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RESEARCH ARTICLE

HOOKWORM INFECTION CLASSIFIED INTO FIVE STAGES BASED ON ANAEMIA AND EOSINOPHILIA IN PATIENTS WITH HOOKWORMS FOUND IN DUODENUM WHILE DOING ENDOSCOPY

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ABSTRACT

Objective: A detailed study was done in the patients with hookworm infection found in the duodenum while doing upper gastro intestinal endoscopy in order to classify patients with hookworm infection into five stages based on anaemia and eosinophilia in patients with hookworms found in duodenum while doing endoscopy. Such classification of hookworm infection into 5 stages has not been described so far in the literature and is described here for the first time in the literature.

Methods: A study of 1307 patients who had undergone upper gastro-intestinal endoscopy for a period of 5 years and one month from May 2009 to May 2014 was carried out. In all the patients found to have hookworms in duodenum, investigations were done to know about the presence or absence of anaemia and presence or absence of eosinophilia.

Results: Out of these 1307 patients, 14 patients found to have hookworms in duodenum while doing upper gastro-intestinal endoscopy were taken into consideration for our study. Out of these14 patients, 5 patients did not have anaemia and 9 patients had anaemia. Out of the 5 patients who had absence of anaemia, one patient also had absence of eosinophilia, but the remaining 4 patients had eosinophilia. Based on the presence or absence of anaemia and presence or absence of eosinophilia, hookworm infection is classified into 5 stages. Absence of anaemia and eosinophilia is the earliest stage or the first stage, absence of anaemia but with eosinophilia is the early stage or the second stage, mild anaemia is the third stage, moderate anaemia is the fourth stage and severe anaemia is the fifth or the late stage of hookworm infection.

Conclusion: Such classification of hookworm infection into 5 stages will be extremely useful to the clinicians to stage hookworm infection according to its severity, to diagnose hookworm infection properly and as early as possible especially by using upper gastro intestinal endoscopy and to treat hookworm infection as early as possible.

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INTRODUCTION

Anaemia is commonly reported to occur in hookworm infection (Hyun *et al*., 2010; Wu *et al*., 2002; Kuo *et al*., 2010; Basset *et al*., 2010; Lee *et al*., 1994; AnjumSaeed *et al*., 2008; Rodríguez *et al*., 2013; Li *et al*., 2007; Kalli *et al*., 2011; Chen *et al*., 2012; Kato *et al*., 1997; Cedrón-Cheng and Ortiz, 2011; Yan and Chu, 2007; Chao and Ray, 2006; Christodoulou *et al*., 2010; Genta and Woods, 1991; Nakagawa *et al*., 2009). But so far detailed study was not done to classify patients with hookworm infection into various stages based on anaemia and eosinophilia in patients with hookworms found in duodenum while doing endoscopy. Hence a detailed study was done in patients with hookworm infection found in the duodenum while doing upper gastro intestinal endoscopy to classify patients with hookworm infection into 5 stages based on anaemia and eosinophilia in patients with hookworms found in duodenum while doing endoscopy.

Such classification of hookworm infection into 5 stages were made in our study based on extensive and detailed research and analysis of as many as14 patients who were found to have hookworms in duodenum while doing upper gastro-intestinal endoscopy and has not been described so far in the literature and is described here for the first time in the literature.

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MATERIALS AND METHODS

This study was conducted in the department of general surgery, Aarupadai Veedu Medical College and Hospital, Puducherry. A study of 1307 patients who had undergone upper gastro-intestinal endoscopy for a period of 5yearsand one month from May 2009 to May 2014 was carried out. In all the patients found to have hookworms in duodenum, investigations were done to know about the presence or absence of anaemia and presence or absence of eosinophilia. Anaemia is defined as haemoglobin<12g/dl or 12g% in women and haemoglobin < 13g/dl or13g% in men (Sikosana *et al*., 1998; WHO, 2001). Mild anaemia is taken as haemoglobin 10to12g/dl or g%, moderate anaemia is taken as haemoglobin 7to10g/dl or g% and severe anaemia is taken as haemoglobin<7g/dl or g% (Hyder *et al*., 2004). Eosinophilia is defined as eosinophils>or =500cells/cu.mm (Meltzer *et al*., 2008). The results were found as given below.

RESULTS

1. Out of these 1307 patients, 14 patients found to have hookworms in duodenum while doing upper gastro-intestinal endoscopy were taken into consideration for our study.
2. Out of these 14 patients with hookworms in duodenum taken into consideration for our study,
   a. 5 patients did not have anaemia.
   b. 9 patients had anaemia.
   c. Out of the 5 patients who had absence of anaemia, one patient with absence of anaemia also had absence of eosinophilia.
   d. But the remaining 4 patients who had absence of anaemia had eosinophilia.

Based on the presence or absence of anaemia, presence or absence of eosinophilia, patients with hookworm infection found in the duodenum while doing upper gastro intestinal endoscopy were classified into 5 stages as-

Stage 1. Very early stage of hookworm infection [no anaemia and no eosinophilia] [1 patient]
Stage 2. Early stage of hookworm infection [no anaemia but had eosinophilia] [4 patients]
Stage 3. Stage of mild hookworm infection [mild anaemia] [6 patients]
Stage 4. Stage of moderate hookworm infection [moderate anaemia] [1 patient]
Stage 5. Late stage of hookworm infection or stage of severe hookworm infection [severe anaemia] [2 patients]

Such classification of hookworm infection into 5 stages were made in our study based on extensive and detailed research and analysis of as many as 14 patients who were found to have hookworms in duodenum while doing upper gastro-intestinal endoscopy and has not been described so far in the literature and is described here for the first time in the literature.

DISCUSSION

Stage 1. Very early stage of hookworm infection [no anaemia and no eosinophilia] [1patient]

This stage is characterized by the following features

1. Anaemia is absent.

2. Eosinophilia is also absent.

This patient with hookworm infection neither had anaemia [haemoglobin -14g%] nor had eosinophilia [absolute eosinophil count - 160cells/cu.mm].

Anaemia is absent due to very minimal loss of blood due to very low burden of hookworms.

Only single hookworm was found in the duodenum in this patient who had absence of anaemia. Eosinophilia only peaks at 5to 9weeks after the onset of infection, a period that coincides with the appearance of adult hookworms in the intestine (Maxwell *et al*., 1987). Hence eosinophilia will not be present in very early stage of hookworm infection before5to 9weeks after the onset of infection. Since this patient had absence of anaemia and also had absence of eosinophilia, hookworm infection in this patient is in the very early stage just before5to 9weeks after the onset of infection as described above.

Stage 2. Early stage of hookworm infection [no anaemia but had eosinophilia] [4patients]

This stage is characterized by the following features

1.Anaemia is absent.

2.But eosinophilia is present

Eosinophilia is present since eosinophilia will occur after 5to 9weeks after the onset of infection, a period that coincides with the appearance of adult hookworms in the intestine (Maxwell *et al*., 1987).

Single hookworm in duodenum without anaemia [haemoglobin17.6g %] but with eosinophilia indicating early stage of hookworm infection due to the absence of anaemia is shown in Fig 1.

The hookworm in duodenum is identified by its bent head which lookslike a hook (Fig.1) and by its S-shaped appearance (Cedrón-Cheng and Ortiz, 2011) (Fig.1).

Single hookworm in duodenumin a female patient without anaemia [haemoglobin 12.8 g %] but with eosinophilia indicating early stage of hookworm infection due to the absence of anaemia is shown in Fig 2.

Stage 3. **Stage of mild hookworm infection [mild anaemia] [6 patients]**

This stage is characterized by the following feature

1. Mild anaemia (haemoglobin 10 to12 g%) due to loss of blood caused by hook worm infection Single hookworm in duodenum seen in one of another these patients with mild anaemia [haemoglobin 11.7 g%] indicating stage of mild hookworm infection is shown in Fig 3. The hookworm in duodenum is identified by its bent head which looks like a hook (Fig.2) and by its S-shaped appearance (Cedrón-Cheng and Ortiz, 2011) (Fig 3). Single hookworm in duodenum found in another patient with with mild anaemia [haemoglobin10g%] indicating stage of mild hookworm infection is shown in Fig 4. The hookworm in duodenum is identified by its benthead which looks like a hook (Fig. 3) and by its S-shaped appearance (Cedrón-Cheng and Ortiz, 2011) (Fig 4).

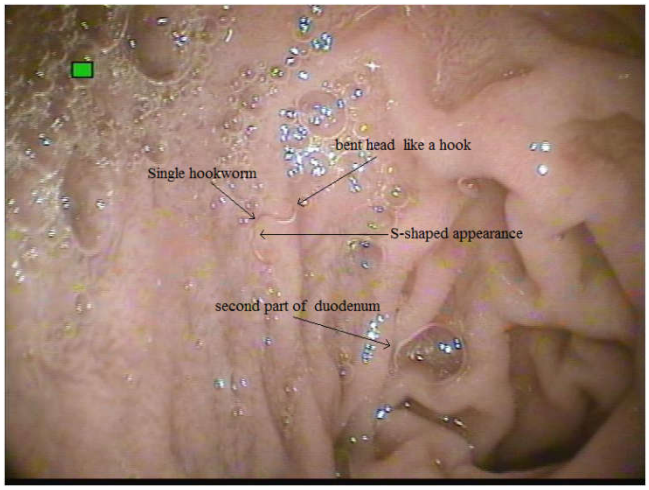

Fig. 1. Single hookworm in duodenum with its bent head and S-shaped appearance in a patient without anaemia [haemoglobin 17.6g%] but with eosinophilia indicating early stage of hookworm infection

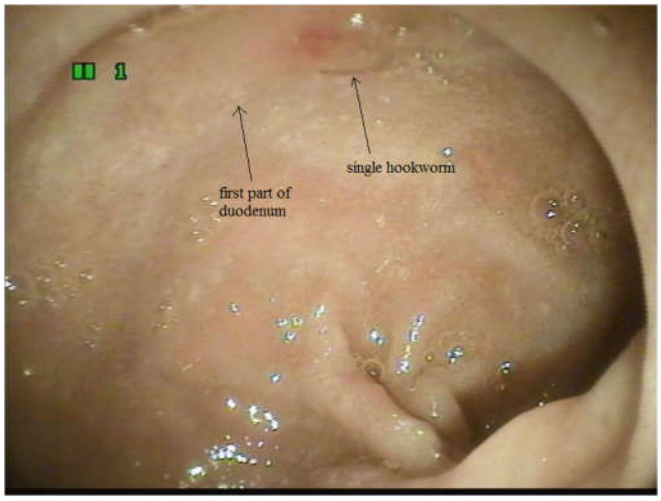

Fig. 2. Single hookworm in duodenum in a female patient without anaemia [haemoglobin 12.8g%] but with eosinophilia indicating early stage of hookworm infection

Fig. 3. Single hookworm in duodenum with its bent head like a hook and S-shaped appearance in the patient with with mild anaemia [haemoglobin 11.7g %] indicating stage of mild hookworm infection

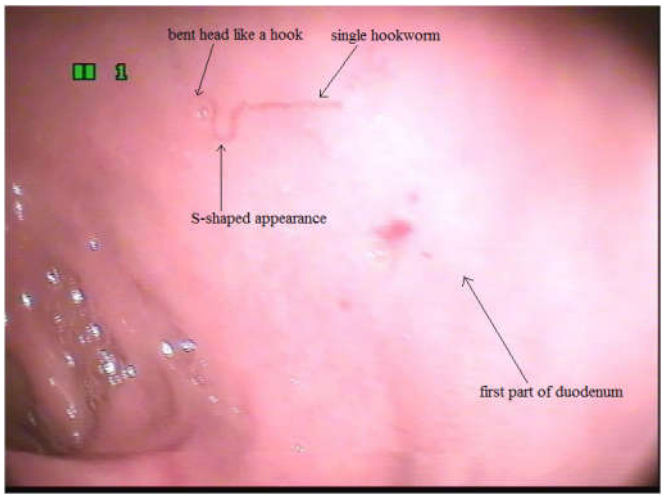

Fig. 4. Single hookworm in duodenum with its bent head like a hook and S-shaped appearance in the patient with mild anaemia [haemoglobin 10 g%] indicating stage of mild hookworm infection

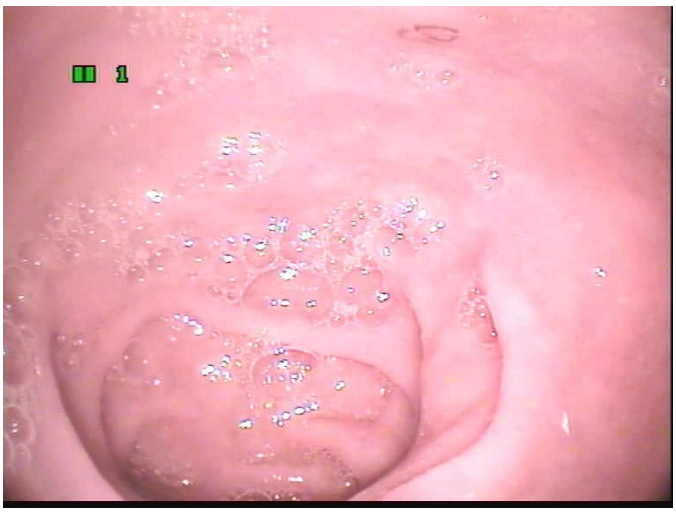

Fig. 5. Multiple hookworms in duodenum with severe anaemia [haemoglobin 3.2 g %] indicating late stage of hookworm infection or stage of severe hookworm infection

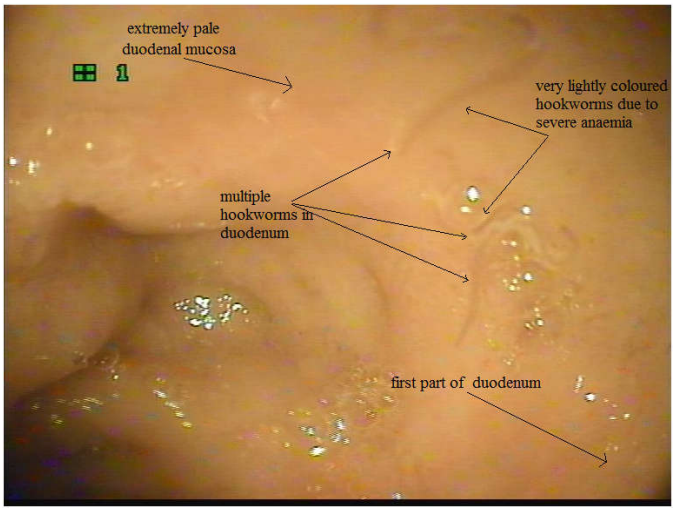

Fig. 6. Multiple hookworms in duodenum with severe anaemia [haemoglobin 2.1 g %] indicating late stage of hookworm infection or stage of severe hookworm infection

Stage 4. Stage of moderate hookworm infection [moderate anaemia] [1 patient]

This stage is characterized by the following feature

1.Moderate anaemia is present [haemoglobin7to10g %] due to significant loss of blood due to more number of hookworms.
This patient with hookworm infection had moderate anaemia [haemoglobin 8.6g%] and had more than one hookworm in duodenum.

Stage 5. Late stage of hookworm infection or stage of severe hookworm infection[severe anaemia] [2 patients]

This stage is characterized by the following feature

1. Severe anaemia (haemoglobin<7 g%) due to significant loss of blood due to very heavy burden of hookworm infection.
Multiple hookworms in duodenum with severe anaemia [haemoglobin 3.2 g%] indicating late stage of hookworm infection or stage of severe hookworm infection is shown in Fig5.

Multiple hookworms in duodenum with severe anaemia [haemoglobin 2. 1g%] indicating late stage of hookworm infection or stage of severe hookworm infection is shown in Fig. 6.

Severe anaemia is due to significant loss of blood due to large number of hookworms and indicates late stage of hookworm infection or stage of severe hookworm infection.

Conclusion

1. Absence of anaemia and eosinophilia is the earliest stage or the first stage of hookworm infection.
2. Absence of anaemia but with eosinophilia is the early stage or the second stage of hookworm infection.
3. Mild anaemia is the third stage of hookworm infection.
4. Moderate anaemia is the fourth stage of hookworm infection.
5. Severe anaemia is the fifth or very late stage of hookworm infection.
6. Such classification of hookworm infection into 5 stages will be extremely useful to the clinicians to stage hookworm infection according to its severity, to diagnose hookworm infection properly and as early as possible especially by using upper gastro intestinal endoscopy and to treat hookworm infection as early as possible.

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