tissue. The vitamin B₆ content of all malignant tumors, irrespective of origin, fell within a narrow range of 0.33 to 1.35 mcgm./gm. This range was similar to that of those normal tissues having a low vitamin B₆ content. The various normal tissues studied had a wide range of values, from 0.26 to 8.90 mcgm./gm. The biotin content of all malignant tumors fell within the range of 0.02 to 0.16 mcgm./gm., while the normal tissues had a range of 0.03 to 0.66 mcgm./gm. The vitamin content of the neoplasms did not seem to bear any relation to the vitamin content of the surrounding normal tissue.

REFERENCES

Vitamin B₆ and Biotin in Human Cancer Tissue

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