The child's weight was 12 kg. The fall in body temperature was 1.6° C., from 103.4° F. (39.7° C.) to 100.6° F. (38.1° C.). Assuming the specific heat of body tissues to be 1, then in this cooling the body would give up 20 large calories. The difference, 12 large calories, probably represents much of the endogenous heat produced and removed during the period of cooling.

Summary

A method of raising and lowering the body temperature in animals and man by the introduction of changes of water into an intragastric bag is described. It has possible applications in the treatment of excessively high and low body temperatures and also in the management of hypothermia in operative surgery.

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REFERENCES

- Barcroft, J., and King, W. O. R. (1909-10). *J. Physiol., Lond.*, 39, 374.
Khalil, H. H. (1954). *British Medical Journal*, 2, 732.

JUSTIFICATION FOR APPENDICECTOMY IN CHRONIC APPENDICITIS

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The very existence of chronic appendicitis is often a subject of controversy, yet appendicectomy for this condition is one of the most commonly performed surgical operations. Is there any justification for removing the appendix of a young man or woman complaining of pain in the right iliac fossa? An investigation of a large series of cases was undertaken in an attempt to elucidate whether operation had been justified by results.

When appendicectomy is performed in patients suffering from recurrent attacks of pain in the right iliac fossa there is usually very little correlation between clinical, operative, and pathological findings. The removal of an apparently normal appendix may relieve the patient of all symptoms, yet little or no relief may be obtained from the excision of a fibrosed and adherent organ.

The difficulty of assessing the significance of pathological changes in the appendix is well illustrated by the findings of Shelley (1937). He found that 63% of the appendixes removed incidentally in the course of other operations showed inflammatory changes, and that 72% of the appendixes removed for chronic appendicitis showed similar changes, the other 28% being normal microscopically. Further, in an inquiry into the clinical aspects of the condition, he found (1938) that of those patients whose appendixes showed microscopical evidence of disease, 89% could be regarded as cured, but where the appendix was microscopically normal the cure rate was as high as 80%. It would therefore seem that an appendix showing pathological changes is only slightly more likely to be a cause of symptoms than an apparently normal one. It seems equally clear that the presence of inflammatory changes is no guarantee that the symptoms are due to these. Accordingly,

fibrosis and adhesions may be more indicative of previous appendicitis than of present symptoms.

The part played by faecaliths in acute appendicitis seems fairly well established (Shattock, 1916), but their importance in chronic appendicitis is less certain. That their presence may be responsible for attacks of appendicular colic is generally accepted, but the frequency of such occurrence is in doubt, as is the significance of faecaliths found at operation. The belief that they do have some importance is supported by Shelley's (1937) findings that where faecaliths formed the only pathological finding the cure rate of appendicectomy was 85%, compared with 74% for appendixes showing no apparent abnormality.

Chronic appendicitis has long been incriminated as a cause of pylorospasm and dyspepsia, and there is no doubt that many cases of dyspepsia are clinically improved by appendicectomy. Whether this is a case of cause and effect or merely the result of the rest enforced by convalescence from the operation is a matter for discussion. That the early benefit conferred on many cases of undiagnosed dyspepsia is considerable and misleading is well exemplified by an article on five such cases written by Moynihan in 1910. The correspondence evoked by this article is illuminating, and a possible result was to induce a spate of appendicectomies in the treatment of dyspepsia which may not have completely subsided yet. Confusion regarding the interrelation of stomach, duodenum, and appendix is also shown in an article by Braithwaite (1942), in which he states that duodenal ulcer is often mimicked by chronic appendicitis and that haematemesis occurs in about 4% of cases of the latter disease. Such a misconception possibly arises from overreliance on the accuracy of radiological diagnosis, which, although reliable in the demonstration of chronic peptic ulcers, is fallible in the elucidation of recurrent minor ulceration.

Radiological examination of cases of chronic appendicitis is not helpful, and generally no specific evidence of disease is procurable. It may, on occasion, enable one to relate tenderness accurately to the appendix, but the main value of barium examinations lies in the exclusion of other pathological conditions of the gastro-intestinal tract.

Present Investigation

In view of certain doubts about the existence and importance of chronic appendicitis, the present investigation was undertaken. All patients operated on for chronic appendicitis in one unit of the Glasgow Royal Infirmary from 1946 to 1950 inclusive were contacted so far as was possible and interviewed. The years 1945 and earlier have not been included, as during the war these cases were dealt with mainly by the hospitals of the Emergency Medical Service, and the years subsequent to 1950 have been excluded to allow an adequate interval between operation and interview. In all, 429 females and 134 males were available for study and 316 females and 97 males were traced, a follow-up of 73.3%. Of those traced, the majority (65%) were personally interviewed and examined by us, and the remainder replied to a questionnaire.

A certain degree of selection of the cases submitted to operation is bound to have occurred, since these cases were admitted via the out-patient department, but the selection was not unduly rigorous and patients complaining of persistent and recurring pain were usually admitted for operation. The basis of this inquiry, therefore, lies in the assumption that those in whom the diagnosis had been correct would, after operation, remain free from pain; and, conversely, if a similar pain persisted after appendicectomy the diagnosis had been wrong. In many of the latter group

the correct diagnosis had been elucidated by subsequent events or investigations, but where this was not evident a full investigation was undertaken by us before the final classification was made. In many of the cases reviewed slight residual pain remained in the right iliac fossa, but this was regarded lightly by the patients concerned, possibly because, as they stated, it was a considerable improvement on their previous state or because their fear of a severe attack of appendicitis had been removed. Such cases were classed among the "cured" and accounted for 15% of the total cures.

Sex and Age Incidence

In this series females outnumber males in the proportion of 3.2:1, this ratio being higher than that found by other observers—for example, Willauer and O'Neill (1943), 1.6:1; Shelley (1937), 2:1; and Paulson (1950), 2:1. The cure rate for females was found to be 83.5% and for males 74.2%.

If the belief is correct that subsequent freedom from pain is evidence of cure, there would, on the above figures, seem to be a much higher and unexplained incidence of chronic appendicitis in females. On the other hand, if the attempt is made to explain the higher incidence of right-sided pain in females as being due to functional or organic disorders of the pelvic organs, it might be expected that a reasonably high proportion would show evidence of gynaecological complaints at a later date. Rather to our surprise we found that in only 4 of the 316 females traced did the pain appear to have been produced by gynaecological conditions.

As might be expected, the condition occurs mainly in young people, the average age being 24 years in women and 25 years in men. The age distribution (see Chart) is similar in both sexes, the maximal incidence lying between 15 and 30 years of age.

Chart showing age incidence in chronic appendicitis.

Pain in Chronic Appendicitis

Pain was found to be the presenting symptom in every case; it had been present on an average for eighteen months in females and for sixteen months in males. These figures are somewhat elevated by the inclusion of some patients who had had symptoms for many years. In 12.7% of the females and 22.7% of the males symptoms had been present for less than three months.

In the majority (Table I) the pain occurred in the right iliac fossa and was typically recurrent in type, the patient having several episodes of pain at irregular intervals. Rarely could these attacks be identified in retrospect as attacks of subacute appendicitis. The next most common site was the central abdomen, where pain occurred either alone or combined with pain in the right iliac fossa. In the case notes pain was sometimes noted to have occurred in other sites—namely, right hypochondrium, epigastrium, right lumbar region, and right groin—this group of patients accounting for 9.5% of the women and 19.6% of the men.

TABLE I.—Pain in Chronic Appendicitis

Site of Pain	No. of Patients	
	Females	Males
Right iliac fossa	240 (75.9%)	61 (62.9%)
Central abdomen and right iliac fossa ..	46 (14.6%)	17 (17.5%)
Other sites	30 (9.5%)	19 (19.6%)
Total	316	97

When the patients were divided into three groups according to the site of occurrence of pain, and these groups were related to the number of patients cured of pain by operation, the figures shown in Table II were obtained. The occur-

TABLE II.—Cure Rate in Relation to Site of Pain

Site of Pain	Percentage Cure Rate	
	Females	Males
Right iliac fossa	86	77
Central abdomen and right iliac fossa ..	85	82
Other sites	60	58

Percentages are taken to nearest whole number.

rence of pain in the right iliac fossa or central abdomen was associated with a high percentage of cures. On the other hand, pain experienced elsewhere was associated with a lower cure rate, this being 60% for females and 58% for males. Accordingly, it would appear that pain in the right iliac fossa or central abdomen is a more reliable guide to diagnosis than pain elsewhere. Furthermore, it would seem inadvisable to accept a diagnosis of chronic appendicitis when the pain is atypical before a full investigation has been carried out.

Ultimate Diagnosis

An analysis was made of the actual or probable diagnosis reached in the 52 (16.5%) females and 25 (25.8%) males who continued to complain of pain after operation and were not classed as cured by appendicectomy (Table III).

TABLE III.—Ultimate Diagnosis in 413 Cases of Chronic Appendicitis

	No. of Patients	
	Females	Males
Cured	224 } 83.5%	62 } 74.2%
Cured with minimal residual pain ..	40 } 12.7%	10 } 10.3%
Duodenal ulcer	10 (3.2%)	1
Cholecystitis	6	1
Gynaecological lesions	4	—
Renal lesions	2	2
Mesenteric adenitis	1	—
Ulcerative colitis	1	—
Carcinoma	1 (rectum)	1 (caecum)
Spinal tuberculosis	—	1
Tuberculous enteritis	1	—
Sarcoma of ilium	—	1
Constipation	—	1
Neurosis	8	2
No diagnosis reached	18	6
Total	316	97

The commonest source of error lay in the misinterpretation of symptoms not characteristic of duodenal ulcer, but which, in retrospect, appear undoubtedly to have been due to this cause. This fallacy was greater in males, of whom 10.3% were thought to have been suffering from duodenal ulceration and not appendicitis at the time of operation. This figure is exclusive of those who were known to be suffering from ulcer at the time of operation and of those whose subsequent affliction by ulcer was thought to bear no relation to their appendicitis. This experience emphasizes the need for care in the interpretation of recurring attacks of abdominal pain, a feature of both duodenal ulcer and chronic appendicitis. This fallacy is more likely to occur in the older patient (Table IV), but it can also be a source of error in younger ones, as shown by the presence of duodenal ulcer in two boys aged 12 and 14 years at the time of appendicectomy.

TABLE IV.—*Diagnosis in Relation to Age*

Final Diagnosis	Females		Males	
	Under 30 Years	Over 30 Years	Under 30 Years	Over 30 Years
Cured ..	193 (86.6%)	71 (76.3%)	52 (83.8%)	20 (57.1%)
Duodenal ulcer ..	5 (2.2%)	5 (5.4%)	4 (6.5%)	6 (17.1%)
Other diagnoses ..	25 (11.2%)	17 (18.3%)	6 (9.7%)	9 (25.8%)
Total ..	223	93	62	35

Great care in the taking and interpreting of the case history is necessary and sometimes vital, as can be seen by the varied assortment of final diagnoses which resulted. The danger is that a more serious condition might be missed rather than that an unnecessary appendicectomy might be performed. In the cases of sarcoma of the right ilium and carcinoma of the caecum and rectum which occurred, the correct diagnosis was not made until three to six months after appendicectomy, and vital time was lost before appropriate treatment was carried out.

On the whole, Table III follows the expected lines, though fewer cases of cholecystitis and of gynaecological lesions occurred than might have been expected.

In a small number of cases—namely, 26 females and 8 males—no definite organic lesion could be found to account for the persistent pain. A psychiatrist's assessment of the personalities of this group might differ radically from our own, but we were able to classify only eight females and two males as frankly neurotic, this being considered to be the cause of their complaints. In the remaining 18 females and 6 males no explanation of the cause of the pain is offered.

Mortality and Morbidity of the Operation

No patient in this series died after operation for chronic appendicitis; this accords with general experience, though Shelley (1937) noted four deaths in 881 cases. There is, however, a definite morbidity attributable to the operation as shown by the post-operative complications listed in Table V. Several of these—thrombosis, pulmonary collapse,

TABLE V.—*Morbidity of Operation*

Post-operative Complication	No. of Patients	
	Females	Males
Pulmonary ..	14	5
Haematoma ..	4	4
Wound sepsis ..	9	4
Phlebo-thrombosis ..	1	1
Tonsillitis ..	2	—
Enteritis ..	2	—
Pelvic abscess ..	1	—
Major rectal haemorrhage ..	—	1
Incisional hernia ..	1	—
Pericaecal haemorrhage; paralytic ileus; faecal fistula ..	—	1
Total ..	34	16
Percentage morbidity ..	10.8	16.5

and wound sepsis—are possible hazards of any surgical operation, but others such as pelvic abscess, major rectal bleeding, and faecal fistula were more surprising. The occurrence in one unfortunate patient of pericaecal haemorrhage followed in turn by paralytic ileus, faecal fistula, and incisional hernia indicates that convalescence from the operation is not always uneventful.

With regard to any late morbidity of the operation, it was found that three women who had had no further abdominal pain complained rather bitterly of disabling headaches dating from, and presumably attributable to, the use of spinal anaesthetics. They thought the exchange had not been a fair one. Four other women complained of dysmenorrhoea which dated from the time of appendicectomy.

The Incision.—The incision most commonly employed in this series was the muscle-splitting or grid-iron approach;

this was used in 90% of the cases. As might be expected, the cure rate when a paramedian incision was employed (60%) was lower than that when a grid-iron incision was used (83%), which merely reflects the pre-operative diagnostic doubt in the former cases.

The removal of the appendix in chronic appendicitis is probably best performed through a grid-iron incision, which gives minimal disturbance to the patient and a short convalescence. Such an approach, which permits of only a limited abdominal exploration, is justified by the high cure rates recorded here, and by Shelley (1937), 87% in 704 cases, and by Davis (1927), 76% in 420 cases. In some cases, especially in older patients, an abdominal exploration through a paramedian incision would appear to be preferable. Although in the majority no gross abnormality would be revealed, the occasional demonstration of more serious lesions would justify the routine use of a paramedian incision in patients over 40 years of age.

Conclusion

As Shelley (1939) was forced to conclude that chronic appendicitis is a clinical entity, we suggest that the findings of this investigation provide ample justification for appendicectomy in patients who have recurrent attacks of pain in the right iliac fossa or central abdomen. Good results are to be anticipated in the great majority of cases.

The operation, however, is never an urgent one, and undue haste can be productive of serious errors. Time should be spent in assessing the patient's disability, and all appropriate investigations must be carried out.

Examination by barium meal would seem to be desirable in men over 30 years of age. Its routine use over the past few months in such cases has already yielded positive results for duodenal ulcer in patients with very atypical pain.

Summary

The results of a follow-up of 413 cases of appendicectomy for chronic appendicitis are presented.

Females preponderated in a proportion of 3.2:1 and most patients were aged between 15 and 30.

The overall cure rate was 83.5% for females and 74.2% for males.

Duodenal ulcer proved to be an important fallacy in the diagnosis of chronic appendicitis.

We wish to thank Mr. John Dunbar for the facilities granted us to pursue this investigation and for his encouragement throughout.

REFERENCES

- Braithwaite, L. R. (1942). *Brit. J. Surg.*, 30, 15.
 Davis, W. T. (1927). *Bull. Taylor Hosp., Scranton*, 1, 1.
 Moynihan, B. G. A. (1910). *British Medical Journal*, 1, 241.
 Paulson, E. C. (1950). *Minn. Med.*, 33, 46.
 Shattock, S. G. (1916). *Proc. roy. Soc. Med.*, 13 (Path. Sec.), 105.
 Shelley, H. J. (1937). *Arch. Surg., Chicago*, 35, 621.
 — (1938). *Ibid.*, 37, 17.
 Willauer, G. J., and O'Neill, J. F. (1943). *Amer. J. med. Sci.*, 205, 334.

A manual for the guidance of laboratory workers concerned with rabies has just been published by W.H.O. (Monograph Series, No. 23; 150 pp., 51 illustrations; price £1). Fourteen rabies specialists from various parts of the world have contributed papers on five aspects of rabies research technique: laboratory diagnosis, methods of vaccine production, vaccine-potency tests, the production of hyperimmune serum, and the care and breeding of experimental animals. The monograph is not an exhaustive treatise: its aim is to present selected procedures which would be dependable and practicable. It is abundantly illustrated, and a list of general reference sources complements the specific references given in each of the 19 sections. Although the present speed of development in rabies research indicates that modification of some of the techniques described will eventually be necessary, it is thought that they will prove a useful guide for several years to come.