

## Does This Patient Have Splenomegaly?

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### THREE PATIENTS

Among the patients you are seeing today are the following three:

The first is an elderly woman who complains of easy fatigability, and her conjunctivae and nail beds are pale. You suspect that she is anemic due to gastrointestinal blood loss, but among your differential diagnoses you consider a lymphoproliferative disorder and decide to examine her for splenomegaly.

The second is a college student with failing appetite, ability to concentrate, energy, and grades. You think that he is depressed but want to rule out infectious mononucleosis and decide to examine him for splenomegaly.

The third is an otherwise healthy, well-controlled, hypertensive male with a normal cardiovascular examination. As he lies on the examining table, stripped to his waist, you wonder whether you should take the time to examine him for splenomegaly.

### WHY EXAMINE THE SPLEEN?

We examine the spleen to see whether it is palpable. Most palpable spleens are enlarged, and splenomegaly in an adult requires an explanation, for it may be a manifestation of disease. Despite many important causes of splenomegaly, including cancers, infections, and connective tissue diseases, many of these diagnoses are relatively uncommon such that isolated splenomegaly in an otherwise healthy adult is most often associated with nonspecific infections or no obvious cause.<sup>1</sup>

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### ANATOMIC LANDMARKS AND SPLENIC SIZE

The normal spleen is a curved wedge that follows the course of the bony portion of the left 10th rib (Fig 1, top). Its narrow posterior pole points back and to the right, toward the spine. Its outer surface is convex and lies just beneath the left diaphragm, and its blunt anterior pole approaches the midaxillary line, pointing toward the left colic flexure. Its inner convex surface bears a large impression from the posterior wall of the stomach, and its inferior edge bears impressions from the upper pole of the left kidney and occasionally, the tail of the pancreas (Fig 1).

### HOW LARGE IS THE NORMAL SPLEEN?

Autopsies following sudden traumatic death in individuals free of disorders likely to lead to splenomegaly have provided information on the usual weight of the spleen. In Philadelphia, Pa, such spleens exhibited median weights from 90 g (among black women) to 170 g (among young white men), with intermediate values for black men (100 g), white women (115 g), and elderly white men (130 g). The pathologists who conducted these studies stated that the "best rule of thumb is to regard any spleen under 250 grams as normal."<sup>2</sup> This biologic variation in average spleen size underscores the need for an accepted criterion standard definition of splenic enlargement that is acceptable to patients (ie, having one's spleen weighed is painful) and reproducible for clinicians.

One such standard is the radioisotopic scintiscan, presented (with the most commonly used normal values in parentheses) as maximum values for length (12 cm) and width (7 cm),<sup>3</sup> surface area (80 cm<sup>2</sup>),<sup>4</sup> or volume (250 cm<sup>3</sup>).<sup>5</sup> Most recently, an ultrasonographic criterion standard has been suggested with splenomegaly defined as a cephalocaudal diameter of 13 cm or more.<sup>6,7</sup>

### THE CONSEQUENCES OF SPLENOMEGALY FOR THE CLINICAL EXAMINATION

Since the normal-sized spleen almost always lies entirely within the rib cage, it usually cannot be palpated. However, as it enlarges it displaces the stomach but cannot displace the spine, diaphragm, or kidney. Therefore, its anterior pole continues to follow the projection of the bony portion of the left 10th rib, descending below the rib cage and across the abdomen toward the right iliac fossa (Fig 2).

### HOW TO EXAMINE FOR SPLENOMEGALY

#### Inspection

Inspection of the left upper quadrant might reveal a bulging mass emerging from under the left costal margin and descending on inspiration. There are no published assessments of the accuracy of clinical inspection. Nonetheless, this sign would be expected to have low sensitivity, since only massive spleens will distort the abdominal wall sufficiently to be seen. Moreover, since other large masses (a polycystic kidney or a gastric or colon cancer) also can distort the abdominal wall and may descend on inspiration, this sign probably does not have perfect specificity either. In the absence of prior documentation or suspicion of massive splenomegaly, this is unlikely to be a useful sign.

#### Percussion

Percussion seeks to identify the loss of tympany as the enlarging spleen impinges on the adjacent air-filled lung, stomach, and colon. Percussion is often claimed to be more sensitive than palpation for lesser degrees of splenomegaly, although evidence to support this claim (described herein) is scant.

Three percussion methods have been validated against ultrasonography or scintigraphy:

**1. Percussion by Nixon's Method (as Modified by Sullivan and Williams).—**The patient is placed in the right lateral

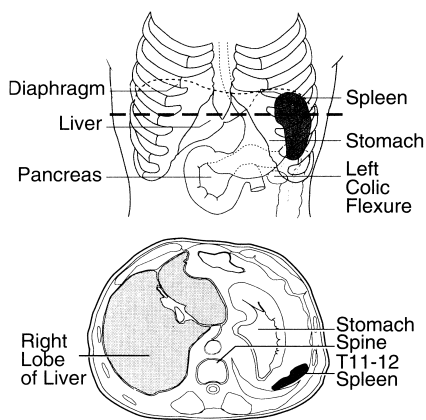


Fig 1.—On anterior-posterior views (top) and cross-sectional views (bottom), the normal spleen is a curved wedge that follows the course of the bony portion of the left 10th rib. Its narrow posterior pole points back and to the right, toward the spine. Its outer surface is convex and lies just beneath the left diaphragm, and its blunt anterior pole approaches the midaxillary line, pointing toward the left colic flexure. Its inner convex surface bears a large impression from the posterior wall of the stomach, and its inferior edge bears impressions from the upper pole of the left kidney and occasionally the tail of the pancreas.

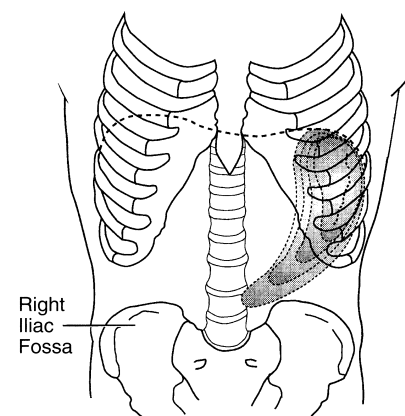


Fig 2.—As the spleen enlarges, its anterior pole continues to follow the left 10th rib as the spleen descends below the rib cage and across the abdomen toward the right iliac fossa.

decubitus position. Percussion is initiated midway along the left costal margin and continued upward along a line perpendicular to the costal margin (Fig 3). In a normal examination, dullness extends no further than 8 cm above the costal margin. Splenomegaly is diagnosed when the upper limit of dullness extends more than 8 cm above the costal margin.<sup>8,9</sup>

**2. Percussion by Castell's Method.**—The patient is placed in the supine position. Percussion is carried out in the lowest intercostal space in the left anterior axillary line in both expiration and full inspiration (Fig 4). In a normal examination, the percussion note re-

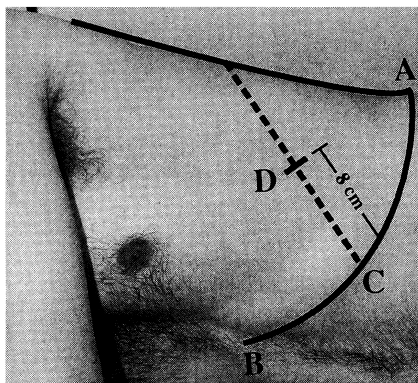


Fig 3.—Nixon's method of percussion requires that the patient be placed in the right lateral decubitus position. Percussion is started at the midpoint (C) of the left costal margin (AB) and proceeds perpendicularly (CD). Splenomegaly is diagnosed if the upper limit of dullness extends more than 8 cm above the costal margin (above D).

mains resonant throughout this maneuver. Splenomegaly is diagnosed when the percussion note is dull or becomes dull on full inspiration.<sup>10</sup>

**3. Percussion of Traube's Space.**—The patient is supine with the left arm slightly abducted for access to the entire Traube's space (after its description by Ludwig Traube who ascribed its disappearance to pleural effusion, not an enlarged spleen),<sup>11</sup> defined by the sixth rib superiorly, the midaxillary line laterally, and the left costal margin inferiorly (Fig 4). With the patient breathing normally, this triangle is percussed across one or more levels from its medial to lateral margins. Normal percussion yields a resonant or tympanitic note. Splenomegaly is diagnosed when the percussion note is dull.<sup>12</sup>

## Palpation

Although many methods for palpation of the spleen have been reported in clinical texts and journals, only three have had their precision and/or accuracy documented in the clinical literature and will be described herein. Relaxation of the abdominal wall is a prerequisite for successful palpation and can be assisted by both the examiner (friendly, gentle, and warm hands) and the patient (flexed, supported knees).

**Two-Handed Palpation, With Patient in Right Lateral Decubitus.**—With the patient in the right lateral decubitus position, the examiner's left hand is slipped from front to back around the left lower thorax, gently lifting the left lowermost rib cage anteriorly and medially. The tips of the fingers of the examiner's right hand are pressed gently just beneath the left costal margin, and the patient is asked to take a long, deep breath as the palpation of a descending spleen is sought. If none is felt, the pro-

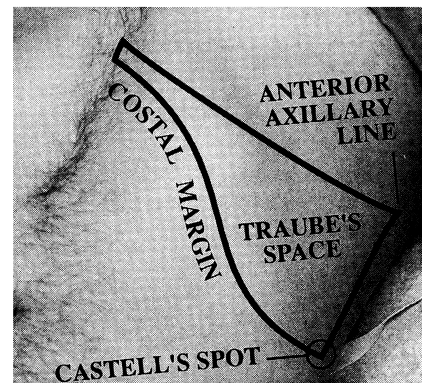


Fig 4.—Traube's space is defined by the sixth rib superiorly, the left anterior axillary line laterally, and the costal margin inferiorly. Castell's spot is located at the junction of the lowest intercostal space and the left anterior axillary line.

cedure is repeated, lowering the right hand 2 cm toward the umbilicus each cycle, until the examiner is confident that a massive spleen has not been missed. (Some authorities suggest starting palpation over the lower abdomen and moving up toward the costal margin.) The same procedure can be carried out with the patient supine.

**One-Handed Palpation, With Patient Supine.**—This method is identical to the former one, except that no counter pressure is applied by the left hand to the rib cage. With the patient supine, the tips of the fingers of the examiner's right hand are pressed gently just beneath the left costal margin, and the patient is asked to take a long, deep breath as the palpation of a descending spleen is sought. If none is felt, the procedure is repeated, lowering the right hand 2 cm toward the umbilicus each cycle, until the examiner is confident that a massive spleen has not been missed. Some examiners like to apply counter pressure to the patient's flank with the left hand while palpating with the right.

**Hooking Maneuver of Middleton, With Patient Supine.**—The patient is asked to lie flat with his or her left fist under the left costovertebral angle. The examiner is positioned to the patient's left, facing the patient's feet. The fingers of both the examiner's hands are curled under the left costal margin, and the patient is asked to take a long, deep breath as the palpation of a descending spleen is sought.<sup>13</sup>

**Additional Features of the Palpable Spleen.**—Given its origin within the rib cage, most texts state that it is never possible to palpate (get above) the upper border of the spleen, helping distinguish it from other abdominal masses that may present an upper border. If a spleen is greatly enlarged, it may be



possible to feel a hilar notch along its medial border.

PRECISION OF THE SIGNS FOR SPLENOMEGALY

When groups of inpatients with and without splenomegaly had their Traube's spaces percussed by three internists, the interexaminer agreement ( $\kappa$  values) ranged from 0.19 to 0.41, which is modest at best.<sup>12</sup> However, it was noted that recent food intake reduced the accuracy of Traube's space percussion in this study and probably decreased the test precision when different physicians examined the same patient at varying times after meals. Among the same patients, a second study<sup>14</sup> showed that the inter-examiner agreement for palpation ranged from 0.56 to 0.70, demonstrating that reproducibility between examiners of palpation was better than percussion.

When tested among 50 patients with alcoholism, agreement among different examiners (using two-handed palpation with the patient in the right lateral decubitus and one-handed palpation with the patient supine) demonstrated an interclass correlation coefficient of .75 and was as good as that for ascites (and marginally better than that for jaundice, Dupuytren's contracture, vascular spiders, gynecomastia, palmar erythema, asterixis, or clubbing).<sup>15</sup> Senior gastroenterologists exhibited marginally better agreement than more junior physicians (intraclass correlation coefficients of .81 and .73, respectively). When different examiners were asked to report the extent to which the spleen tip extended below

a specific bony landmark (eg, the xiphisternal-sternal junction), their estimates varied on average by 6 cm.<sup>16</sup>

ACCURACY OF THE SIGNS FOR SPLENOMEGALY

Table 1 summarizes studies on the accuracy of percussion. Using ultrasonographic results as the criterion standard, percussion of Traube's space had a sensitivity of 62% (95% confidence interval [CI], 51% to 72%) and a specificity of 72% (95% CI, 65% to 80%).<sup>12</sup> Percussion sensitivity was reduced by the presence of obesity (more false-negative results), and its specificity was decreased by recent food intake (more false-positive results). Accordingly, among leaner patients who had not eaten in the previous 2 hours, percussion sensitivity was 78% (95% CI, 62% to 90%), and its specificity was 82% (95% CI, 70% to 90%).

A second study<sup>9</sup> examined the sensitivity and specificity, individually and in combination, of the Nixon and Castell methods of percussion (as well as two-handed palpation in the supine and right lateral decubitus positions). In comparing the Nixon and Castell methods of percussion, the Castell method exhibited a statistically significantly ( $P<.05$ ) higher sensitivity (82% vs 59%) but lower specificity (83% vs 94%) (Table 1).

Table 2 summarizes seven studies of the accuracy of palpation. The first two studies<sup>17,18</sup> assessed the accuracy of the routine examination for splenomegaly by abstracting the clinical examinations (performed by a large number and range of clinicians) from routine clinical charts.

Both studies found low sensitivity (20% to 28%) but high specificity (98% to 100%). Most enlarged spleens were missed (a high rate of false-negative results, leading to low sensitivity), but few examiners reported palpating spleens that were not there (a low rate of false-positive results, leading to high specificity). Combining the results of these two studies, the routine examination for splenomegaly had a sensitivity of 27% (95% CI, 19% to 36%) and a specificity of 98% (95% CI, 96% to 100%).

In the other five palpation studies<sup>4,5,9,14,19</sup> (Table 2), the examination for splenomegaly was performed as part of the study. Since the examiners knew that they were under scrutiny, it is not surprising that both their true-positive reports and false-positive reports of splenomegaly rose; that is, the overall sensitivity of palpation was significantly higher ( $P<.0001$ ) and the specificity significantly lower ( $P<.05$ ) than in the two previously described studies that assessed the routine examination as recorded in clinical notes.

One study<sup>9</sup> compared percussion methods and palpation and demonstrated that the Castell method of percussion may be somewhat more sensitive than palpation (82% vs 71%) (Tables 1 and 2). Finally, if splenomegaly was declared when any of the four signs (two for percussion and two for palpation) were positive, true-positive and false-positive declarations of splenomegaly rose, because the rise in sensitivity to 88% (fewer large spleens missed) was accompanied by a fall in specificity to 83% (more normal-sized spleens mistakenly called large).

The final study<sup>14</sup> evaluated the accuracy of bedside diagnostic maneuvers using receiver operating characteristic curve analysis. This analytic technique evaluates the discriminating ability of different tests by comparing the true-positive rate (sensitivity) and false-positive rate (1 - specificity) of each test using different definitions of a positive test

Table 1.—Studies of the Accuracy of Percussion

No. of Patients	Criterion Standard	Maneuver	Sensitivity, % (No.)	Specificity, % (No.)
118*	Ultrasonography	Traube's space percussion		
		All patients <sup>12</sup>	62 (58/94)	72 (109/151)
		Nonobese patients who have not eaten recently <sup>12</sup>	78 (29/37)	82 (54/66)
65	Scintigraphy	Nixon method <sup>9</sup>	59 (10/17)	94 (45/48)
		Castell method <sup>9</sup>	82 (14/17)	83 (40/48)

\*Each patient was examined by one to three examiners for a total of 245 examinations.

Table 2.—Studies of the Accuracy of Palpation

No. of Patients	Criterion Standard	Maneuver	Sensitivity, % (No.)	Specificity, % (No.)
Based on Routine Examinations Recorded in Clinical Charts				
47	Autopsy <sup>17</sup>	Physical examination	20 (3/15)	100 (32/32)
217	Scintigraphy <sup>18</sup>	Clinical impressions	28 (26/92)	98 (122/125)
		Overall	27 (29/107)	98 (154/157)
Based on Specific Examinations Done as Part of the Study				
99	Scintigraphy <sup>4</sup>	Palpation	57 (31/54)	100 (45/45)
32	Operation <sup>19</sup>	Palpability	59 (16/27)	100 (5/5)
100	Scintigraphy <sup>5</sup>	Supine two-handed palpation	56 (47/84)	69 (11/16)
65	Scintigraphy <sup>9</sup>	Supine and right lateral decubitus palpation	71 (12/17)	90 (43/48)
118*	Ultrasonography <sup>14</sup>	Supine palpation or Middleton's maneuver	56 (53/94)	93 (140/151)
		Overall	58 (159/276)	92 (244/265)

\*Each patient was examined by one to three examiners for a total of 245 examinations.

Table 3.—Guidelines for Examining for Splenic Enlargement

Recommendations and Rationale	
Preexamination Clinical Suspicion (Prior Probability) of Splenic Enlargement	
Less than 10%	<p>Percussion or palpation for splenomegaly of limited usefulness</p> <p>Maneuvers are not sufficiently sensitive to rule out splenomegaly</p> <p>Given the low pretest probability of splenomegaly, test specificity of clinical examination is not sufficiently high to rule in splenic enlargement even if both tests are positive</p>
10% or more	<p>Percussion and palpation can be used to rule in splenomegaly if both are positive</p> <p>Percuss first and if positive then palpate</p> <p>If percussion is negative, but your clinical suspicion remains high, order an ultrasonogram as palpation in the presence of abdominal tympany is not specific enough to rule in splenomegaly</p> <p>If percussion is positive but palpation is negative, then an ultrasonogram is also needed to confidently evaluate spleen size</p> <p>To confidently rule out splenomegaly, a radiological procedure is necessary due to the limited sensitivity of bedside examination</p>

result (test thresholds). The discriminating ability refers to the probability of correctly selecting the patient with splenomegaly between two patients: one with an enlarged spleen and one with a normal spleen. A test with a discriminating ability of zero performs no better than chance alone while a perfect test has a discriminating ability of 100%.

In this study, supine palpation, right lateral decubitus palpation, and Middleton's maneuver all demonstrated similar discriminating abilities (73% to 79%). The discriminating ability of palpation and percussion was similar although the test specificity of palpation appeared to be generally superior to percussion.

The most important finding of this study was that palpation was a significantly better discriminator among patients in whom percussion was positive.

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(As might be expected, these patients have the largest spleens.) When percussion dullness was present, palpation discriminated correctly 87% of the time. However, if percussion was not dull, palpation was a poor discriminator (55%) or only slightly better than chance. This confirms that percussion and palpation should be used together, as percussion dullness identifies a subset of patients in whom palpation is a useful test. If percussion dullness is absent, there is no need to palpate, because palpation is a poor test among such patients.

Finally, this study also demonstrated that given a clinical suspicion (the prior probability or disease prevalence) of splenomegaly before examining the patient of 10% to 90%, it is difficult to substantially lower the likelihood of an enlarged spleen because the false-negative rate of bedside diagnosis was 28%, even if percussion and palpation were negative. On the other hand, when a positive bedside examination was defined as both percussion and palpation being positive, the high test specificity of 97% significantly increased the likelihood of splenic enlargement to 60% or more.

## IS SPLENOmegaly EVER NORMAL?

About 3% of otherwise healthy students entering a US college were found to have unexplained palpable spleens<sup>1</sup> and, on incomplete follow-up, appeared to fare none the worse<sup>20</sup>; similarly, 12% of otherwise normal postpartum women at a Canadian hospital had palpable spleens.<sup>21</sup>

## THE BOTTOM LINE (Table 3)

1. Splenomegaly is rare but occurs in a wide variety of conditions. Given the low sensitivity of the clinical examination, it can be argued that the routine examination for splenomegaly cannot definitively rule in or rule out splenomegaly in normal, asymptomatic pa-

tients where the prevalence is less than 10% and additional imaging tests will be required. Rather, the examination for splenomegaly is most useful to rule in the diagnosis of splenomegaly among patients in whom there is a clinical suspicion of at least 10%.

2. The bedside examination of the spleen should start with percussion. If percussion is not dull there is no need to palpate because the results of palpation will not effectively rule in or rule out splenic enlargement. If the possibility of missing splenic enlargement remains an important clinical concern, then ultrasonography or scintigraphy is indicated. In the presence of percussion dullness, palpation should follow. If both tests are positive, the diagnosis of splenomegaly is established (providing the clinical suspicion of splenomegaly was at least 10% before examination). If palpation is negative, diagnostic imaging will be required to confidently rule in or rule out splenomegaly.

## BACK TO THE BEDSIDE

Returning to the three patients originally described at the beginning of this article, you may be able to confidently rule in splenic enlargement in the pale elderly women complaining of fatigue if your preexamination clinical suspicion of splenomegaly is at least 10%, and if both percussion and palpation are positive. Abdominal examination is not sufficiently sensitive to rule out splenic enlargement in the college student with symptoms of depression. Finally, you may choose to examine for splenic enlargement in the asymptomatic hypertensive man, but a negative examination may be a false-negative result, and a positive examination will require radiological confirmation to rule in splenomegaly.

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