A Critical Review of Periodic Health Screening Using Specific Screening Criteria

Part 2: Selected Endocrine, Metabolic, and Gastrointestinal Diseases

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Despite the increasing interest in recent years in prevention and early recognition of asymptomatic disease, there has been a lag in development of a sound scientific basis for efforts in this area. No objectively based program for periodic health screening of asymptomatic adults has yet been proposed for the primary care physician. This is the second in a series of four articles which will critically examine the feasibility of screening procedures for 36 selected diseases. Six basic criteria are adopted as necessary to justify periodic screening. Specific screening recommendations are made for each disease, and a longitudinal screening program for asymptomatic adults will be proposed in the concluding article of this series.

It is important for family physicians to think in terms of selective screening and longitudinal risk factor analysis. This requires extensive knowledge of a large number of diseases. This information is widely scattered in numerous publications, is often controversial, and a substantial amount is unknown.

This is the second in a series of four articles which are intended to assemble and condense as much of this information as possible, and to use it to construct a longitudinal screening program or "life flow sheet" for *asymptomatic adult patients* in our own model family practice unit. Several other life flow sheets have already been published,[1] but none have included the data and rationale behind each recommendation. This series specifically includes a discussion of the rationale for each recommended screening test. Furthermore, it provides an extensive bibliography so that the reader may critically re-evaluate each area and reach his own conclusions.

Methods

The following criteria are generally deemed necessary to justify screening for a given disease:
1. The disease must have a significant effect on quality or quantity of life.
2. Acceptable methods of treatment must be available.
3. The disease must have an asymptomatic period during which detection and treatment significantly reduce morbidity and/or mortality.
4. Treatment in the asymptomatic phase must yield a therapeutic result superior to that obtained by delaying treatment until symptoms appear.
5. Tests must be available at reasonable cost to detect the condition in the asymptomatic period.
6. The incidence of the condition must be sufficient to justify the cost of screening.

Using the "Geller Tables,"[2] American Cancer Society statistics[3] and other sources, we tabulated a list of 36 diseases which were then evaluated according to the above criteria. We arbitrarily considered only diseases affecting adults. The following facts about each disease were specifically sought:
1. Incidence and prevalence of the disease, age and sex specific, if possible.
2. Progression of the disease both with and without treatment, to include morbidity, mortality, and the length of the early asymptomatic period.
3. Risk factors associated with development of the disease.
4. Availability of screening tests, their safety, sensitivity and specificity in the early stages of the disease and their unit cost.

A brief discussion of each disease was then formulated and conclusions were made regarding the suitability and type of screening to be done. This article will deal with nine major endocrine, metabolic, and gastrointestinal diseases. The prevalence of these diseases is shown in Table 1. In the last article of this series, a longitudinal screening program will be proposed based upon the six basic criteria which we have adopted to justify screening in asymptomatic adults.

Diabetes
Occurrence:

For purposes of this paper on routine screening of adults, we need only consider maturity-onset diabetes. Juvenile diabetes is a disease of acute onset primarily occurring in persons under age 25 and is therefore not relevant to this study. Diabetes has an overall prevalence of 1,270 per 100,000 which increases with age from 650 per 100,000 for persons 25 to 44, to 2,700 per 100,000 for persons 45 to 64 years old. Incidence data, or the number of new cases each year, is less

Table 1. Selected Endocrine, Metabolic, and Gastrointestinal Diseases

Disease	Occurrence per 100,000	
Obesity	25,000	(P)
Cholelithiasis	11,000	(P)
Hyperlipidemia	5,300	(P)
Diabetes	1,270	(P)
Carcinoma of colon and rectum	45	(I)
*Cirrhosis of liver	14	(DR)
Carcinoma of pancreas	9	(I)
Carcinoma of stomach	8.5	(I)
Carcinoma of mouth and pharynx	6	(I)

I = Incidence   P = Prevalence
DR = Death Rate

*The relative prevalence of this disease is probably understated in this table due to difficulties in determining true prevalence rates.

readily available but an incidence of 100 per 100,000 has been estimated.[4]

Progression:

Eighty-six percent of adult diabetics experience an insidious onset of their disease over a period of years. Chemical diabetes, defined as an abnormal glucose tolerance test in an asymptomatic person with a normal fasting blood sugar, may last only weeks to months or may persist for many years before the disease becomes overt. Symptoms may often be insidious: fatigue, weight loss, urinary frequency, or thirst not noticed by the patient. Often the presenting complaint is a vascular, infectious, ocular, or neurologic complication of the disease. The major risk factors in diabetes are heredity and obesity. Eighty percent of new adult onset diabetics are overweight.[4]

Benefit from Treatment:

The metabolic complications of acidosis and hypoglycemic shock can usually be well controlled if good medical care and patient motivation are present. There is considerable doubt and controversy about whether or not the vascular, ocular, neural, and renal complications are arrested or altered by good medical management.[4-6] Studies have shown vascular abnormalities in pre-diabetics before glucose intolerance could be demonstrated.[5] Other studies indicate an osmotic cause for

some ocular and neural complications which should, therefore, improve with good control.[6] At present, the final answer to the crucial question of the relationship between control and complications is not available.

Diagnosis:

Good diagnostic methods are readily available for the detection of diabetes. Chemical diabetes is defined by an abnormal glucose tolerance test. One or two-hour postprandial blood sugars are less specific but still highly accurate methods of detecting chemical diabetes. Overt diabetics will have abnormal glucose tolerance tests and, in most cases, abnormal urine sugars and fasting blood sugars. The cost to our patients of a blood sugar is $3, as is a urinalysis. Thus, if one wishes to screen for chemical diabetes, a one or two-hour postprandial blood sugar can be used. A fasting blood sugar or urine sugar is probably an adequate screen for overt diabetes. Of these tests, the urine sugar is the least sensitive.

Conclusion:

Most people would agree that diabetes has a high enough incidence to warrant screening (criterion 6), that it has significant morbidity and mortality (criterion 1), that adequate means of diagnosis are available, and that it has a significant presymptomatic stage (criterion 5). The crucial, unresolved question regarding screening for asymptomatic diabetes is "What is the benefit from early detection?" (criteria 3,4)

We do not recommend screening asymptomatic adults for diabetes because there is little evidence that treatment in the asymptomatic phase yields better results, in terms of long-term morbidity, than withholding treatment until symptoms appear. (Fails criterion 4) If there were substantial evidence that the incidence and severity of vascular complications can be reduced by early, vigorous treatment of chemical diabetes, this recommendation would be different.

Furthermore, the mainstay of treatment for chemical diabetes is weight reduction, which is not applicable to the hypothetical "asymptomatic" person of normal weight. Screening for diabetes may be indicated as part of the workup and treatment of obesity.

Cirrhosis
Occurrence:

There is very little data on the incidence of early fatty liver changes or asymptomatic cirrhosis. The reported death rate from cirrhosis is 13.9 per 100,000 but autopsy studies have found histologic cirrhosis in one to six percent of the population.[7] It is a disease of middle-aged and older people. Thirty-two percent of those dying from primary cirrhosis are over 70. The ratio of males to females is 1.2 to 1.0.[8]

The single greatest risk factor for cirrhosis is alcohol! Sixty[8] to 90[9] percent of cirrhotics are alcoholics. Carbon tetrachloride exposure is a much less significant risk factor.

Progression and Benefit from Treatment:

There is no hard data on the duration of the asymptomatic period between the onset of cirrhosis and development of severe symptoms, but it is felt to be a question of years, or even decades. In one study of patients without ascites, jaundice, or esophageal varices, the overall five-year survival was about 75 percent. It was 88.9 percent in those who stopped drinking and 68.2 percent in those who continued to drink.[9] This difference between drinkers and those who stopped was not statistically significant. The overall survival for all stages of cirrhosis was 63 percent for those who stopped drinking and 40 percent for those who continued to drink.[9] After the onset of ascites the five-year survival is reduced to 30 percent.[7]

There is no specific treatment for cirrhosis other than cessation of alcohol consumption. Treatment during the later stages is geared towards dealing with complications of the disease.

Diagnosis:

Liver biopsy is the definitive diagnostic test for cirrhosis but is too complex to be used as an initial screen. Liver function tests such as the serum glutamic-oxaloacetic transaminase (SGOT), serum glutamic-pyruvic transaminase (SGPT), and alkaline phosphatase are sensitive general indicators of liver malfunction. They are not, however, specific for cirrhosis. The Bromsulphalein excretion test is perhaps

more sensitive than the liver enzymes as an indicator of liver disease, but not enough to compensate for the increased inconvenience and expense of the test.

Conclusions:

Cirrhosis has a high incidence and long asymptomatic course. Good, though not specific, screening tests are available in the SGOT and SGPT. However, the only treatment is cessation of alcohol consumption. We feel no benefit is achieved by the early diagnosis of this condition for which there is no specific treatment. Therefore, screening for cirrhosis in asymptomatic adults is not justified. (Fails criteria 2,4) Alcoholics, however, should have periodic liver function tests as another tool in the effort to help them arrest their drinking.

Hyperlipidemia
Occurrence:

Any definition of the prevalence of hyperlipidemia depends on the arbitrary definition of normal values. Stamler[10] points out that the mean cholesterol levels in the United States are higher than in many other parts of the world. A "normal" cholesterol in the United States might be abnormal elsewhere. A serum cholesterol greater than 275 mg/100 ml and a fasting serum triglyceride greater than 200 mg/100 ml are common definitions of abnormal values in the United States. Using these definitions of abnormal, hypercholesterolemia is seen in 5.3 percent of the adult population.[11] It is equally common in men and women. The prevalence rises with age, reaching 15 percent of women in their sixties and 8.3 percent of men. Hypertriglyceridemia is more common; it is found in ten percent of the adult population. It is twice as frequent in men (15 percent) as in women (6.4 percent). Hypertriglyceridemia in men rises from a prevalence of 5.9 percent in their twenties to 22 percent in their fifties, before declining to 5.9 percent in their seventies. In women there is a steady rise in prevalence from 3.9 percent in their thirties to 22 percent in their seventies.[11]

Most hyperlipidemia is acquired and nonfamilial. The genetically determined types are much less common

and are not significant in terms of mass population screening.

Progression and Benefit from Treatment:

The severe or familial hyperlipidemias are associated with a variety of clinical findings including xanthomas, vascular disease, abdominal pain, pancreatitis and lipemia retinalis.[12] The much more common, mild, acquired hyperlipidemias are asymptomatic. They are important because of their association with premature atherosclerosis and coronary heart disease.

Many studies have shown a definite association between increased cholesterol levels and an increase in coronary heart disease.[10] This association has been demonstrated epidemiologically,[13] by coronary angiography,[14,15] and by autopsy studies.[10] Dietary and drug therapy will lower cholesterol levels, and several early studies have shown that this lowering of serum cholesterol reduces the risk of subsequent coronary heart disease.[16-18] In contrast, Little[19] found no relation between post infarction survival and serum lipid levels.

The relation between elevated triglycerides and coronary heart disease is more controversial than that of cholesterol. There is no question that people with elevated triglycerides have an increased risk of heart disease. The problem is that these people also usually have elevated serum cholesterols, and it is difficult to separate the two and show an independent risk from hypertriglyceridemia. Kannel[13] could show triglycerides to be an independent risk factor only in older women. Brown[20] also concluded the value of the triglyceride level was limited in predicting ischemic heart disease. In patients referred for coronary angiography, triglyceride level was a poorer prediction of the chance of heart disease than either the patient's age or cholesterol. However, at high levels (540 mg/100 ml) it had a 79 percent correlation with coronary atherosclerosis. Elevated triglyceride levels can be lowered by weight reduction and low carbohydrate diet.[21]

Diagnosis:

Determination of serum cholesterol and triglycerides is done by laboratory

analysis of venous blood. Subjects should fast for at least 14 hours prior to triglyceride determinations.

Conclusion:

Hypercholesterolemia is asymptomatic and has significant morbidity. Early studies indicate that treatment will reduce morbidity and mortality. We, therefore, recommend screening all adults with a serum cholesterol determination every four years. This time interval is somewhat arbitrary, but it reflects evidence that the morbidity from elevated cholesterol levels stems from long-term acceleration of atherosclerosis rather than an acute toxic effect.

There is little objective evidence that elevated triglycerides are an independent risk factor in coronary heart disease or that routine screening for triglycerides leads to any added benefit over screening for cholesterol. We, therefore, recommend no screening for triglycerides in spite of a strong subliminal urge to do so. (Fails criteria 1,3,4)

Obesity
Occurrence:

Obesity, defined as weighing at least 20 percent more than ideal body weight, affects 20 percent of American males and 30 percent of females. In males it rises from a prevalence of ten percent between ages 18 and 24, to 27.8 percent from age 45 to 55, before dropping to 19 percent from ages 65 to 75. Women have a higher prevalence starting at 13.1 percent of those between ages 18 and 24 and rising to 47.7 percent from ages 65 to 74.[22] The most important risk factor for obesity is a family history of it.

Progression and Benefit from Treatment:

Obesity is characterized by a gradual onset and progression to an individually specific level where the person's weight stabilizes. For mild obesity, less than 20 percent above ideal weight, it is difficult to demonstrate an increased morbidity or mortality. Weighing more than 20 to 30 percent above ideal weight increases the risk of death from all causes by 50 percent, from cardiovascular and renal disease by 50 percent, from diabetes by 283 percent, from liver cirrhosis by 150 percent,

and from gallbladder and biliary tract disease by 52 percent.[23] (It should be stated that these figures are from actuarial data and do not prove a cause and effect relationship).

The treatment of obesity depends on patient motivation, and overall success rates are poor.[24,25] Actuarial evidence does indicate that patients who are motivated and do achieve sustained weight loss will decrease their risk of death from the previously listed conditions.[23]

Diagnosis:

The diagnosis of obesity presents no problem. The patient is weighed and his weight is compared to a table of ideal weights for a given height and body frame.

Conclusion:

Obesity is a common condition with a gradual onset, which subjects the patient to significant morbidity. Its detection is simple and treatment, if the patient is motivated, will decrease morbidity and mortality. We recommend that all adults have height and weight measured every four years for comparison with a table of ideal weights.

Cholelithiasis

Occurrence:

Approximately 11 percent of American adults have gallstones. The prevalence for white females ages 20 to 30 is 4.2 percent. It rises steadily to 34.9 percent in women over age 80. For white males ages 20 to 30 the prevalence is 0.9 percent and rises to 21.4 percent over age 80.[26] American Indians have more gallstones than whites who, in turn, have a higher prevalence than Negroes.

Most gallstones are mixed cholesterol stones. About ten percent are composed of bile pigments. General risk factors include obesity and lipid abnormalities. Hemolytic anemias contribute to formation of some bile pigment stones.[27]

Progression and Benefit from Treatment:

Asymptomatic gallstones are common. Autopsy studies show that 60 to 80 percent of gallstones are unsuspected.[28] In a series of male executives screened by oral cholecystogram, 70 percent of those with gallstones were asymptomatic.[29] Thirty to 50 percent of patients with gallstones will develop symptoms, and 15 to 20 percent of these will develop severe complications.[30] Wenkert followed 781 patients with unoperated cholelithiasis (not necessarily asymptomatic) and found 49 percent remained asymptomatic or had mild symptoms, 33 percent had severe symptoms, 22 percent finally had surgery, and 18 percent developed complications, including acute cholecystitis, obstruction, icterus, pancreatitis and cancer.[31]

The mortality from gallbladder disease in one series of unoperated patients, most of whom were symptomatic, ranged from one percent in persons ages 45 to 55, to seven percent in those over age 65. The overall mortality was 2.7 percent.[32]

Surgery is the definitive treatment for cholelithiasis. The surgical mortality in young, low-risk groups is 0.3 percent.[28] Increasing age, presence of common duct stones, or acute or chronic cholecystitis can increase the mortality to four percent in higher-risk patients over age 60.[33]

Diagnosis:

The oral cholecystogram is the usual method of diagnosing gallstones. In those patients with a nonvisualizing gallbladder the rate of false positives is 2.2 percent. When the gallbladder does visualize there are about two percent false positive exams and 1.7 percent false negatives.[34]

Conclusion:

Screening asymptomatic people for gallstones is only indicated if one believes that asymptomatic gallstones should be surgically removed. This controversial question is discussed by Peskin.[28] Our opinion is that asymptomatic gallstones should not be removed, and we do not recommend screening for cholelithiasis. If safe medical therapy for gallstones becomes a reality, the situation will be changed considerably.[27] (Fails criterion 4)

Carcinoma of the Mouth and Pharynx

Occurrence:

Cancer of the mouth and pharynx includes several different tumors with different rates of progression and varying prognosis. The overall incidence for this group of tumors is 5.0 to 7.5 per 100,000. Carcinoma of the tongue has an incidence of 1.5 per 100,000, carcinoma of the lip one per 100,000, and carcinoma of pharynx about 2.5 per 100,000.[3] These tumors occur in people over 40, with a peak incidence in the sixth and seventh decades. They are more frequent in men and in smokers. The incidence of lip cancer is increased by habitual exposure to sunlight.[35]

Progression and Benefit from Treatment:

Cancer of the lower lip is a slow growing tumor which usually presents as a blister that lasts for months or years. It has a 95 percent cure rate with either surgery or radiotherapy. The progression is slower, and the prognosis considerably better, than for cancer of the upper lip.[35]

By contrast, carcinoma of the anterior tongue is a rapidly progressive disease with a five-year survival of 30 percent. Forty percent of cases have metastases when first seen.[35] Other tumors have varying rates of progression and prognosis.

Diagnosis:

There are no specific screening tests for cancer of the mouth and pharynx other than examination, palpation, and biopsy of suspicious lesions. Painting the area with toluidine blue to observe differential staining is a helpful aid but is not an independent diagnostic test. No studies of periodic screening for these tumors have been reported.

Conclusions:

Cancer of the lower lip is slowly progressive and has a high cure rate even when not specifically screened for. There seems little likelihood that periodic screening would increase the already 95 percent survival. Cancer of the tongue and other pharyngeal areas is more virulent and rapidly progressive. Screening by periodic examination would have to be very frequent and thorough to detect early lesions. No study has shown that such screening will increase the survival of persons with such lesions. Although the total region accounts for five percent of all

cancer,[3] the incidence of each individual tumor is probably too low in itself to justify screening. Finally, it should be mentioned that the area is amenable to self-examination. Patients can be taught to report any minor sores, irritations, or lumps that do not disappear in a short time.

We recommend that persons over 40 be educated to report any lip sores, mouth irritations, or lumps which do not resolve within three weeks to one month. We do not feel any specific screening by physician examination is justified. (Fails criteria 5,6)

Cancer of the Stomach

Occurrence:

The incidence of stomach cancer in the United States has decreased markedly during the past several decades to the present rate of 8.5 per 100,000 population. This is in sharp contrast to the situation in other countries, such as Japan, where it accounts for 54 percent of all cancer in males.[36] The disease is slightly more common in men, is rare before age 30, and becomes more common with increasing age. Eighty percent of cases are in persons over 50.[37] Risk factors include family history,[36] pernicious anemia, and atrophic gastritis.[38]

Progression and Benefit from Treatment:

Carcinoma of the stomach is a rapidly progressive disease once symptoms appear. The length of the asymptomatic period is not known but is presumed to be relatively short, perhaps months or at most one to two years. The overall five-year survival rate is 5.1 to 17.7 percent. Twenty-five to 46 percent of patients with gastric cancer are considered candidates for "curative resection" at the time of diagnosis. In this group, the five-year survival ranges from 21 percent to 46 percent.[36,39] In one series, patients requiring only a partial gastrectomy as the "curative procedure" had a 60 percent five-year survival.[39] The median survival for those who do not live five years is six months.

Diagnosis:

The possible methods of presymptomatic detection of gastric cancer include radiologic examination via bari-

um meal, gastroscopy, and exfoliative cytology, either singly or in combination.

X-ray examination after a barium meal is the most frequently used diagnostic test. It is reported to be 74 to 90 percent accurate in persons with symptoms.[36,37]

In Japan, mass population screening has been done using x-rays and, occasionally, endoscopy.[38] It is reported that a single physician can do 50 examinations in a morning. About 20 percent of patients are recalled for subsequent thorough examinations after suspicious lesions were noted on the initial screen. No mass screening program has been reported in this country. A major drawback to x-ray screening is the $40 cost for an upper GI series.

Gastroscopy is usually used as a confirmatory test for suspected malignancy. In one study,[40] it correctly diagnosed 15 of 19 suspected cancers, an accuracy similar to x-ray and cytology. Gastroscopy is expensive and requires a skilled operator. In addition, it is doubtful whether asymptomatic patients would submit to the discomfort of repeated examinations.

Exfoliative cytology is most simply done by gastric washing with saline or Ringer's lactate.[41] Wide variations in accuracy of the technique are reported. Taebel reports a series of 2,304 examinations with 12.8 percent false negatives in 282 patients with proven cancer and less than one percent false positives in those with benign disease.[41] By contrast, Crumb reports a smaller series in which cytology was positive in only one third of patients with proven malignancy.[36] Several authors[41,42] insist that cytology is only accurate if done by experienced, skilled personnel.

Conclusions:

Gastric cancer is a rapidly fatal disease the prognosis of which is improved somewhat by early surgical treatment. Because of its rapid progression, any screening technique would have to be done frequently, probably at least yearly. The diagnostic methods presently available are all expensive, complex and involve some patient discomfort. We agree with Prolla[38] that, considering the low incidence of the disease in this country,

periodic mass screening is not indicated. (Fails criterion 5)

Carcinoma of the Pancreas

Occurrence:

The incidence of pancreatic carcinoma is increasing. It is more common in blacks than whites and in males than females. White males have an incidence of 11.9 per 100,000 while the incidence is 7.3 per 100,000 in females.[43] The disease has been reported at all ages but is most common in the middle and later years. The incidence rises with age.

Progression and Benefit from Treatment:

Cancer of the pancreas is a lethal disease with or without treatment. The one-year survival is ten percent and the five-year survival is two percent.[43]

Diagnosis:

The diagnosis of pancreatic cancer by noninvasive means is difficult at any stage of the disease. Diagnostic procedures used include: the upper GI series, hypotonic duodenography, isotope scanning, and angiography.[44] All of these are expensive, complex procedures unsuitable for screening. Furthermore, there is no evidence that they can consistently detect early disease.[45]

Conclusion:

No screening is recommended for pancreatic carcinoma because no suitable screening test is available and treatment is ineffective. (Fails criteria 2–5)

Carcinoma of the Colon and Rectum

Occurrence:

Carcinoma of the colon and rectum has an overall incidence of 45 per 100,000 and a death rate of 21 per 100,000.[46] The disease occurs in all ages, with equal frequency in both sexes. Ninety-five percent of cases, however, occur in persons 45 or older and 75 percent occur in those over 55.[47] The median age at diagnosis is 60 to 67 years old.[47,48] Risk factors associated with an increased susceptibility to colon and rectal cancer include ulcerative colitis, familial polyposis, villous adenomas, and increasing age to the

sixth decade.

Adenomatous polyps have, in the past, been felt to be associated with an increased risk of colorectal cancer and the question is still controversial. There is a much higher incidence of them than of carcinoma, and they occur in five to ten percent of persons over age 40 undergoing proctosigmoidoscopy. In one series of patients undergoing repeated protosigmoidoscopies, at least one polyp was found in 28 percent of persons studied.[50] Autopsy studies have shown polyps in 38.8 percent of persons over age 30.[49] Castleman,[51] in a study of the malignant potential of polyps, concludes "The overwhelming majority of cancers of the colon arise as cancer de novo or in villous adenomas not in adenomatous polyps. The adenomatous polyp is a lesion of negligible malignant potential."[51]

Progression and Benefit from Treatment:

Seventy percent of colorectal cancers occur in the distal 25 cm of bowel.[52] Initial symptoms depend to some extent on the anatomic location of the lesion. Eighty-one percent of persons with cancer of the rectum will complain of bloody stools while only 22 percent of cases of cancer of the cecum will have this symptom.[53]

The presymptomatic duration of the tumor is not known. As with many other tumors, there is a significant lag of six to seven months between the onset of symptoms and institution of definitive treatment.[53] Even with this considerable delay in reporting symptoms, 42 percent of tumors are localized when diagnosed.[46]

The five-year survival with surgical treatment for localized disease is 50 to 66 percent.[46,47,54] This survival decreases to 30 to 35 percent for disease with regional spread and to five percent if distant metastases have occurred.[47] A five-year survival of 88 percent is reported in 50 patients who were asymptomatic at the time of diagnosis.[55] Clearly the prognosis is improved if the disease is detected and treated early.

Diagnosis:

Methods of diagnosing colorectal cancer which must be considered as possible screening studies include: the barium enema, digital rectal exam, proctosigmoidoscopy, and testing stools for occult blood. Other tests, such as the serum carcinoembryonic antigen titer,[56] colonic exfoliative cytology,[57] and silicone foam enema,[58] are either unsuitable for screening or have not been widely used.

The barium enema is the standard method of diagnosing colon cancers above the peritoneal reflection. Excluding the rectum, barium enemas are 90 percent accurate in diagnosing colon carcinoma.[59] However, it is a poor method of detecting the 40 percent of cancers occurring in the rectum. It costs $40 and at least 15 minutes of trained professional time. Furthermore, if periodically repeated, the one to two rads per test amount to a significant radiation exposure.

Digital rectal exam has long been recommended as a primary diagnostic test for rectal cancer. Close examination of the data, however, reveals that its sensitivity has been overrated. No more than 13 percent of carcinomas of the colon and rectum can be felt on digital exam.[52] In one series of 58 carcinomas only 9.5 percent were palpable on rectal exam at the time of diagnosis.[55] But, digital exam is easy to do and has few complications.

Proctosigmoidoscopy is an important technique in the diagnosis of colorectal cancer. Seventy percent of carcinomas can be seen on sigmoidoscopic exam. Because of this impressive figure, many have recommended its use as a routine periodic screening procedure. Studies of periodic proctosigmoidoscopy have consistently found a high incidence of adenomatous polyps.[49] The yield of carcinomas has been much smaller. Hertz found 44 cancers on 47,000 examinations,[55] Greegor found one carcinoma on 2,500 examinations,[60] and Gilbertsen found 19 carcinomas on 12,000 initial examinations.[50] Of interest is the fact that there is a much higher rate of carcinoma detection on initial exam than on repeat, periodic proctosigmoidoscopy. Hertz found 70 percent of his cancers on the initial examination and only 30 percent on subsequent proctosigmoidoscopies.[55] Gilbertsen did 41,000 repeat examinations and found nine carcinomas at a rate of one per 4,400 examinations. This is much less than the one cancer per 630 initial examinations.[53]

Gilbertsen attributes the lower incidence of carcinoma on repeat exam at least in part to the removal of many adenomatous polyps. From the proceeding discussion of polyps, this conclusion seems open to question.

Proctosigmoidoscopy costs about $20 and may cause some patient discomfort. The incidence of bowel perforations is about one per 1,000 examinations.[61] Using Gilbertsen's data, if a family physician were to do repeat yearly proctosigmoidoscopies on 1,000 patients (three per day), he would detect one cancer and perforate four bowels in four years at a cost of $80,000.

Testing stools for occult blood has been recently proposed as a screen for colorectal cancer by Greegor.[60,62,63] The procedure involves having patients collect six stool occult blood slides from three consecutive bowel movements while on a no meat, high residue diet. The special diet is necessary to reduce the number of false positive reactions. Greegor reports detecting nine carcinomas in 900 persons tested over 3½ years by this method. All but one were in early stages. In another uncontrolled report, only one false negative slide was found.[62] These studies have all been reported from one source and the number of patients is small. However, the method is cheap, causes no discomfort, and should detect cancer from a wider anatomic area than sigmoidoscopy alone.

Conclusion:

Colorectal carcinoma has a high incidence and mortality. It has a significant asymptomatic period of unknown duration. The prognosis is much better if the disease is detected and treated early.

The problem with regard to screening is finding an adequate diagnostic test. The barium enema is too expensive and is a poor detector of rectal lesions. The rectal exam only detects ten to 15 percent of all tumors. Proctosigmoidoscopy is expensive and uncomfortable; its yield decreases markedly with repeated examination. Testing stools for occult blood is a method which has good potential but has been used on relatively small numbers of patients. All of the methods have advantages and disadvantages.

We recommend that all patients over 40 have stools tested for blood by

Greegor's method every two years until age 50 and every year thereafter. We do not recommend routine, repeat proctosigmoidoscopies because of the low yield, expense, time, and possible discomfort involved. We do feel that a single proctosigmoidoscopy on all patients at age 55 would have a higher yield and is justified.

Discussion

We have attempted to strictly require that all criteria were fulfilled before recommending any particular screening test. Failing a single criterion was enough to disqualify a test or disease from screening. This is perhaps more rigid than many of us are in practice but was necessary to avoid the pitfall of being carried away by intuition, special interest group propaganda, "common practice," and personal emotional bias. Therefore, many commonly used reasons for doing screening tests such as, "The test has a high yield," "It is so easy to do," or "It's good to have a baseline value," were not sufficient.

It should also be emphasized that we are considering screening only the hypothetical *completely asymptomatic person*. This does not imply that the screening test is a sufficient workup for the disease being screened once detected or that incidental symptoms should not be evaluated.

We feel that health screening programs must be objectively based. In an area as controversial as health screening, many people will undoubtedly disagree with some of our conclusions. This is good if it leads to further discussion of the issues and objectively based arguments and experimentation. We have purposely included a large bibliography referencing as much of the data on which our conclusions are based as possible so the reader can explore any area in greater depth.

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