

REVIEWS

Chronic ischaemic bowel diseases in the aged—go with the flow

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Abstract

Background: intestinal ischaemia is caused by a reduction in intestinal blood flow. This entity is being increasingly recognised as a cause of abdominal symptoms but is often not diagnosed accurately. Chronic mesenteric ischaemia (intestinal angina) refers to chronic post-prandial abdominal pain caused by intestinal hypoperfusion usually related to atherosclerosis. Colonic ischaemia refers to colonic injury as a result of hypoperfusion and is also referred to as ischaemic colitis.

Methods: review of the English-language medical literature, with the key words diagnosis, treatment, chronic mesenteric ischaemia and colonic ischaemia.

Conclusion: there is a lack of evidence based on randomised controlled clinical trials for both the diagnosis and treatment of mesenteric ischaemia. A high index of clinical suspicion is important to facilitate rapid diagnosis. Chronic mesenteric ischaemia can be accurately diagnosed by non-invasive CT and MRI techniques, and less so by duplex ultrasound. In order to confirm the diagnosis, demonstration of the involvement of at least two of the main splanchnic vessels is required. Successful treatment involving both percutaneous and surgical revascularisation is available. Colonic ischaemia requires sequential diagnostic techniques and the majority of cases resolve with supportive treatment. More severe cases may require surgical intervention.

Keywords: *mesenteric ischaemia, intestinal angina, ischaemic colitis, elderly*

Introduction

Intestinal (mesenteric) ischaemia is caused by a reduction in intestinal blood flow due to hypoperfusion, occlusion, or vasospasm of the mesenteric vasculature. The intestines have a rich collateral circulation [1] but any area of the colon may be involved by mesenteric ischaemia.

Mesenteric ischaemia can be classified into three types, based on the rapidity and extent of the disruption of the blood supply: acute mesenteric ischaemia, chronic mesenteric ischaemia and colonic ischaemia.

Acute mesenteric ischaemia refers to the sudden onset of intestinal hypoperfusion, usually presents with severe acute abdominal pain, does not usually present a diagnostic problem and will not be discussed here.

Chronic mesenteric ischaemia (intestinal angina) refers to episodic or constant intestinal hypoperfusion, resulting from a blood supply insufficient to satisfy the metabolic demands of post-prandial bowel activity.

Colonic ischaemia (ischaemic colitis) refers to colonic injury resulting from hypoperfusion. Consequent to inadequate tissue blood flow, the metabolic demands of the intestine outstrip oxygen delivery, producing a colonic injury. The

purpose of this review is to describe the clinical picture and to assess the sensitivity and specificity of the diagnostic techniques as well as the results of the available treatments for chronic mesenteric ischaemia and colonic ischaemia.

Search strategy and selection criteria

A Medline search using the key words mesenteric ischaemia, ischaemic colitis, splanchnic ischaemia, diagnosis, guidelines and treatment limited to the English language and from 1974 onwards was performed. Studies that included less than 10 patients were excluded. Since there were no randomised controlled trials of treatment, no meta-analysis of the data was performed.

Chronic mesenteric ischaemia

Clinical signs and symptoms

A review of 332 cases reported in the literature to 1997 [2] showed that 94% presented with abdominal pain, which was post-prandial in 88%. Most patients (78%) lost weight, while nausea or vomiting was present in 33%, diarrhoea was noted in 36% and constipation in 18%. The typical history

is of a crampy pain in the upper abdomen that appears 10–15 minutes after eating. The pain steadily increases, plateaus and resolves during the next 1–2 hours. Patients become afraid to eat (sitophobia). Gastric involvement may present as multiple, small intractable ulcers and gastroparesis [3]. Patients are usually in their 5th or 6th decade [2] and there is a female predominance of 3:1 [4]. Associated medical conditions include smoking (75%), peripheral vascular disease (55%), previous vascular surgery (52%), coronary artery disease (43%), hypertension (37%), chronic renal failure (20%) and diabetes (10%) [2]. The examination of the abdomen is non-specific in most cases, although an epigastric bruit was present in 63% overall [2]. Steatorrhoea and decreased D-xylose absorption, linked to non-specific abnormalities in small bowel biopsy samples, have been described [5].

Diagnosis

A high degree of clinical suspicion is required for the clinical triad of post-prandial upper abdominal pain, weight loss and an epigastric bruit. However, these findings together are often absent. Most diagnostic tests available demonstrate the anatomy of the blood vessels but not the functional significance of any stenosis. A definitive diagnosis requires symptom relief following a revascularisation procedure.

Angiography

Biplanar selective angiography of the mesenteric arteries is considered to be the gold standard for diagnosing vascular disease. Since angiography is a projection technique, surrounding structures are only indirectly visualised. Intestinal angiography that demonstrates stenosis or occlusion of at least two of the major vessels is required in order to establish the diagnosis of arterial insufficiency. In one review, 91% of patients with chronic mesenteric ischaemia had occlusion of two vessels and 55% had involvement of all three vessels [6]. However, occlusions of all three vessels have also been found in the absence of symptoms.

A typical angiogram is shown in Appendix 1 in the supplementary data on the journal website (<http://www.ageing.oupjournals.org>).

Duplex ultrasound

Although employed for more than 20 years for assessing the splanchnic vascular tree, the role of duplex ultrasound is not fully defined. There are a total of nine studies comparing splanchnic duplex ultrasound with multi-plane angiography which have been reviewed recently [7]. Only two were in a prospective blind setting and two others included solely patients suspected of having chronic splanchnic ischaemia. A haemodynamically significant stenosis in the coeliac axis (CA) is suggested if the peak systolic velocity (PSV) is greater than 200 cm/s and end-diastolic velocity is greater than 55 cm/s. For the superior mesenteric artery (SMA), PSV should be greater than 275–300 cm/s and end-diastolic velocity greater than 45 cm/s. Ultrasound has a sensitivity of 92–100% and a specificity of 92% [8]. The findings on ultrasound have been examined in a validation study comparing 46 scans with angiography in patients suspected of having chronic mesenteric ischaemia [9]. The sensitivity, specificity, positive and negative predictive value and overall

accuracy were all over 90%. There is, however, a poor correlation between anatomical details and abdominal symptoms. For example, significant disease in the coeliac and superior mesenteric arteries was noted in 18% of asymptomatic patients over the age of 65 [10].

Abdominal CT and CT angiography

CT has two main advantages for examining patients with suspected ischaemia. Firstly, it can help detect ischaemic changes in the affected small bowel loops and mesentery. Secondly, it permits an evaluation of the mesenteric vasculature for atherosclerosis, thrombus occlusion, or tumour invasion. CT was not accurate for detecting mesenteric ischaemia with the use of first and second generation scanners [11, 12]. The use of spiral CT with narrow collimation and faster scanning coupled with bolus timing with intravenous contrast improved the ability to demonstrate the mesenteric vessels but this was still not sensitive enough for the early detection of reversible small bowel ischaemia [13]. In a study of acute mesenteric ischaemia, CT sensitivity and specificity were only 64 and 92%, respectively [13].

Multi-detector row CT is a new advance in CT technology and is becoming widely available. It combines multiple rows of detectors and a faster gantry rotation with narrow collimation. This allows creation of 3D volume sets and reformatting, termed CT angiography [14]. This technique increased the sensitivity and specificity for acute mesenteric ischaemia to 96 and 94%, respectively [15]. There are no randomised controlled trials comparing multi-detector CT with conventional angiography for the diagnosis of chronic mesenteric ischaemia.

Magnetic resonance angiography

Gadolinium-enhanced MR angiography of the splanchnic circulation is well established for evaluation of the aorta, renal arteries and peripheral vasculature [16] and is also employed for the diagnosis of chronic mesenteric ischaemia. There is no need for arterial catheterisation, administration of nephrotoxic contrast material or radiation exposure. The primary disadvantage of gadolinium-enhanced MR angiography is a lower image resolution. A recent study of 26 patients who underwent conventional angiography in addition to MRA [17] and had the images reviewed by two observers blinded to the other results showed a high degree of accuracy in detecting proximal stenosis with good interobserver agreement for CA and SMA proximal stenosis. The interobserver agreements for inferior mesenteric artery (IMA) stenosis were, however, much less.

Thus, both CT angiography (CTA) and MR angiography (MRA) techniques can demonstrate visceral artery disease with sufficient anatomical detail for diagnosis. Consequently, invasive procedures can be limited to patients requiring therapeutic intervention. Specifically, both helical multi-detector row CT (MDCT) and fast MRI acquisitions produce large volume slabs with a single breathhold. Multiplanar and curved planar reconstructions of these images and image rotation in multiple planes can permit pre-intervention selection of appropriate catheters, angioplasty balloons, and vascular stents (Gambrelli WD Clinical Applications

Specialist, Voxar Inc., Florida, USA, personal communication) (Figure 1). CTA has the advantage of shorter acquisition times over MRA and is in addition considerably cheaper and more widely available.

Physiological testing

Angiography demonstrates the morphological appearance of the mesenteric vessels but does not provide information on any physiological consequences. MRI can provide functional information on splanchnic blood flow. Flow velocities and total flow volumes in both the SMA and the superior mesenteric vein (SMV) have been measured with MRI. In a study of 32 patients without chronic mesenteric ischaemia and eight patients with chronic mesenteric ischaemia, the T2 relaxation time of the SMV was shown to increase significantly post-prandially in the control patients and to decrease significantly post-prandially in the patients with chronic mesenteric ischaemia [18].

Insufficient perfusion of the intestine results in anaerobic metabolism generating an increase in the gastrointestinal luminal to blood pCO_2 gradient above the normal range. A tonometer is a device that measures the pCO_2 of the stomach, small intestine or sigmoid colon directly and has potential as a diagnostic test in patients with chronic mesenteric ischaemia [19].

Treatment

There are no randomised controlled trials of treatments for chronic mesenteric ischaemia. The data in the literature are of case series from different centres, with different criteria for patient selection and based on individual experience and preference.

The treatment of choice has been surgical revascularisation. This is indicated if other gastrointestinal causes of abdominal pain have been excluded and there is angiographic evidence of occlusion of at least two of the three splanchnic vessels. For a summary of surgical results of revascularisation, see Appendix 2 in the supplementary data on the journal website (<http://www.ageing.oupjournals.org>). The results depend on the type of operation performed, the number of splanchnic vessels revascularised, and any concomitant vascular operations performed. The surgical techniques employed include antegrade and retrograde bypass grafting, aortic reimplantation of the SMA, and transarterial and transaortic mesenteric endarterectomy. There are a total of 790 patients with a perioperative mortality of 0–16%, success rates of between 59 and 100%, and a recurrence rate of 0–40%. The results in the more modern series have been on the whole better with success rates >90% and recurrence rates of <10%. The results in terms of vessel patency have been satisfactory but there are few

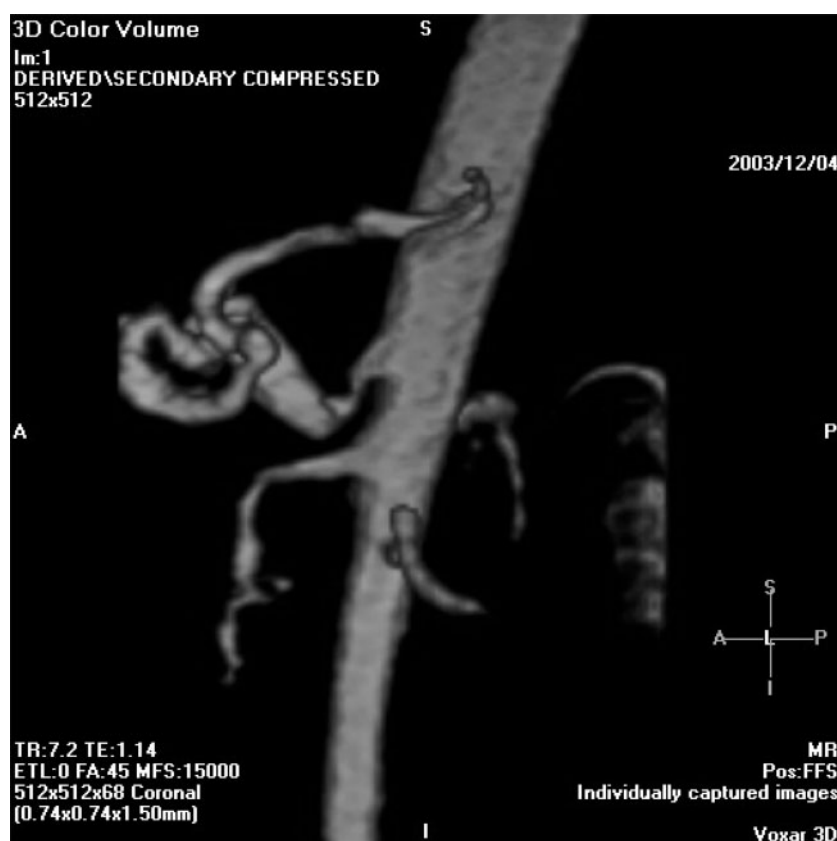


Figure 1. Selected sagittal projection from 360° rotational MRA images of the abdominal aorta and its branches. Patient with clinical symptoms of intestinal angina showing severe stenosis of the proximal coeliac artery (CA), segmental stenosis of the superior mesenteric artery (SMA) and occlusion of the inferior mesenteric artery (IMA).

reports of vessel patency objectively determined by angiography and/or duplex ultrasonography and calculated by the life table method. McMillan *et al.* [20] reported patency rates between 89 and 93% at 3 years and 89% at 6 years. Kihara *et al.* [21] reported a 73% patency rate at 2 years, better results in females and also with prosthetic bypass grafts compared with autologous material.

There is also a problem with recurrent splanchnic ischaemia following a failed revascularisation procedure. Schneider *et al.* [22] reported their results from an experienced centre. From 1959–1997 they treated 109 patients with primary visceral revascularisation; 17.4% had recurrent visceral ischaemia. There were 30 reoperations (22 first, 5 second and 3 third) in 24 patients. Postoperative mortality was 6.7% and the complication rate was 33%.

More recently, percutaneous transluminal mesenteric angioplasty (PTMA) has been employed with increasing success. The initial success rates are similar to surgical revascularisation, 63–100% with a low incidence of mortality (Appendix 3 on the journal website: <http://www.ageing.oupjournals.org>). However, there is a high rate of recurrence of symptoms, ranging from 12.5 to 67%.

Drawing from the large pool of experience with stenting in coronary angioplasty, it may be possible to decrease the rate of clinical recurrence by the use of stents at the time of PTMA. A recent publication in 33 patients, with the use of stents in 12 and angioplasty alone in 21, has reported long-term clinical success of 96.6% and a 30 day mortality of 0% [23]. In addition, four of five patients with recurrent symptoms were successfully retreated with endovascular therapy. An additional report of 16 patients, of whom six were treated with stents, had a clinical recurrence in two (12.5%) patients and these were both patients without stents who were then treated by stent insertion [24]. Poorer results have been reported from a single centre comparing angioplasty in 28 patients (82% stents) [61] with 85 patients previously reported with open surgery [51]. There was a similar 3 year recurrent stenosis and mortality rate but a higher incidence of recurrent symptoms with angioplasty.

In summary, there is a paucity of evidence-based medicine on which to base both diagnostic and treatment decisions. We use CT angiography as our initial investigation and suggest that the initial treatment be PTMA, especially for poor-risk surgical candidates. Our current approach is summarised in Figure 2.

Colonic ischaemia

Colonic ischaemia refers to a spectrum of disease ranging from reversible colopathy through transient colitis, gangrene and perforation, stricture formation and chronic colitis. Colonic ischaemia is estimated at 1 in 2000 acute hospital admissions [3], but is probably underdiagnosed [25]. The causes of colonic ischaemia are shown in Table 1. More than 90% of non-iatrogenic lesions occur in patients aged 70 or more.

There had been only a small number of reports of treatment [26–30], but recently three studies with a combined total of 242 patients have been published [31–33].

We have grouped together these studies in order to better characterise the clinical picture, the diagnostic approach employed and the treatment.

Clinical presentation

The most important risk factors were hypertension in 139 (57.4%) patients, cardiovascular disease in 124 (51.2%), renal failure or nephropathy in 73 (30.2%) and diabetes mellitus in 45 (24.7%) patients. The mean age of the patients was 68.2 years and the gender distribution was similar: 123 (50.8%) were female and 119 (49.2%) were male.

Abdominal pain appeared in 77 of 113 (68.1%) patients and melaena or rectal bleeding was found in 124 (51.2%). Patients may have systemic signs: 20 of 129 (15.5%) had a temperature greater than 38.3°C and 22 of 129 (17.1%) had a systolic blood pressure less than 90 mmHg.

The right colon was involved in 77 of 233 (33%), the transverse colon in 23 of 113 (20.4%), the splenic flexure in 33 of 129 (18.1%), the left colon in 110 of 233 (47.2%) and pancolitis in 30 of 233 (12.9%).

Diagnosis

The early diagnosis of colonic ischaemia depends on a high index of clinical suspicion and the use of repeat radiological or colonoscopic studies of the colon, which demonstrate either complete remission, segmental colitis or the presence of ulcers. Routine laboratory tests are unhelpful. For example, a leukocytosis was present in only 60 of 129 (46.5%) patients and a pH less than 7.34 in 15 of 129 (11.6%) patients [31]. A stool culture should be performed in order to check for infectious colitis including *Escherichia coli* O157:H7 [34].

Colonoscopy is the investigation of choice, enabling both direct visualisation of the mucosa and taking a biopsy [35]. Few details were available regarding the diagnostic methods employed, but endoscopy was performed in a total of 166 (68.6%) patients, with no procedure-related complications. Colonoscopy may show haemorrhagic nodules, representing submucosal bleeding, or the presence of a single linear ulcer running longitudinally (colonic single-stripe sign) mainly in the left side of the colon in mild ischaemic colitis [36]. Barium enema may show 'thumbprinting' (submucosal bleeding) and pseudotumours. Overdistension of the colon at both barium enema and colonoscopy may cause high intraluminal pressure which could exacerbate ischaemic damage [35].

Abdominal CT typically shows a non-specific thickening of the colonic wall. Sequential investigations together with clinical follow-up are necessary both to confirm the diagnosis and determine the outcome of colonic ischaemia. The submucosal haemorrhages are replaced with ulcerations over 48 hours and subsequently resolve. Alternatively, there may develop segmental universal colitis suggestive of Crohn's disease [37].

Since colonic blood flow usually returns to normal by the time of clinical presentation, mesenteric angiography is not indicated [38] and was only performed in 14 (5.8%) of the above 242 patients. In one series of 60 patients, diagnostic angiography was not performed at all [32]. We perform

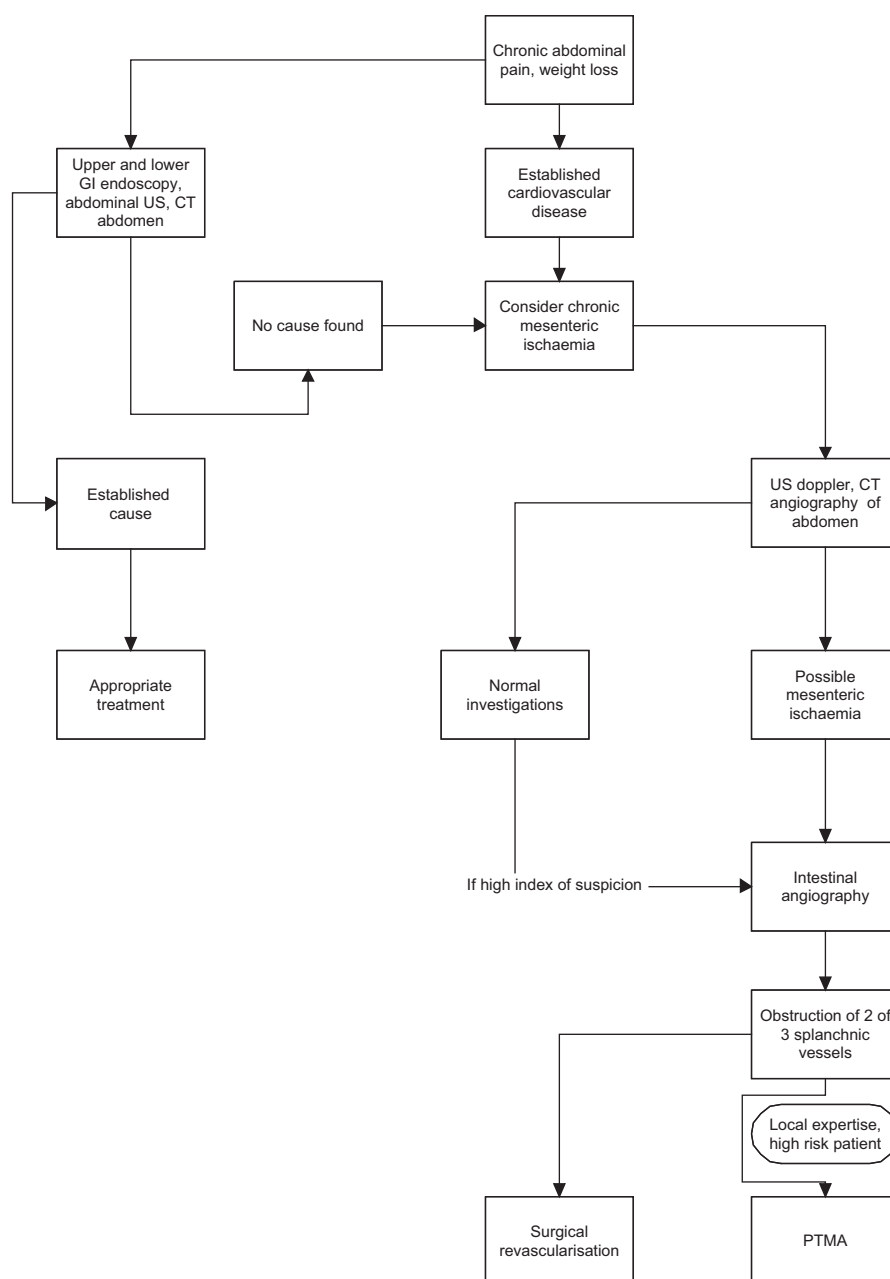


Figure 2. Algorithm of suggested diagnostic and therapeutic approach.

angiography in severe cases clinically and also in cases with right colonic involvement to rule out the diagnosis of acute mesenteric ischaemia.

Treatment

Ischaemic colitis can be divided into two main types [25]. There is a spontaneous, self-limiting form which occurs days or weeks after the initial ischaemic insult. Colitis normally resolves with conservative therapy, although there may be a stricture during recovery. Some patients develop a fulminant form of the disease with transmural gangrenous necrosis of the colon, which is fatal if not treated early. Management of ischaemic colitis depends on the severity of the illness. Surgical intervention is indicated if there is peritonitis,

or transmural infarction, failure to respond to medical management, chronic symptomatic colitis or strictures. Until recently, few studies have been conducted analysing the factors associated with poor prognosis, but a review of the data of 242 patients treated in the last decade allows some conclusions to be made. The studies were retrospective and from three different centres. One group of patients was treated medically with bowel rest, intravenous fluids and antibiotics, whereas the more severely ill patients were treated surgically, within 12 hours in the group of 129 patients [31] and within 24 hours in the other group of 113 patients [32, 33].

Of the 242 patients, 144 (59.5%) were treated conservatively and 98 (40.5%) operatively. Of the 144 treated conservatively, 112 (77.8%) survived, 9 (6.3%) died and

Table 1. Aetiology of colonic ischaemia

Thrombosis
Embolus
Cholesterol embolus
Aortic or cardiac bypass surgery
Small vessel disease—diabetes mellitus, amyloidosis, radiation injury, systemic vasculitis (SLE, periarthritis nodosa)
Infections (CMV, <i>E. coli</i> O157:h57)
Coagulopathies (protein C and S deficiency, anti-thrombin III deficiency, APC resistance)
Oral contraceptives
Cocaine use
Obstructing lesions of colon—diverticulitis, carcinoma
Major cardiovascular episode resulting in hypotension
Colonoscopy or barium enema
Intestinal adhesions

23 (16%) required surgery. Of these latter 23, 20 survived and three died.

98 patients were treated operatively, 61 (62.2%) survived and 37 (37.8%) died. The total mortality was 49 (20.2%) of the 242 patients ($P < 0.005$ survival in conservative versus surgical groups).

Thus, the majority of patients with ischaemic colitis do survive with conservative therapy but there is a sub-group who require surgery and have a much worse prognosis. We pooled the results of these three series together in an attempt to identify factors predictive of severity (Table 2). Patients with severe ischaemic colitis had significantly more right colonic involvement, but had less left colonic and splenic flexure involvement. The extent of colonic lesions is not in itself associated with a poor outcome. In addition there was less hypertension, diabetes mellitus and rectal bleeding in the patients with severe colitis compared with the patients with moderate colitis. There is no role for corticosteroids in ischaemic colitis [38], which may increase the ischaemic damage and predispose to colonic perforation [39].

Table 2. Comparison of patients with moderate and severe colonic ischaemia

	Severe	Moderate
Location		
Right colon	53/75	22/75 $P < 0.001$
Splenic flexure	4/33	29/33 $P < 0.001$
Left colon	7/33	26/33 $P < 0.001$
Pancolitis	19/41	13/41 $P = 0.09$
Risk factor		
Cardiovascular disease	39/90	51/90 $P = 0.5$
Diabetes mellitus	17/45	28/45 $P < 0.01$
Hypertension	41/103	62/103 $P < 0.001$
Renal disease	47/85	38/85 $P < 0.001$
Symptom		
Melaena/rectal bleeding	28/95	67/95 $P < 0.0001$

242 patients with ischaemic colitis reported in English-language publications since 2000 [31–33].

The patients were divided into severely ill and moderately ill categories by clinical assessment. Comparison between the groups was by Student's *t*-test. $P < 0.05$ was regarded as significant.

In summary, ischaemic colitis is a disease prevalent in the aged, especially with underlying co-morbid conditions. A high index of suspicion is the key to an early diagnosis and colonoscopy should be performed to assess such patients. In over half the patients the disease is reversible, non-transmural and can be treated conservatively. Urgent surgical intervention is required to decrease the high mortality associated with transmural disease.

Key points

- Atherosclerosis can affect the mesenteric vasculature.
- There are two main chronic presentations: chronic mesenteric ischaemia (intestinal angina) and ischaemic colitis.
- Chronic mesenteric ischaemia presents as post-prandial abdominal pain and can be diagnosed non-invasively by CT angiography.
- Ischaemic colitis is spontaneously reversible in many cases.
- Treatment of these conditions is by revascularisation, which may be via surgery or angioplasty.

Please note that due to the long list of references only a few are listed here (those cited in bold). The full list can be found on our website. Please see Appendix 4 in the supplementary data on the journal website (<http://www.ageing.oupjournals.org>).

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Received 1 April 2004; accepted 30 July 2004

Age and Ageing 2005; **34**: 16–20
doi:10.1093/ageing/afh228

Age and Ageing Vol. 34 No. 1 © British Geriatrics Society 2004; all rights reserved
Published electronically 20 October 2004

Capacity and coercion: dilemmas in the discharge of older people with dementia from general hospital settings

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Abstract

Discharge planning of older people with dementia can present difficult ethical dilemmas to the general hospital clinician. These difficulties may be particularly pronounced for those who are moderately severely affected and for whom hazards are anticipated on discharge home. In many cases the wishes of the individual to return home may differ markedly from those of