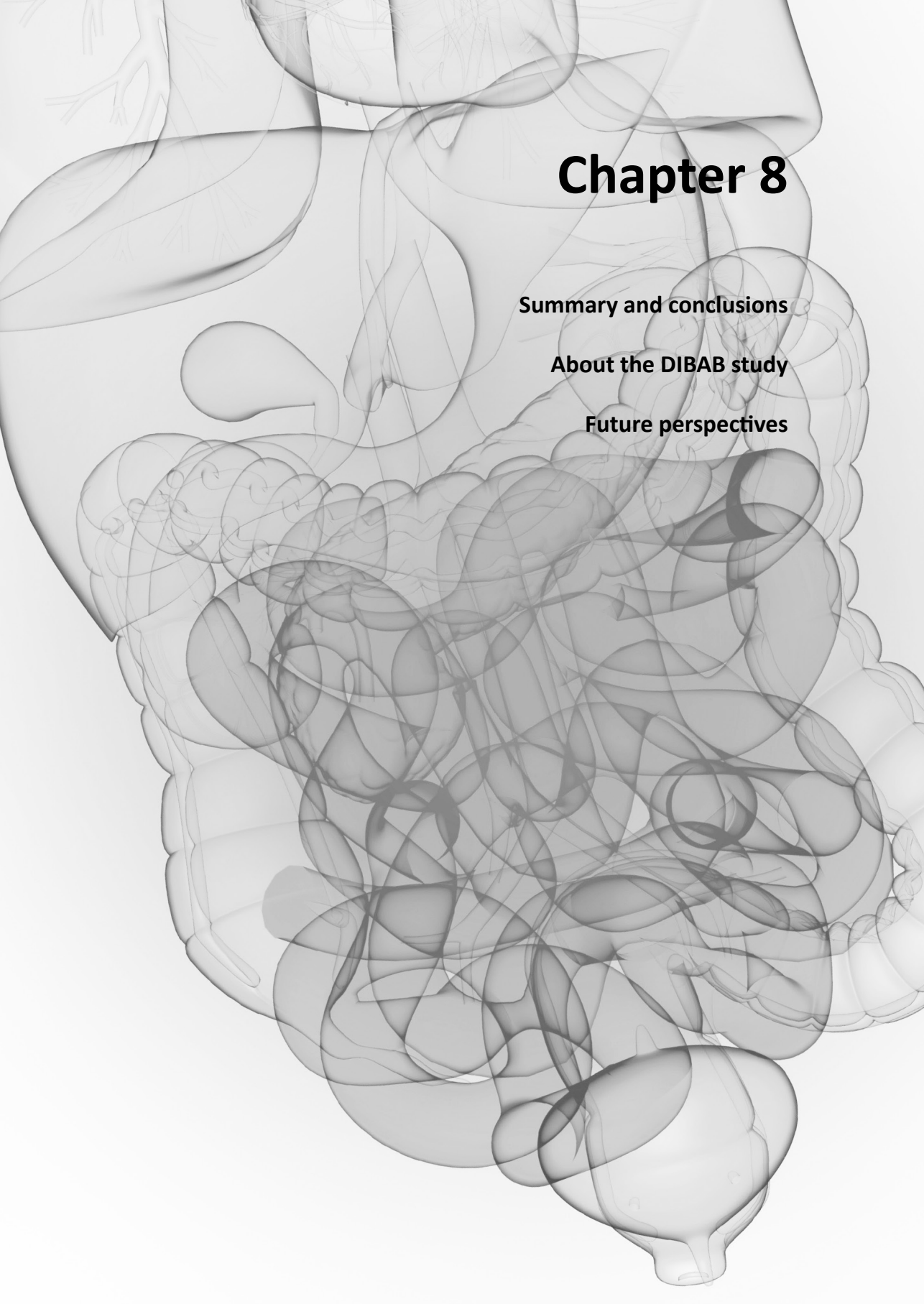
# Acute abdominal pain : considerations on diagnosis and management

Toorenvliet, B.R.



# Chapter 8

**Summary and conclusions**

**About the DIBAB study**

**Future perspectives**

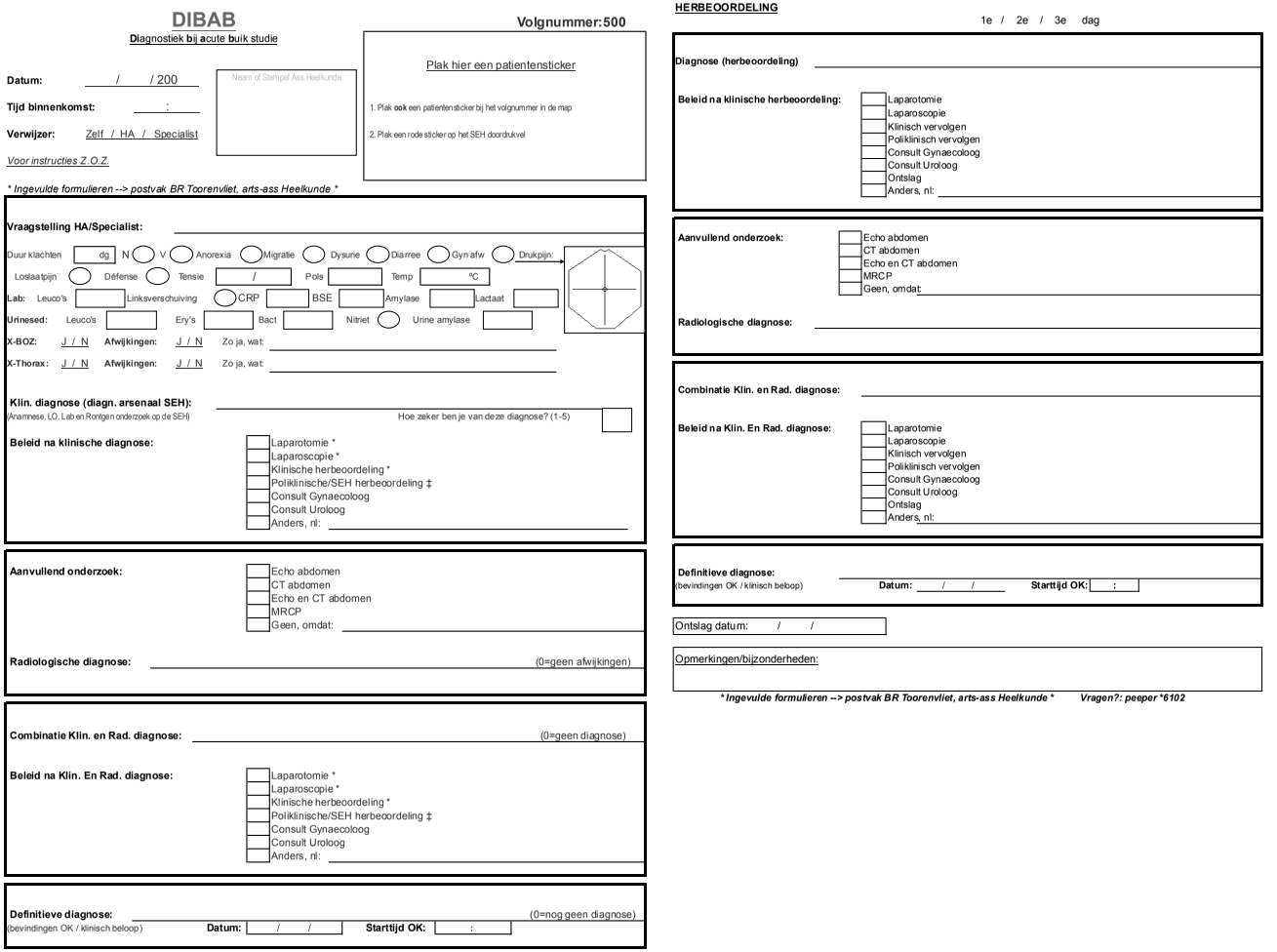
## Summary and conclusions

Most patients presenting at the emergency department for acute abdominal pain do not require an admission to the hospital for medical treatment. For example, in the hospital where the studies of this thesis were conducted, 41% of patients were admitted to the hospital and 21% had emergency surgery.

Patients with acute abdominal pain that do need surgery or an admission to the hospital should be diagnosed swiftly and accurately so that they receive the correct medical treatment as soon as possible. The diversity of pathology and symptoms however, can make an accurate diagnosis a challenging task. Some patients will present at the emergency department with symptoms that are easily recognized; a 'classic presentation'. Most patients however, present with equivocal symptoms, and these patients are the most difficult to diagnose accurately. The majority of patients with equivocal abdominal complaints will have non-surgical or self-limiting pathology, but not always. Some patients with equivocal symptoms may present during the early stages of acute surgical pathology and will require prompt surgical management. An accurate diagnosis is important to determine the correct management of the patient. False positive diagnoses for perceived surgical emergencies will lead to unnecessary surgical explorations, whereas false negative diagnoses for surgical emergencies may result in treatment delay. Both these diagnostic shortcomings may thus result in unnecessary morbidity and should be avoided. Solid clinical evaluation by patient history, physical examination and standard laboratory testing is the cornerstone of any emergency department evaluation for acute abdominal pain. Because clinical evaluation will not provide an accurate diagnosis for all patients[1,2], many additional diagnostic modalities have been proposed in the literature. Clinical scoring systems, computer based analysis, radiological imaging (CT, ultrasound, MRI) and diagnostic laparoscopy have all been recommended to improve the diagnostic accuracy. In **chapter 1** the pro's and con's of some complementary diagnostic modalities to the 'basic' clinical evaluation are discussed.

The data presented in chapters 2-6 was collected during the DIBAB study ('Diagnostiek bij Acute Buik'). This prospective cohort analysis was conducted at the Red Cross Hospital in the Hague (currently the HAGA hospital) from June 2005 to July 2006. During study design several measures were taken to ensure that an accurate assessment could be made of the diagnostic performance of clinical evaluation and additional imaging and what impact they would have on patient management. Routine daily practice at the emergency department was mimicked. The strategy of the study was based on the premise that the least detrimental and non-invasive diagnostic modalities should always come first for diagnosing and managing patients with acute abdominal pain at the emergency department. All patients not admitted to the hospital received appointments for routine re-evaluation at the outpatient clinic, or the emergency department in the weekend. All patients suspected to have acute appendicitis received additional imaging. Ultrasound was the primary investigation of choice, CT was performed if the ultrasound result was equivocal. Data was collected prospectively on study forms (Figure 1), and a uniform reference standard was used for the final diagnoses (pathology or follow-up). The study forms and all the final diagnoses were doubled checked by two researchers after completion of the study.

In **chapter 2** the value of standard outpatient re-evaluation was investigated for patients that were presumed not to require a hospital admission after emergency department evaluation for acute abdominal pain.
Hospital admission for patients with equivocal abdominal complaints has been a common practise for many years. The aim of these hospital admissions was to distinguish non-surgical and self-limiting disorders from surgical pathology. The effectiveness was limited as most of these patients ultimately had non-specific abdominal pain (NSAP) for which an admission was not required[1,3,4]. Outpatient re-evaluation may also help to discriminate surgical from non-surgical pathology in this patient group by way of natural progression. Patients with abdominal pathology requiring surgery who initially present during the early stages of the disease will become more easily identifiable, whereas the symptoms will regress in those patients with self-limiting disease allowing them to be safely discharged from follow-up. Five hundred patients were included in this analysis.



**DIBAB**

Diagnostiek bij acute buik studie

Volgnummer:500

Datum: / / 200

Tijd binnenkomst: :

Verwijzer: Zelf / HA / Specialist

*Voor instructies Z.O.Z.*

Naam of Stempel Ass Heelkunde

Plak hier een patientensticker

1. Plak **ook** een patientensticker bij het volgnummer in de map

2. Plak een rode sticker op het SEH doordrukvel

** Ingevulde formulieren --> postvak BR Toorenvliet, arts-ass Heelkunde **

**Vraagstelling HA/Specialist:**

Duur klachten dg N V Anorexia Migratie Dysurie Diarree Gyn afw Drukpijn:

Loslaatpijn Défense Tensie / Pols Temp °C

**Lab:** Leuco's Linksverschuiving CRP BSE Amylase Lactaat

**Urinesed:** Leuco's Ery's Bact Nitriet Urine amylase

**X-BOZ:** J / N **Afwijkingen:** J / N Zo ja, wat:

**X-Thorax:** J / N **Afwijkingen:** J / N Zo ja, wat:

**Klin. diagnose (diagn. arsenaal SEH):**
(Anamnese, LO, Lab en Rontgen onderzoek op de SEH) Hoe zeker ben je van deze diagnose? (1-5)

**Beleid na klinische diagnose:**
- Laparotomie *
- Laparoscopie *
- Klinische herbeoordeling *
- Poliklinische/SEH herbeoordeling ‡
- Consult Gynaecoloog
- Consult Uroloog
- Anders, nl:

**Aanvullend onderzoek:**
- Echo abdomen
- CT abdomen
- Echo en CT abdomen
- MRCP
- Geen, omdat:

**Radiologische diagnose:** (0=geen afwijkingen)

**Combinatie Klin. en Rad. diagnose:** (0=geen diagnose)

**Beleid na Klin. En Rad. diagnose:**
- Laparotomie *
- Laparoscopie *
- Klinische herbeoordeling *
- Poliklinische/SEH herbeoordeling ‡
- Consult Gynaecoloog
- Consult Uroloog
- Anders, nl:

**Definitieve diagnose:** (0=nog geen diagnose)
(bevindingen OK / klinisch beloop) **Datum:** / / **Starttijd OK:** :

* Rode sticker op status (liggen bij de balie SEH), DIBAB formulier aan SEH doordrukvel nieten, op de afdeling verder invullen. (Z.O.Z.)
‡ Formulier aan SEH doordrukvel nieten. Het formulier op de poli/SEH verder invullen (Z.O.Z.)

**HERBEOORDELING**

1e / 2e / 3e dag

**Diagnose (herbeoordeling)**

**Beleid na klinische herbeoordeling:**
- Laparotomie
- Laparoscopie
- Klinisch vervolgen
- Poliklinisch vervolgen
- Consult Gynaecoloog
- Consult Uroloog
- Ontslag
- Anders, nl:

**Aanvullend onderzoek:**
- Echo abdomen
- CT abdomen
- Echo en CT abdomen
- MRCP
- Geen, omdat:

**Radiologische diagnose:**

**Combinatie Klin. en Rad. diagnose:**

**Beleid na Klin. En Rad. diagnose:**
- Laparotomie
- Laparoscopie
- Klinisch vervolgen
- Poliklinisch vervolgen
- Consult Gynaecoloog
- Consult Uroloog
- Ontslag
- Anders, nl:

**Definitieve diagnose:**
(bevindingen OK / klinisch beloop) **Datum:** / / **Starttijd OK:** :

Ontslag datum: / /

Opmerkingen/bijzonderheden:

***Ingevulde formulieren --> postvak BR Toorenvliet, arts-ass Heelkunde *** ***Vragen?: peeper *6102***

**Figure 1.** DIBAB study form

The majority had non-surgical or self-limiting pathology as a final diagnosis such as NSAP, constipation, gastroenteritis, mesenteric lymphadenitis, cystitis, and other mild disorders. After standard re-evaluation more than a quarter of the patients had a different final diagnosis than the diagnosis initially given after evaluation at the emergency department. A change in management was seen in 17% of the cases after re-evaluation, and 4% patients were admitted to hospital for surgery. Only 6 patients (1%) had diagnoses that should preferably have been made at initial evaluation. This however did not lead to increased morbidity. This study supported the hypothesis that serial outpatient re-evaluation is safe, will improve diagnostic accuracy and facilitate proper treatment selection for patients that are not admitted to the hospital after surgical consultation for acute abdominal pain at the emergency department.

For patients that are suspected to have acute appendicitis after clinical evaluation for acute abdominal pain at the emergency department the aim should be to minimize the negative appendectomy rate without delaying the treatment for patients that have perforated appendicitis. In our opinion, the use of non-invasive modalities such as clinical evaluation, ultrasound and clinical re-evaluation should be the preferred method for diagnosing acute appendicitis. CT and diagnostic laparoscopy should only be employed if these less detrimental modalities do not suffice. A diagnostic pathway using routine ultrasound, limited CT and clinical re-evaluation for the diagnosis and management of acute appendicitis was assessed in **chapter 3.** Eight hundred and two patients were included of whom 164 were clinically suspected to have appendicitis. Clinical evaluation alone had a positive predictive value of 64% for acute appendicitis. Relying on the clinical diagnosis would therefore have led to an unacceptable number of negative surgical explorations. Additional radiological imaging had excellent diagnostic accuracy for acute appendicitis. The overall sensitivity and specificity of additional radiological imaging was 93% and 99% respectively with a minimal use of CT (18%). Additional imaging provided the correct diagnosis and corresponding strategy regarding appendicitis in 98% of cases. The negative appendectomy rate was 3.3%. In comparison, an analysis in 8 Dutch hospitals in 2005 yielded a mean negative appendectomy rate of 15.9%[5]. The missed perforated appendicitis rate was 3.4%.

The results presented in this chapter support the hypothesis that additional radiological imaging should be mandatory for all patients with suspected appendicitis. Even though CT has a higher diagnostic accuracy, ultrasound should be the primary investigation of choice. Ultrasound is safe, easily accessible, and most important, does not use ionizing radiation. When the ultrasound result is equivocal a CT should be carried out.

Acute appendicitis is the most common surgical emergency for children that present at the emergency department with acute abdominal pain. Acute mesenteric lymphadenitis is a canny mimic of acute appendicitis in children and has been a common finding during radiological imaging and negative surgical explorations for suspected appendicitis. In **chapter 4** we investigated if it is possible to accurately distinguish acute appendicitis from acute mesenteric lymphadenitis in children using clinical evaluation. Two hundred and eighty-nine patients were eligible for analysis. Thirty-eight children had acute mesenteric lymphadenitis as a final diagnosis, and 69 children had acute appendicitis. This prospective analysis showed that there are many clinical parameters that differ significantly between children with acute appendicitis and acute mesenteric lymphadenitis. These differences however did not lead to an accurate clinical differentiation between the two entities. The positive predictive value for acute appendicitis and acute mesenteric lymphadenitis was 0.62 and 0.42 respectively. The Alvarado score and a logistic regression model had a positive predictive value of 0.81 and 0.79 respectively, whereas ultrasound had a positive predictive value of 0.96. On the basis of the results presented in this chapter it was concluded that clinical evaluation alone cannot accurately distinguish between acute appendicitis and acute mesenteric lymphadenitis in children. Additional radiological imaging should be performed in order to determine the appropriate management for children with suspected appendicitis. In our institution ultrasound is the primary investigation of choice in these cases, and CT was hardly ever necessary.

**Chapter 5** evaluated the additional value of secondary signs of appendicitis when performing ultrasound examinations for suspected appendicitis in children. Two hundred and twelve consecutive patients with suspected appendicitis were

examined. Ultrasound examinations for suspected appendicitis were classified into four groups: 1, normal appendix; 2, appendix not visualized, no secondary signs of appendicitis; 3, appendix not visualized, with one of the following secondary signs of appendicitis: hyperechoic mesenteric fat, fluid collection, local dilated small bowel loop; 4, inflamed appendix. Ninety-six patients were classified into group 1, 41 into group 2, 13 into group 3, and 62 into group 4. The negative predictive values of groups 1 and 2 were 0.99 and 1.00 respectively, and none of these patients had, or went on to have appendicitis at one year follow up. Positive predictive values of groups 3 and 4 were 0.85 and 0.95 respectively. This study showed that appendicitis can be safely ruled out in children if there are no secondary signs of appendicitis during an ultrasound examination for suspected appendicitis, even if the appendix is not visualized. The presence of secondary signs for appendicitis without visualization of the appendix is a strong indicator for acute appendicitis.

The value of clinical evaluation and additional radiological imaging for patients with acute colonic diverticulitis was assessed in **chapter 6**. Fifty-seven patients were identified with acute colonic diverticulitis as a final diagnosis. The positive and negative predictive values for the clinical diagnosis colonic diverticulitis were 0.65 and 0.98 respectively. Additional cross-sectional imaging had a positive and negative predictive value of respectively 0.95 and 0.99. These additional examinations led to a correct change of the initial clinical diagnosis in 37% of the patients, but a change in management for only 7% of all cases. Based on these results we concluded that clinical evaluation alone is inadequate for diagnosing colonic diverticulitis because of the poor positive predictive value. Both ultrasound and CT have excellent diagnostic accuracy for diagnosing diverticulitis, but rarely change the initial management proposal.

**Chapter 7** of this thesis is a systematic review on the efficacy and outcome of laparoscopic peritoneal lavage for patients with perforated diverticulitis. After an extensive search of the literature we included 2 prospective cohort studies, 9 retrospective case series and 2 case reports reporting a total of 231 patients. Three quarters of the patients had a purulent peritonitis (Hinchey III). Laparoscopic

peritoneal lavage and antibiotics successfully controlled abdominal and systemic sepsis for almost all of the patients (>95%). The mortality was less than 2%, the morbidity 10% and only four of the 231 patients (<2%) received a colostomy.
Although we found no publications of high methodological quality, the published papers do show promising results. Laparoscopic peritoneal lavage for patients with perforated colonic diverticulitis seems to be effective, with a low mortality, a low morbidity and a minimal need for a colostomy.

## About the DIBAB study

For this study we chose to analyze an unselected population of patients with acute abdominal pain for two reasons. The first reason was that we did not want to miss false negative results. The second reason was based on the fact that the diagnostic value of clinical signs, symptoms and laboratory testing is influenced by the prevalence and spectrum of disease in a study population[6]. We wanted to attain an accurate assessment of the diagnostic accuracy of clinical evaluation that would apply to the actual population that is evaluated at the emergency department. This is also the reason why a stringent definition for acute abdominal pain was not used. All patients that were triaged to have surgical consultation for acute abdominal pain at the emergency department, or those that were referred by a general practitioner or consultant from another specialty, were included in the analysis.
A prospective cohort design was chosen instead of a randomized controlled trial. For a randomized controlled trial, half the patients would have been allocated to a 'clinical evaluation only' arm. Because radiological imaging for suspected appendicitis was adopted at our hospital several years before the start of the study, half of the patients would have been allocated to a treatment that was less than our standard of care.

In the DIBAB study 60% of the patients were referred by a general practitioner or a consultant from another specialty. It is well known that referral patterns can influence the case-mix of a study population. Other studies on acute abdominal pain in the Netherlands have reported 44%[7] and 75%[8] general practitioner referrals, although the latter study (the OPTIMA study) only included patients that were presumed to require additional imaging. The prevalence of appendicitis in our study population was 14.8%. This was 28% in the study by the OPTIMA group. Of all the patients that were clinically suspected to have acute appendicitis in our study, 63% had appendicitis as a final diagnosis. This is comparable to other Dutch studies in which 66%[9] and 67%[10] of patients were reported to have acute appendicitis as a final diagnosis if they were suspected to have appendicitis after clinical evaluation. On the basis of these figures, we can conclude that our study population is similar to other

groups of patients with acute abdominal pain presenting at other Dutch hospitals. During this analysis we did not register whether the non-admitted patients were presumed to require an outpatient re-evaluation or if they were only re-evaluated in accordance with the study protocol. Due to this omission we could not perform a cost analysis or analyze the efficiency of standard outpatient re-evaluation.

## Future perspectives

Surgeons and emergency department physicians should strive to continue improving diagnostics for patients with acute abdominal pain. Until new modalities to this purpose are found, the formula for the successful management of these patients will still be good clinical judgment based on thorough clinical evaluation, good radiological imaging and minimal ionizing radiation.

Due to the shortcomings of clinical evaluation for urgent surgical diagnoses there is a trend towards the increasing use of radiological imaging for patients with acute abdominal pain. The current guideline for acute appendicitis in the Netherlands advocates the use of radiological imaging for all patients with suspected appendicitis[5]. In case of a negative or equivocal ultrasound for suspected appendicitis a CT is advised, due to the low negative predictive value of ultrasound. The results from the DIBAB study do not support the implementation of this practice at our hospital. We found that a negative ultrasound for appendicitis did not justify a subsequent CT. This may be due to the fact that the quality of the ultrasound investigations was higher in this study than has been reported in most publications. This in turn may be attributed to the fact that these examinations were performed by experienced radiologists, and not by residents or ultrasound technicians. The conclusions of the current guidelines for acute appendicitis can therefore be questioned. The use of CT examinations for diagnosing acute appendicitis must be minimalized. Although the risk for a patient to develop radiation induced cancer after an abdominal CT is very small[11], the indication for ordering a CT must always be carefully scrutinized. The growing use of CT is rapidly increasing the collective dose of medical radiation that patient populations are subjected to, and this may become a public health concern, especially for children[12]. A recent report advocates that the benefit-risk ratio should be as high as can reasonably be achieved for every individual imaging procedure, and that imaging use should be optimized with the aid of clinical decision guidelines[13]. When adhering to a conditional CT protocol in case of an equivocal or negative ultrasound for patients with suspected appendicitis, 47% needed a complementary CT examination in a diagnostic strategy investigation by the OPTIMA study group[14]. When using the strategy adopted in the DIBAB study, where a conditional CT examination was made

after an equivocal ultrasound, only 18% of the patients had a CT examination. This did not lead to an unacceptable number of false negative diagnoses for appendicitis. The difference in exposure to ionizing radiation between these 2 imaging strategies is not marginal and could have important repercussions if translated to a national or European scale. Future efforts should therefore focus on the reduction of CT use for diagnosing appendicitis. This may be achieved by improving the quality of ultrasound investigations or by introducing MRI as the conditional investigation to an equivocal or negative ultrasound. MRI has been reported to be safe, reliable and potentially cost-effective for patients with suspected appendicitis[15]. It does not require ionizing radiation and may therefore be an interesting alternative to CT following an inconclusive ultrasound[16]. The use of MRI for patients with suspected appendicitis is currently being investigated in a multicenter diagnostic accuracy study[17].

Another concern addressed by some authors on the increasing use of imaging for acute appendicitis, is that we may now also be identifying patients with appendicitis that would resolve without surgical intervention. There is indeed a growing body of evidence suggesting that resolving appendicitis is a common phenomenon[18-22], and we may therefore be operating a proportion of the patients with appendicitis unnecessarily. Future research should focus on this matter and the identification of these patients will be a challenging undertaking. Proper patient selection will be pivotal, and without pathology as a reference test, clinical and radiological assessment will probably play the lead diagnostic roles.

The promising results presented in the review on laparoscopic lavage for perforated diverticulitis justifies a randomized controlled trial comparing laparoscopic lavage to colonic resection for these patients. Such a multicenter trial has now commenced (Ladies trial) and is currently allocating patients with a purulent peritonitis due to perforated diverticulitis (Hinchey III) to either colonic resection or laparoscopic lavage.

## References


1. Laurell H, Hansson LE, Gunnarsson U. Diagnostic pitfalls and accuracy of diagnosis in acute abdominal pain. Scand J Gastroenterol 2006; 41:1126-1131.
2. Birnbaum BA, Wilson SR. Appendicitis at the millennium. Radiology 2000; 215:337-348.
3. de Dombal FT. Acute abdominal pain--an O.M.G.E. survey. Scand J Gastroenterol Suppl 1979; 56:29-43.
4. Sheridan WG, White AT, Havard T et al. Non-specific abdominal pain: the resource implications. Ann R Coll Surg Engl 1992; 74:181-185.
5. Richtlijn voor diagnostiek en behandeling van acute appendicitis. S.l.: S.n.; 2010.
6. Ransohoff DF, Feinstein AR. Problems of spectrum and bias in evaluating the efficacy of diagnostic tests. N Engl J Med 1978; 299:926-930.
7. Van Geloven AA, de Vries GM, van der Eerden MM et al. Treatment of self-referred patients with abdominal complaints by emergency physicians. A prospective observational study in an emergency department in The Netherlands. Eur J Emerg Med 1999; 6:317-321.
8. Lameris W, van Randen A, van Es HW et al. Imaging strategies for detection of urgent conditions in patients with acute abdominal pain: diagnostic accuracy study. BMJ 2009; 338:b2431.
9. Poortman P, Lohle PN, Schoemaker CM et al. Comparison of CT and sonography in the diagnosis of acute appendicitis: a blinded prospective study. AJR Am J Roentgenol 2003; 181:1355-1359.
10. Lameris W, van Randen A, Go PM et al. Single and combined diagnostic value of clinical features and laboratory tests in acute appendicitis. Acad Emerg Med 2009; 16:835-842.
11. Committee to Assess Health Risks from Exposure to Low Levels of Ionizing Radiation. Health risks from exposure to low levels of ionizing radiation: BEIR VII, Phase 2. Washington, D.C.: National Academies Press; 2006.
12. Brenner DJ, Hall EJ. Computed tomography-an increasing source of radiation exposure. N Engl J Med 2007; 357:2277-2284.
13. Hricak H, Brenner DJ, Adelstein SJ et al. Managing Radiation Use in Medical Imaging: A Multifaceted Challenge. Radiology 2010; 258:889-905.
14. Laméris W, van Randen A, Wiezer MJ et al. Selective use of imaging in patients with suspected appendicitis, a scenario analysis. Submitted 2011.
15. Cobben L, Groot I, Kingma L et al. A simple MRI protocol in patients with clinically suspected appendicitis: results in 138 patients and effect on outcome of appendectomy. Eur Radiol 2009; 19:1175-1183.
16. Cobben L, Groot I, Kingma L et al. The use of ultrasonography and optional magnetic resonance imaging in patients with suspected appendicitis: effect on the outcome of appendectomy. In: Magnetic resonance imaging in acute appendicitis. [S.l.: s.n.]; 2009:59-80.

17. Leeuwenburgh MM, Lameris W, van Randen A et al. Optimizing imaging in suspected appendicitis (OPTIMAP-study): a multicenter diagnostic accuracy study of MRI in patients with suspected acute appendicitis. Study Protocol. BMC Emerg Med 2010; 10:19.
18. Migraine S, Atri M, Bret PM et al. Spontaneously resolving acute appendicitis: clinical and sonographic documentation. Radiology 1997; 205:55-58.
19. Cobben LP, de Van Otterloo AM, Puylaert JB. Spontaneously resolving appendicitis: frequency and natural history in 60 patients. Radiology 2000; 215:349-352.
20. Kirshenbaum M, Mishra V, Kuo D et al. Resolving appendicitis: role of CT. Abdom Imaging 2003; 28:276-279.
21. Andersson RE. The natural history and traditional management of appendicitis revisited: spontaneous resolution and predominance of prehospital perforations imply that a correct diagnosis is more important than an early diagnosis. World J Surg 2007; 31:86-92.
22. Andersson RE. Resolving appendicitis is common: further evidence. Ann Surg 2008; 247:553.