

# Accuracy and reliability of palpation and percussion for detecting hepatomegaly: a rural hospital-based study

Rajnish Joshi, Amandeep Singh, Namita Jajoo, Madhukar Pai,\* S P Kalantri

Department of Medicine, Mahatma Gandhi Institute of Medical Sciences, Sevagram 442 102, Maharashtra; and \*Division of Epidemiology, University of California at Berkeley, Berkeley, CA 94720, USA

**Background:** Palpation and percussion are standard bedside techniques used to diagnose hepatomegaly. Ultrasonography is a noninvasive and accurate method for measurement of liver size, but many patients in developing countries have limited access to it. We compared the accuracy of palpation and percussion in a rural population in central India, using ultrasonography as a reference standard. **Methods:** The study design was a blinded, cross-sectional analysis of a hospital-based case series. Three physicians, blind to clinical data and to each other's results, independently used palpation and percussion to detect hepatomegaly. Diagnostic accuracy was measured by computing sensitivity, specificity, and likelihood ratio values. Inter-physician agreement was assessed using the kappa statistic. **Results:** Of the 180 study patients, 36 (20%) had enlarged liver on ultrasonography. The likelihood ratios for findings at both palpation (2.2, 3.0, and 2.5 for the three physicians, respectively) and percussion (1.1 for all three physicians) as predictors of true hepatomegaly were low. The kappa values for inter-observer agreement between three physicians for the presence of hepatomegaly at palpation ( $\kappa=0.44-0.53$ ) and percussion ( $\kappa=0.17-0.33$ ) were low, indicating poor reliability of these techniques. **Conclusion:** Clinical assessment of hepatomegaly by palpation and percussion lacks both accuracy and reliability. [*Indian J Gastroenterol* 2004; 23:171-174] **Key words:** Likelihood ratio, palpation, percussion, predictive value

See editorial on page 163

Physicians routinely use palpation and percussion for detecting enlarged liver. Although ultrasonography provides an accurate and noninvasive test for detecting hepatomegaly, patients in developing countries, particularly in rural settings, often have limited access to it. Thus, clinicians in resource-limited settings often rely on physical examination to detect hepatomegaly. According to our hospital records (unpublished data), about 15% of hospitalized patients have diseases that are likely to be associated with an enlarged liver, and hence determination of enlarged liver is an important part of clinical examination.

Although many physicians believe that physical examination can accurately identify hepatomegaly, some published reports suggest that physical signs lack accuracy and reliability.<sup>1,2,3</sup> To our knowledge, no study from India has evaluated the accuracy of physical examination in the assessment of enlarged liver. We conducted this study to determine how accurately doctors can distinguish an enlarged liver from a normal sized one, and how often they agree with one another while assessing liver size.

## Methods

We enrolled consecutive patients admitted to the Medicine wards between February 1 and 15, 2003. Patients with pleural diseases (effusion or pneumothorax) or chronic obstructive airway disease were excluded. Written informed consent was obtained from all patients.

Three physicians with varying levels of training in internal medicine (NJ, AS and RJ, who graduated in 2002, 1999 and 1996, and are referred to as Physicians 1, 2 and 3, respectively) evaluated patients sequentially. The interval between the first and third physician's examination ranged between 10 minutes and two hours. Before the study began, the three physicians agreed on a standardized examination technique, and an experienced physician (SPK), reviewed their bedside techniques. The study population consisted of patients with hepatic diseases (hepatitis, alcoholic cirrhosis, and hepatoma) as well as non-hepatic diseases (congestive heart failure, malaria, sepsis, typhoid fever, pneumonia, snake bite, stroke and pulmonary tuberculosis).

In each patient, the physicians identified the acromio- and sternoclavicular joints by palpation and marked the midpoint of a line joining these two points (mid-clavicular point). A vertical line was drawn from the mid-clavicular point to the mid-inguinal point, and was defined as the midclavicular line (MCL);<sup>4</sup> all clinical as well as sonological measurements were done with reference to this line. Each of the three physicians palpated and percussed the liver and recorded his findings as presence or absence of palpable liver edge, and of hepatomegaly, defined as cranio-caudal dimension of the liver in the MCL of 10 cm or more on light percussion.<sup>5</sup> The physicians were unaware of clinical data and each other's findings.

*Measurement of reference standard*

All patients underwent sonography in the Department of Radiology using a high-resolution real-time scanner (General Electric), with a 3.5 MHz curvilinear transducer, on the same day as clinical evaluation. The sonologist was unaware of clinical history and physical examination findings. Hepatomegaly, as diagnosed by ultrasonography, was defined as vertical height of liver of 13 cm or more.<sup>6</sup> This cut-off point was based on 95th percentile of observations in 840 subjects in a previous study.<sup>6</sup>

*Statistical analysis*

Palpation of the liver edge was recorded as a dichotomous variable. Percussion of liver span (in centimeters) was recorded as a continuous variable, as also as a dichotomous variable (hepatomegaly present or absent) based on the 10-cm cut-off. Point estimates of the following test properties were calculated for each response, using standard methods, namely, sensitivity, specificity, positive likelihood ratio (LR+) and negative likelihood ratio (LR-).<sup>7</sup> The precision of these estimates was evaluated using 95% confidence intervals. Post-test probabilities were computed from the likelihood ratios and the prevalence of enlarged liver in the population by using the formula: pre-test odds x LR = post-test odds.

We used the kappa ( $\kappa$ ) statistic to evaluate chance-corrected agreement between pairs of physicians. A kappa value of 0 indicates that the observed agreement is the same as that expected by chance, and that of 1 indicates perfect agreement. The following guides were used for interpreting the kappa statistic: values of <0.20 indicated poor agreement, 0.21–0.40 fair agreement, 0.41–0.60 moderate agreement, 0.61–0.80 good agreement, and 0.81–1.00 very good agreement.<sup>8</sup>

Age, body mass index, liver span and gender were compared between patients with and without hepatomegaly using *t* test for continuous, normally-distributed variables,  $\chi^2$  test for categorical variables, and Wilcoxon's Mann-Whitney U test for non-parametric variables. STATA (Version 8, Stata Corporation, Texas, USA) and PEPI (Sagebrush Press, Salt Lake City, Utah, USA) statistical softwares were used for data analysis.

**Table 1: Characteristics of study population**

Parameter	Hepatomegaly		p value
	Present (n = 36)	Absent (n = 144)	
Age [mean (SD)] (years)	45.5 (16.4)	43.7 (14.8)	ns*
Body mass index [mean (SD)] (Kg/m <sup>2</sup> )	20.6 (3.2)	20.2 (3.5)	ns*
Number (%) of women	10 (27.7)	60 (41.5)	<0.04**

\**t* test. \*\*Chi-squared test

**Results**

A total of 208 patients were admitted to the Medicine wards during the study period. Eleven patients with pleural disease (n=6) or chronic obstructive airway disease (n=5), and another 17 who were too ill to be transferred to the Department of Radiology were excluded. We thus studied 180 patients (70 women); their mean age was 44.1 (SD 15.1) years, mean height 1.52 (0.11) m, and mean body mass index 20.4 (3.5) Kg/m<sup>2</sup>.

On ultrasonography, the mean liver span in study patients was 11.4 cm (SD 1.7). A total of 36 patients (20%) had enlarged liver (11 patients had congestive cardiac failure, 8 hepatitis, 6 cirrhosis of liver, 6 acute febrile illness, 3 severe anemia, and 2 leukemia) (Table 1). Thus, our study population had a 20% pre-test probability of having hepatomegaly.

Liver size on clinical examination varied from 4 cm to 20 cm with three observers using two methods of clinical examination. The accuracy of clinical examination is outlined in Table 2. Finding of hepatomegaly either at palpation or at percussion argued only weakly for the presence of hepatomegaly (LR+ for clinically palpable liver, 2.2, 3.0, and 2.5 for three physicians, respectively). Similarly, absence of hepatomegaly as judged by palpation and percussion did not reliably rule out hepatomegaly. Thus, the reliability of both palpation of liver or percussion span in the MCL in diagnosing hepatomegaly was poor.

Although the percent agreement between the three physicians for palpable liver edge appeared to be good (82% to 84%), the agreement beyond chance was only moderate ( $\kappa$  statistic 0.44 to 0.53). For percussion find-

**Table 2: Accuracy of detection of liver edge on palpation and of liver span  $\geq 10$  cm on percussion in diagnosing hepatomegaly using ultrasonography as reference standard**

Physician	Sensitivity (95% CI)	Specificity (95% CI)	LR+ (95% CI)	LR- (95% CI)	Post test probability	
					Of positive test (95% CI)	Of negative test (95% CI)
<i>Clinical diagnosis of hepatomegaly using palpable liver edge</i>						
Physician 1	38.9 (24.1, 55.4)	81.9 (75.0, 87.6)	2.2 (1.3, 3.7)	0.7 (0.6, 1.0)	35.0 (23.9, 47.9)	15.7 (12.4, 19.6)
Physician 2	41.7 (26.5, 58.1)	86.1 (79.7, 91.1)	3.0 (1.7, 5.2)	0.7 (0.5, 0.9)	42.9 (29.9, 56.8)	14.5 (11.3, 18.4)
Physician 3	38.9 (24.1, 55.3)	84.7 (78.1, 89.9)	2.5 (1.5, 4.5)	0.7 (0.5, 0.9)	38.9 (26.6, 52.7)	15.3 (12.1, 19.1)
<i>Clinical diagnosis of hepatomegaly using percussion span <math>\geq 10</math> cm</i>						
Physician 1	38.9 (24.1, 55.4)	63.9 (55.8, 75.4)	1.1 (0.7, 1.7)	0.9 (0.7, 1.2)	21.2 (14.5, 29.9)	19.3 (15.2, 24.1)
Physician 2	47.2 (31.4, 63.4)	59.0 (50.8, 66.8)	1.1 (0.8, 1.7)	0.9 (0.6, 1.2)	22.3 (16.2, 30.0)	18.2 (13.7, 23.8)
Physician 3	61.1 (44.6, 75.9)	43.1 (35.1, 51.2)	1.1 (0.8, 1.4)	0.9 (0.6, 1.4)	21.1 (16.6, 26.5)	18.4 (12.5, 26.1)

**Table 3: Inter-physician agreement in determination of palpable liver and percussion liver span  $\geq 10$  cm**

	Palpation		Percussion	
	Percent agreement	Kappa (95% CI)	Percent agreement	Kappa (95% CI)
Physician 1 vs. physician 2	82	0.44 (0.29, 0.60)	68	0.33 (0.19, 0.47)
Physician 2 vs. physician 3	84	0.49 (0.33, 0.65)	64	0.31 (0.17, 0.44)
Physician 1 vs. physician 3	84	0.53 (0.38, 0.68)	57	0.17 (0.04, 0.30)

ings, the percent agreement was lower and  $\kappa$  statistic values revealed only poor to fair agreement (Table 3).

### Discussion

Our study shows that physical examination of liver by palpation or percussion was neither accurate nor reliable to rule in or rule out hepatomegaly in our patients. We found that palpation and percussion findings were only modest predictors of hepatomegaly. The overall probability of hepatomegaly in our patient population was 20%. When a physician found hepatomegaly by palpation, the probability of truly having hepatomegaly increased to between 35% to 43%, being somewhat different for each physician. If the physician found that the liver was not enlarged on palpation, the post-test probability fell to 14.5% to 15.7%. Similarly, on percussion, when a physician found that the liver was enlarged, the probability of the patient actually having hepatomegaly was 22%, and if he thought that it was not enlarged, the probability dropped to 18%.

These data confirm observations from previous studies that palpation and percussion do not discriminate well between those with and without hepatomegaly. Pooled data from 1464 patients in previous studies showed that LR+ for identifying hepatomegaly by palpation was 2.5 (95% CI 2.2, 2.8) and the LR- was 0.45 (95% CI 0.38, 0.52).<sup>2</sup> In another study, the finding of palpable liver edge was found to be an unreliable sign of hepatomegaly (LR=1.7).<sup>9</sup> Palpability as a sign of hepatomegaly had a 54% false-positive rate as compared to liver size judged by hepatic scintiscan.<sup>10</sup> Similarly, in another study, there was no correlation between the distance of the liver edge below the costal margin, located by auscultatory percussion and the actual distance (by ultrasonography) for any of 11 different examiners.<sup>11</sup>

Most studies that evaluated the accuracy of physical examination do not fulfill standard criteria for a diagnostic study (an independent blind comparison with a relevant reference standard among an appropriate spectrum of consecutive patients).<sup>7</sup> For example, some studies were case-control and not cross-sectional,<sup>10</sup> contained very few patients,<sup>2,12</sup> did not use a standard reference standard,<sup>3</sup> or reported the frequency of pa-

tients whose clinical assessment of liver size was within two centimeters of actual size determined by scintigraphy or ultrasound.<sup>3</sup> A large study reported from India (n=973) evaluated patients across wide age groups (range 8 days to 75 years; mean 17.1 years).<sup>13</sup> The clinical liver span in this study was 8.9 (SD 2.1) cm. However, in this study, the index test (palpation of liver) was compared with the standard (fluoroscopy) in only 143 randomly selected subjects.

We used a cross-sectional (rather than case-control) design in our study and compared palpation and percussion with the reference standard (ultrasonography) in an independent and blind manner. We avoided verification (work-up) bias by ensuring that all patients, irrespective of finding on physical examination, underwent ultrasonography. Third, the MCL is known to vary up to 10 cm when evaluated by different doctors.<sup>4</sup> By pre-determining the MCL for both clinical as well as sonographic assessment of hepatomegaly, we ensured consistency of measurement. Despite using these precautions, the inter-rater agreement between the three study physicians in our study was modest.

Several limitations of our study deserve comment. First, our results, derived from an inpatient setting, may not be generalizable to the community or outpatient department setting. Second, our study physicians had 1 year to 8 years of experience after graduation from medical school, and may not be applicable to physicians with greater or less experience than this; however, experience and accuracy have been shown to have a poor correlation.<sup>10</sup> Third, liver span on ultrasonography is known to correlate with height.<sup>8</sup> The short mean height of our study patients and the relatively low mean body mass index suggest that our results may not be applicable to tall, overweight or obese patients. Finally, we did not evaluate the accuracy of several palpatory characteristics (tenderness, nodularity of surface, and consistency of liver edge) that can contribute significantly to the overall bedside assessment of hepatomegaly.

In conclusion, our study suggests that physical examination is neither sufficiently accurate nor reliable to confirm or exclude hepatomegaly. Other factors in the history and examination also need to be formally evaluated to determine whether these really contribute to the diagnostic yield or not.

### References

1. McGee SR. *Evidence Based Physical Diagnosis*. Philadelphia: W B Saunders. 2001.
2. Naylor CD. The rational clinical examination. Physical examination of the liver. *JAMA* 1994;271:1859-65.
3. Sullivan S, Krasner N, Williams R. The clinical estimation of liver size: a comparison of techniques and an analysis of the source of error. *Br Med J* 1976;2:1042-3.

4. Naylor CD, McCormack DG, Sullivan SN. The midclavicular line: a wandering landmark. *Can Med Assoc J* 1987;136:48-50.
5. Skrainka B, Stahlhut J, Fulbeck CL, Knight F, Holmes RA, Butt JH. Measuring liver span. Bedside examination versus ultrasound and scintiscan. *J Clin Gastroenterol* 1986;8:267-70.
6. Niederau C, Sonnenberg A, Muller JE, Erckenbrecht JF, Scholten T, Fritsch WP. Sonographic measurements of the normal liver, spleen, pancreas, and portal vein. *Radiology* 1983;149:537-40.
7. Sackett D, Richardson WS, Rosenberg W, Haynes RB. *Evidence-Based Medicine*. London: Churchill Livingstone. 1997.
8. Sackett DL. The rational clinical examination. A primer on the precision and accuracy of the clinical examination. *JAMA* 1992;267:2638-44.
9. Halpern S, Coel M, Ashburn W, Alazraki N, Littenberg R, Hurwitz S, *et al*. Correlation of liver and spleen size. Determinations by nuclear medicine studies and physical examination. *Arch Intern Med* 1974;134:123-4.
10. Zoli M, Magalotti D, Grimaldi M, Gueli C, Marchesini G, Pisi E. Physical examination of the liver: is it still worth it? *Am J Gastroenterol* 1995;90:1428-32.
11. Tucker WN, Saab S, Rickman LS, Mathews WC. The scratch test is unreliable for detecting the liver edge. *J Clin Gastroenterol* 199;25:410-4.
12. Fuller GN, Hargreaves MR, King DM. Scratch test in clinical examination of liver. *Lancet* 1988;i:181.
13. Singh K, Bhasin DK, Reddy DN, Koshy A. Liver span in normal Indians. *Indian J Gastroenterol* 1985;4:73-5.

**Acknowledgments: Dr Pai is supported by the Fogarty AIDS International Training Program (1-D43-TW00003-15), National Institutes of Health, Bethesda, USA**

**Correspondence to: Prof. Kalantri. Fax: (7152) 284 333. E-mail: sp\_kalantri@rediffmail.com**

**Received February 22, 2004. Received in final revised form June 28, 2004. Accepted July 4, 2004**

## News and Notices

### **The Asian Pacific Association for Study of the Liver 14th Biennial Conference will be held in New Delhi December 11-15, 2004**

For details, contact: Dr S K Sarin, President APASL, Room 201, Academic Block, Department of Gastroenterology, G B Pant Hospital, New Delhi 110 002.

Phone: (11) 2323 2013. Fax: (11) 2321 9710

E-mail: welcome@apaslindia2004.com

Website: www.apaslindia2004.com

### **Symposium on Hepatitis E Virus: Epidemiology, Virology and Control of an Emerging Pathogen will be held in New Delhi February 18 and 19, 2005**

For details, contact: Dr Rakesh Aggarwal, Department of Gastroenterology, Sanjay Gandhi Postgraduate In-

stitute of Medical Sciences, Lucknow 226 014.

Phone: (522) 266 8700 Extn: 2431

Fax: (522) 266 8017 or 266 8078

E-mail: rakesh@sgpgi.ac.in

### **The 3rd World Conference on Prevention and Treatment of Caustic Esophageal Burns in Children and Pediatric Thoracic Surgery will be held in Turkey April 15-17, 2005**

For details, contact: Prof Oktay Mutaf, Ege University Hospital, 35100 Izmir, Turkey.

Fax: +90 (232) 375 4990

E-mail: omutaf@ege.edu.tr

Website: www.pediatrikoraks.org/pages/5/index.htm

## Clinical assessment of liver enlargement?

Looking back over the last 30 or 40 years, many of the tests we assiduously carried out on our patients have been declared unreliable. Many of the findings on cardiac auscultation were shown to be erroneous by electrical and imaging tests, yet we continue to listen to the various heart sounds. A pathway to celebrity was to describe a new physical sign that became eponymous. Professor Niels Rovsing of Copenhagen, in 1907, showed that in patients with acute appendicitis, pressure in the left iliac fossa produced sharp pain in the right iliac fossa, attributed to compression of the left colon driving round bowel gas to distend the cecum. We later learned that it is unusual for a significant amount of gas to accumulate in the descending and sigmoid colon. The sign is unreliable, yet many senior clinicians continue to test for it, and teach their students to use it.

I was astonished when reviewing the literature at the number of reports demonstrating that palpation and percussion provide poor evidence of liver enlargement. The paper by Joshi and colleagues<sup>1</sup> is a valuable addition to the long list. Apart from being a well conducted study, the added value is that it comes from India. I have visited many parts of India over many years – not only the famous institutions in big cities but also small rural hospitals where facilities for advanced investigations and treatment are in short supply. As a result, reliance on clinical judgement and sedulous pursuit of physical findings must be as good as anywhere in the world. This gives added weight to the finding that liver enlargement cannot be reliably diagnosed by abdominal palpation and percussion.

We should not be surprised. The anterior surface of the liver in contact with the anterior abdominal wall, moving up and down by about 10 cm during full inspiration and expiration, has an upper surface receding from us; below, the organ normally becomes progressively thinner and more flexible. How can we accurately detect a thin soft liver edge through a variably thick, variably flexible and variably tensed abdominal wall? Unless there is air-containing bowel below, how can we define the edge by percussion? If there is a thick chest wall it may be equally difficult to define the upper edge in the same manner.

The question we should ask is, "Should we try?" I have had the privilege of working in a hospital alongside one of the most distinguished hepatologists in the world, Dame Professor Sheila Sherlock. Although she had available the latest diagnostic equipment, and used it liberally, she never failed to carry out a routine clinical examination and to relish demonstrating the resulting physical signs. Woe betide an assistant who ordered a

test without first examining the patient and applying the findings to justify the selection of an appropriate investigation.

There is far more to abdominal examination than determining the vertical length of the anterior surface of the liver in the mid-clavicular line. The authors make it plain that they are well aware of this. The more carefully one looks, feels, listens, smells, gently moves, percusses, ballots, watches as the patient moves, the deeper our knowledge of the person becomes and we develop what we call a 'sixth' sense.

There are two types of knowledge, explicit and tacit. Explicit (L. *ex* = out + *plicare* = to fold; hence, unfold) encompasses scientific knowledge; when Watson and Crick described the double helix mechanism of the DNA molecule it could be explained in words, numbers, diagrams. In contrast, tacit (L. *tacere* = to be silent) knowledge cannot be transmitted in words. It must be passed from one person to another by demonstration and example. In palpating the liver; in placing a hand over it and asking the patient to breathe so that it passes beneath the 'watching,' still hand; in percussing it gently and firmly, information that is difficult to put into words is gathered by the examiner. Indeed, just watching a consummate expert examining an abdomen is educational in a verbally indefinable way.

This 'personal' knowledge is described by Michael Polanyi.<sup>2</sup> Although he was a doctor, he used as an example the genius of Antonio Stradivari, the violin-maker of Cremona. He had learned as an apprentice to the famous Amati family and brought violin making to the pinnacle of perfection. Polanyi points out that in spite of subsequent meticulous measurements of his instruments, sophisticated physical and chemical examination of the wood, varnish, and other components, no one has duplicated a Stradivari violin. One can imagine the intimate, tacit, personal knowledge of Stradivari as he held a piece of wood and felt in it the makings of a wonderful instrument.

It is this tacit familiarity and 'feel' that makes me adjure trainees to take every opportunity to examine patients by every means. They may not be able to make certain accurate measurements but in a subtle way they accumulate a knowledge of what is the range of normality. Without knowing this, how can we look patients in the eye and say, firmly, and reassuringly, 'All is well'? It is for this reason that I sent my children who studied medicine to the Indian subcontinent, where they learned superb clinical medicine by examining patients under the supervision of outstanding clinicians. Physical examination is more than the laying on of hands, although in so-

called 'complementary medicine', many patients derive comfort and reassurance from this.

**R M Kirk**

Royal Free Hospital, London NW3 2QG, England

### References

1. Joshi R, Singh A, Jajoo N, Pai M, Kalantri SP. Accuracy

and reliability of palpation and percussion for detecting hepatomegaly: a rural hospital-based study. *Indian J Gastroenterol* 2004;23:171-4.

2. Polanyi M. *Personal Knowledge: Towards a Post-critical Philosophy*. London: Routledge & Keegan Paul. 1973: p. 49-64.

---

**Correspondence to: Dr Kirk, Professor of Surgery and Honorary Consulting Surgeon**

## Indian Journal of Gastroenterology J Mitra Memorial Award

The Indian Journal of Gastroenterology bestows this award for the best original scientific contribution published in the Journal during the year

This award carries a prize of Rs 20 000, and will be given to the department(s) submitting the selected paper. The paper will be selected by a scientific committee appointed by the Editor, from among all the Original Articles published in the Journal during the year.

In the event of a tie, the award will be distributed equally. Terms for eligibility will apply.

The award has been made possible by a generous endowment from  
M/s J Mitra and Co Ltd, New Delhi