Longer-Life Foundation Mini Grant Report: The Use of an Abdominal Pain Evaluation Tool to Study Decision Making in the Emergency Department

ABSTRACT

Introduction: Though there are several studies in the literature studies describing CT utilization in the ED, there is almost no data regarding which factors drive CT ordering or if CT improves diagnostic accuracy. To further evaluate clinical decision-making in the ED evaluation of abdominal pain, we developed a standardized method for obtaining real-time information regarding the physician's clinical decision making. The form was developed, field tested, and modified before using it in the following study.

Objectives: Use a standardized Abdominal Pain Evaluation Tool (APET) to answer the following questions: (1) Do patients with abdominal CT have a change in diagnosis or disposition more often than patients without? (2) Is ED diagnostic accuracy improved in patients with vs. without CT? (3) What factors most influence the decision to order an abdominal CT? (4) Is physician (EP) confidence in diagnosis and disposition improved with the use of CT?

Methods: ED patients $\geq$ 60 years, with non-traumatic abdominal pain were enrolled over a 6 week period. Age, gender, race; rate of x-ray, ultrasound, and CT utilization; preliminary and final ED Diagnosis (Dx); patient disposition; discharge and 2-week follow-up Dx were entered into the database. Using the APET, research assistants recorded the EPs Dx and disposition, and pre/post evaluation confidence levels, using a 5 point ordinal scale. Decision to order or not order a CT was recorded, along with the clinical information (history, PE, lab) that most influenced that decision. Patients had follow-up at 2 weeks to determine repeat ED visits or change in Dx. We compare

percent change in pre/post ED Dx and disposition for patients with vs. without CT using 95% CI. Percent agreement of final ED Dx to that of the follow-up diagnosis was compared between patients with CT and without, using 95% CI. EP (pre/post)confidence in Dx and disposition is compared for patients with CT vs. without, using the Wilcoxen Rank Sum test.

Results: 126 patients were enrolled with complete follow-up information. The rate for abdominal CT was 59% (95% CI = 50, 67). CT increased the percent of time that EPs changed their Dx (pre/post) [46% (95% CI = 34, 58) vs. 29% (95% CI = 16, 42.]. There was no significant difference in change in disposition (pre/post) between patients with vs. without CT. There was no difference in percent agreement of ED Dx to follow-up Dx between groups (CT=77% vs. No CT=81%). Preliminary Dx confidence was significantly lower for EPs who ordered a CT than for those who did not ($z= 3.96$, $p<0.001$). Patient history most influenced ordering a CT, whereas prior lab/imaging most influenced not ordering a CT.

Conclusion: Patients with CT had a change in Dx more often than patients who did not. This was associated with lower preliminary diagnostic confidence in this group. Percent change in disposition and concordance with 2-week follow-up diagnosis did not differ between the CT and no CT groups. EPs most often ordered CT based on history, and did not order CT when other diagnostic evaluation supported a diagnosis.

FULL REPORT

Introduction

Abdominal pain is the most common chief complaint among patients presenting to emergency departments (ED) in the United States.[1] Elderly patients presenting to EDs with abdominal pain frequently have serious conditions, with an estimated 25 to 42% requiring surgery.[2-4] The atypical presentations of abdominal pathology in seniors has also been documented.[5-10] Due to these concerns, a liberal policy towards these patients with regard to diagnostic evaluation, particularly radiologic imaging, and admission to the hospital has emerged. A recent study showed almost two-thirds of elderly patients with non-traumatic abdominal pain undergo either computed tomography (CT), ultrasound (US), or plain films during their initial ED evaluation, and over half of these patients were admitted to the hospital.[11, 12] There have been several recent studies[13-15] which have looked at the effect of abdominal CT to alter diagnosis and disposition in patients with abdominal pain, but none of these had a control group (i.e. patients with identical inclusion criteria who did not get CT during the course of their evaluation). Also, these studies did not follow-up patients to determine if the use of CT was associated with greater diagnostic accuracy than was seen in those patients without CT.

The objectives of this study were to use a standardized, real-time decision-making assessment tool to answer the following questions: (1) Do patients with abdominal CT have a change in diagnosis or disposition more often than patients without? (2) Is ED diagnostic accuracy improved in patients with vs. without CT? (3) What factors most

influence the decision to order an abdominal CT? (4) Is physician (EP) confidence in diagnosis and disposition improved with the use of CT?

We anticipate this information will help better understand the role of CT in the evaluation of seniors with acute non-traumatic abdominal pain and may potentially aid in the development of a clinical decision guide for diagnostic imaging in this challenging patient population.

Methods

Patients 60 years or older, presenting to a large academic ED during a six-week period (June/July 2004) with non-traumatic abdominal pain were eligible for the study. Patients with chronic abdominal pain (defined as duration $\geq$ 7 days) were excluded as were patients with surgery or trauma within the past 30 days. Informed consent was obtained from all study participants. Demographic data (age, gender, race); rate of plain x-rays, US, and CT utilization; patient disposition; and discharge diagnosis were obtained by chart review, using a standardized data collection form The APET was used to record preliminary and final ED diagnosis; and to measure preliminary and final physician confidence levels for both diagnosis and disposition, using a 5 point ordinal system (1=0-20%; 2=21-40%; 3=41-60%; 4=61-80%; 5=81-100%). Following the initial history and physical examination, research assistants asked the primary treating physician to rank up to two initial diagnoses and the likely disposition, along with their degree of confidence for each. Diagnoses were entered into the database using one of 30 discrete diagnostic categories and an "other" category. Disposition was limited to two choices: admit or discharge.

The decision to order a CT scan was recorded prospectively on the APET form. If a CT was ordered, the EP was asked what clinical information most influenced that decision. Physician responses were grouped into one of three areas: "history", "physical examination", or "laboratory/imaging". The EP was also asked whether the CT was ordered to: (1) confirm a diagnosis, (2) exclude a diagnosis, or (3) "fish" for a diagnosis. If no CT was ordered, the EP was asked what clinical information most influenced the decision to not order a CT.

Following availability of all diagnostic test results, the EP was asked for a final diagnosis and disposition, along with his or her degree of confidence for each. Patients were followed up by telephone interview at two weeks to determine mortality, repeat ED visits, or any change in diagnosis since discharge.

Statistical Analysis

We report overall CT utilization, along with CT utilization by age, race, gender, ED diagnosis, and disposition (admit to hospital vs. discharge home), using proportions with 95% confidence intervals. We compare percent change between the preliminary ED diagnoses and final ED diagnosis for patients who had ED CT and those that did not, using 95% CI. We calculate percent agreement of the final ED diagnosis to that of the discharge or two-week follow-up diagnosis for patients who had ED CT and those that did not, using 95% CI. We also compare percent change in disposition (preliminary disposition different from final disposition) among patients in the ED CT vs. no ED CT group. Physician confidence in their diagnosis and disposition (both pre and post laboratory testing and imaging) is compared between patients with abdominal CT and those without, using the Wilcoxen Rank Sum test. Differences in preliminary and final

physician confidence levels for patients with CT vs. those without, is compared using the Mann-Whitney Rank Sum Test. Finally, we report the percentage of time CT was ordered to "rule-in", "rule-out", or "fish" for a diagnosis. Statistical tests were conducted using Statistical Program for the Social Science (SPSS) Version 12.0**.**

RESULTS

There 158 patients screened, 132 enrolled and 126 with complete follow-up information. The rate of abdominal CT in enrolled patients was 59% (95% CI = 50, 67). This was significantly higher than the 24% (95% CI=17,32) rate in non-enrolled patients meeting selection criteria during the same time period. There was a lower rate of CT utilization in African-Americans compared to Caucasians, and a trend toward lower utilization of CT in women. However, there was an increase in the utilization of ultrasound in these groups, such that the combined rates of CT and ultrasound were similar across all demographics. CT utilization rates did not differ significantly by disposition.

There was a significant increase in the percentage of time that EPs changed their diagnosis (preliminary to final) in patients with abdominal CT, compared to those without [46% (95% CI = 34, 58) vs. 29% (95% CI = 16, 42.]. Change in disposition did not differ between patients who had CT and those that did not: 27.9% (95%CI=16 to 39) vs. 28.2% (95%CI=13 to 43). Concordance between the final ED diagnosis and discharge/follow-up diagnosis did not differ between patients who had CT and those that did not, 77% (95% CI = 67 to 87) vs. 81% (95% CI = 70,to 92)]. EPs who ordered an abdominal CT performed in the ED had significantly lower confidence in their preliminary diagnosis than EPs who did not ($z= 3.96$, $p<0.001$). This difference in

confidence level was no longer present for the final ED diagnosis. The change in diagnostic confidence levels (pre-post evaluation) was significant for both CT ($z= -6.23$, $p<0.001$) and no CT ($z= -3.76$, $p<0.001$) groups. Confidence in the preliminary disposition was not significantly different for EPs that ordered abdominal CT vs. those that did not ($z = 1.24$, $p= 0.24$). There was however, a significant change in the pre-post confidence levels for disposition in both groups, though the CT group showed a larger change: CT ($z = -5.43$, $p<0.001$) vs. no CT ($z= -2.92$, $p=0.004$) (Figure 2).

Patient history was most frequently cited as the major factor in the decision to order a CT, particularly a previous history of a bowel obstruction (N=9; 32%), prior surgery (N=8; 28%), or renal stone (N=8; 28%). The most influential factor for not ordering a CT was a positive urinalysis (N=8; 40%) or plain film results (N=5; 25%). By physician report, CT was obtained 53% of the time to "rule-out" or exclude a diagnosis, 31% to "rule-in" or confirm a diagnosis, and 16% of the time "fishing" for a diagnosis.

DISCUSSION

CT is a commonly utilized imaging procedure in the ED evaluation of adult patients with abdominal pain.[16] We did not see significant differences in the rate of CT utilization based on age, gender, preliminary ED diagnosis, or disposition. CT utilization was significantly lower in African-Americans than Caucasians; however ultrasound utilization was increased in blacks making the overall rate of diagnostic imaging similar in both groups. The APET helped define the clinical reasoning behind these trends, and it seemed that gallbladder disease was more often listed as a likely diagnosis in African-Americans and women, making ultrasound the diagnostic test of choice. There was a

trend toward increasing CT utilization in admitted patients. This might be expected, since admitted patients are presumably more likely to have potentially serious pathology and/or need for surgery. Nevertheless, discharged patients had CT performed well over a third of the time. This suggests that CT is often used to "rule out" serious pathology in patients without a clear diagnosis, who otherwise appear to not have a serious cause of their pain. This is further supported by the fact that physicians reported getting a CT to "rule-out" disease more often than for either of the other two options ("rule-in" or "fish") combined.

It is difficult to isolate and analyze the usefulness of CT in medical decision-making under the real world conditions when other information is concurrently being made available. There are a large number of studies that have looked at the sensitivity of CT in specific diagnostic conditions such as appendicitis[17-20] or mesenteric ischemia.[21-23] These studies provide clinicians the scientific basis to use CT results to "rule-out" specific clinical conditions. However, this is not normally the way the test is used in clinical practice.

The evaluation of the patient with undifferentiated abdominal pain requires the application of various test results to the pre-test probability of a given disease, based on the initial history and physical examination. In our study we used a clinical decision assessment tool (APET) to determine which aspects of the history and/or physical exam play the largest role in the clinical decision to order or not order a CT scan and whether any additional diagnostic tests were also influential in this decision. Historical factors were the most often cited reason for ordering an abdominal CT. Laboratory (e.g. urinalysis) or imaging results (e.g. plain radiographs) that strongly supported a diagnosis

(reflected by high physician confidence) were the most influential factors for NOT ordering a CT.

Several recent studies have examined or reviewed the effect of abdominal CT on diagnosis and disposition of patients with abdominal pain.[13, 14, 20, 24-26] Rosen et al, in a small prospective observational study, found that CT altered diagnosis and patient management over half the time.[26] A larger follow-up study confirmed these findings and demonstrated a net reduction in admission rate (pre CT to post CT) of 17%, which was most marked in the large rule out appendicitis group.[14] Nagurney et al showed a change in diagnosis and disposition in about 40% of subjects, but the contribution of CT imaging to this change was not quantified.[20] Malone et al showed that non-enhanced CT was highly reliable in ruling out appendicitis and finding alternative diagnoses.[25] Esses et al recently evaluated the ability of CT to alter clinical decision-making in elderly ED patients with abdominal pain and showed a change in diagnosis in 45% and a change in disposition in about 25% of patients.[15]

Our results support the hypothesis that CT alters diagnosis in nearly half the subjects in whom it is obtained; compared to all other diagnostic testing which altered diagnosis in under one-third of subjects. Alteration in patient disposition occurred in our study to a smaller degree than that reported by Nagurney or Rosen, but to a similar degree to that reported by Esses, who also studied exclusively an older population. It may be expected that the utilization rate and the way in which abdominal CT is used will vary in this patient population. Also baseline admission rates are higher in seniors and the net effect of diagnostic testing may differ.

It is important to recognize that none of the above referenced studies evaluating the usefulness of CT in diagnosis and disposition had a "control" group, i.e. abdominal pain patients in whom no CT was ordered. This makes it difficult to determine how much CT contributes beyond other diagnostic testing to the overall change in diagnosis and disposition which occurs in these studies. Our study helped demonstrate that all diagnostic testing significantly alters the preliminary diagnosis and to a less extent disposition. But it confirms the unproven notion that CT affects decision making more than other tests. In fact, CT affects decision-making more than all other diagnostic tests combined. A likely related finding was the significantly larger improvement in diagnostic confidence (pre-post evaluation) among EPs who obtained CT on their patients, compared to those who did not. Others have shown improved diagnostic confidence with the use of abdominal CT.[26] However, the comparison with a non-CT group allows us to show that this improved confidence results almost exclusively from a significantly lower initial confidence in the preliminary diagnosis in the CT group, since final EP confidence levels were almost identical whether their patients had CT or not. Physicians tend to use CT in two ways: less often to refine or confirm the presence of a serious condition and most often to rule out a potentially serious condition when they do not have a confident alternative diagnosis based on their preliminary evaluation. Patients who are considered to have a high likelihood of an alternative diagnosis not requiring CT for clarification are not scanned. Finally, it is important to recognize that the concordance of the final ED diagnosis to the discharge or follow-up diagnosis (a surrogate for diagnostic accuracy) was not significantly different between groups, being

about 80% in each. Thus EPs, when they are confident in their diagnosis for the cause of abdominal pain in older adults, are correct about 80% of the time.

NEXT STEP

Using this information, we will attempt to develop a clinical practice guideline which is based on physician confidence along with the more common patient clinical indicators.

LAY SUMMARY

There are currently over 200 clinical decision rules that have been developed, with the simplest and best known rules still having less than 50% of physicians using them. This study confirms the importance of CT testing in older patients with abdominal pain, but more importantly it emphasizes the need to take physician confidence levels into account when developing clinical decision rules. When physician confidence is high, patients without CT are correctly diagnosed as often as those with CT. Thus there is no need for CT for 40% or more of patients. In order to efficiently use this technology, healthcare workers must look at confidence levels as a part of the clinical decision-making process.

Table 1. Distribution of Older Emergency Department Patients with Abdominal Pain, Comparing Demographic and Clinical Factors with Radiology Utilization Rates.

Categories	n=126	**Abdominal X-ray** n=64 # (%; 95% CI)	**Computed Tomography** n=74 # (%; 95% CI)	**Ultrasound** n=16 # (%; 95% CI)
AGE				
60 to 74	n = 75 (60%)	35 (47; 35 to 58)	45 (60; 49 to 71)	9 (12; 4 to 20)
> 74	n = 51 (40%)	29 (57; 43 to 71)	29 (57; 43 to 71)	7 (14; 4 to 24)
RACE[1]				
Caucasian	n = 64 (52%)	34 (53; 41 to 66)	42 (66; 54 to 78)	6 (9; 2 to 17)
A-A**	n = 58 (48%)	26 (45; 32 to 58)	28 (48; 35 to 62)	10 (17; 7 to 27)
SEX				
Female	n = 78 (62%)	38 (49; 37 to 60)	43 (55; 44 to 66)	12 (15; 7 to 24)
Male	n = 48 (38%)	26 (54; 50 to 69)	31 (65; 51 to 79)	4 (8; 0 to 16)
ADMISSION STATUS				
Discharged	n = 39 (31%)	16 (41; 25 to 57)	16 (59; 43 to 75)	5 (13; 2 to 24)
Admitted	n = 87 (69%)	48 (55; 44 to 66)	51 (59; 48 to 69)	11 (13; 6 to 20)

** A-A – African American. Note that for race, four values were not included in this table: two were Asian and two were Hispanic.

Table 2. Leading Preliminary Diagnoses with Computed Tomography, "Final" ED Diagnosis, and Discharge (or Follow-up) Diagnosis (Frequency and Proportions), as well as Preliminary and "Final" ED Diagnostic Confidence (Means).

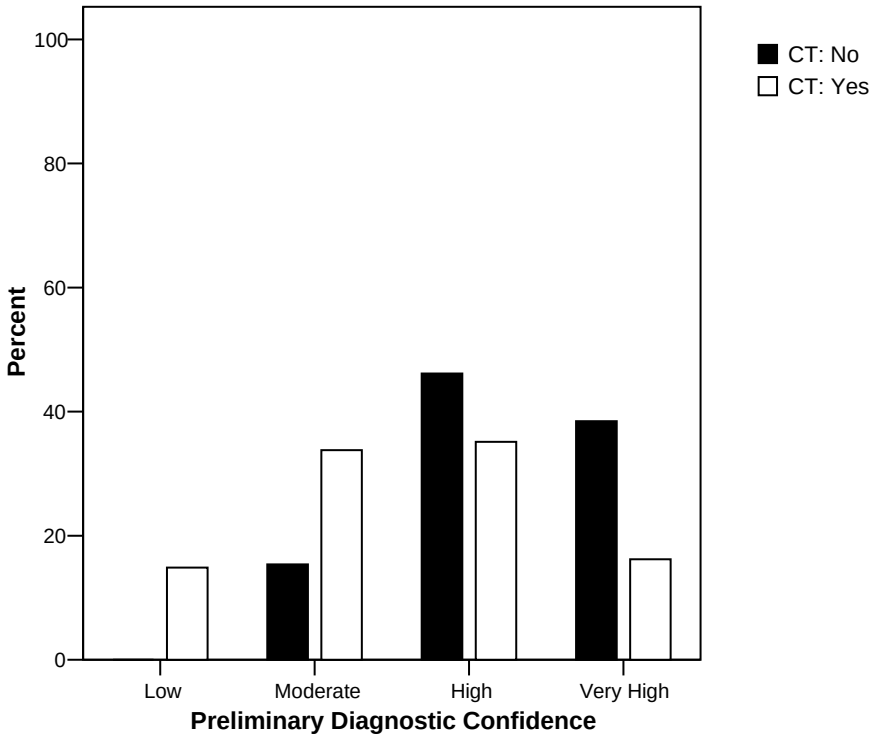
Preliminary Dx.	Received CT	"Final" ED Dx.	D/C or Follow-up Dx.	Preliminary Dx. Confidence*	"Final" ED Dx. Confidence*
Bowel Obstruction 20 (15.9%)					
	Yes 16 (80%)	7 (44%)	7 (44%)	3.94	4.88
	No 4 (20%)	1 (25%)	0 (0%)	4.00	4.75
Biliary Disease 13 (10.3%)					
	Yes 4 (31%)	1 (25%)	1 (25%)	3.50	4.50
	No 9 (69%)	3 (33%)	4 (44%)	3.89	4.22
UTI 12 (9.5%)					
	Yes 7 (58%)	2 (29%)	3 (43%)	3.29	5.00
	No 5 (42%)	4 (80%)	4 (80%)	4.40	5.00
Gastroenteritis 9 (7.1%)					
	Yes 4 (44%)	3 (75%)	3 (75%)	3.50	4.70
	No 5 (56%)	2 (40%)	2 (40%)	4.40	5.00
Peptic Ulcer Disease 8 (6.3%)					
	Yes 3 (33%)	0 (0%)	0 (0%)	3.00	5.00
	No 5 (67%)	3 (60%)	3 (60%)	3.80	4.60
Urolithiasis 8 (6.3%)					
	Yes 6 (75%)	3 (50%)	3 (50%)	3.33	4.33
	No 2 (25%)	1 (50%)	1 (50%)	4.50	4.50
Colitis 7 (5.6%)					
	Yes 3 (43%)	1 (33%)	1 (33%)	3.00	4.67
	No 4 (57%)	3 (75%)	3 (75%)	4.50	4.75
Constipation 7 (5.6%)					
	Yes 2 (29%)	0 (0%)	1 (50%)	4.00	5.00
	No 5 (71%)	4 (80%)	3 (60%)	4.00	4.40
Diverticulitis 7 (5.6%)					
	Yes 7 (100%)	5 (71%)	4 (57%)	3.57	4.71
	No 0 (0%)	0 (0%)	0 (0%)	-	-

Table 3. Changes in Disposition for CT vs. No CT Patients.

		Final ED Disposition		
Patients without CT Scans		Discharged	Admitted	Totals
Preliminary Disposition	Discharged	13	8	21
	Admitted	3	28	31
	Totals	16	36	52
Patients with CT Scans		Discharged	Admitted	Totals
Preliminary Disposition	Discharged	13	7	20
	Admitted	10	44	54
	Totals	23	51	74

ED = Emergency department; CT = computed tomography.

Figure 1. Comparison of Physician Confidence for their Diagnosis, Comparing Preliminary and Final Decisions (n = 126).



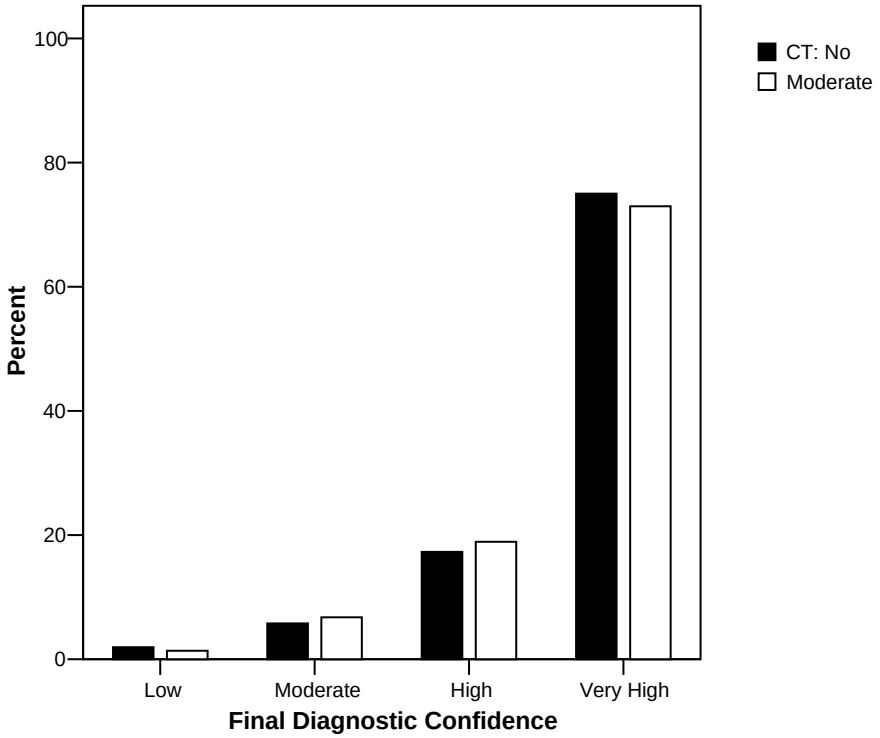
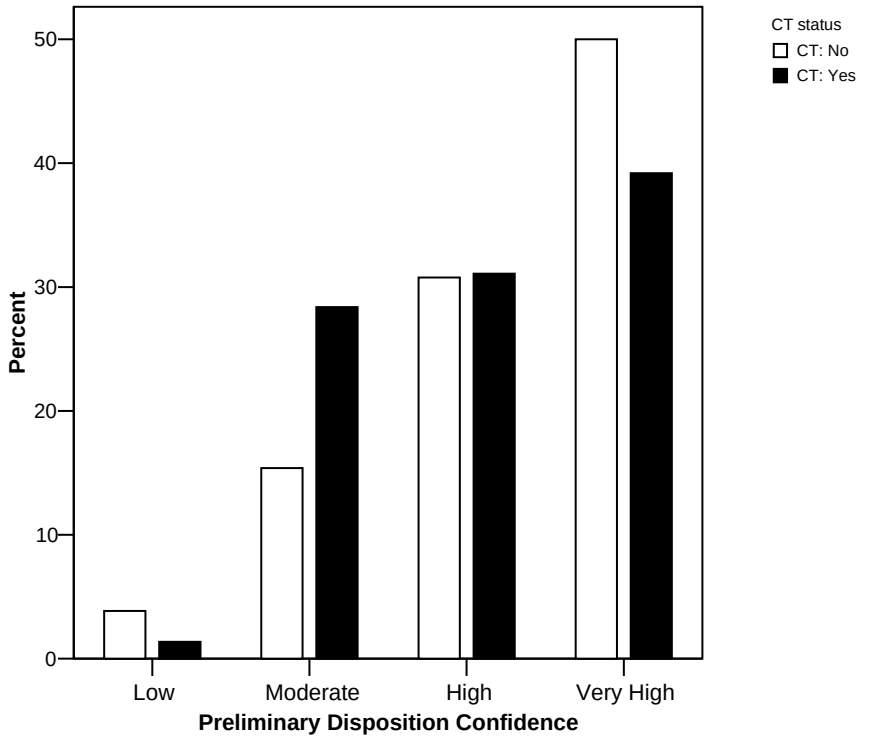
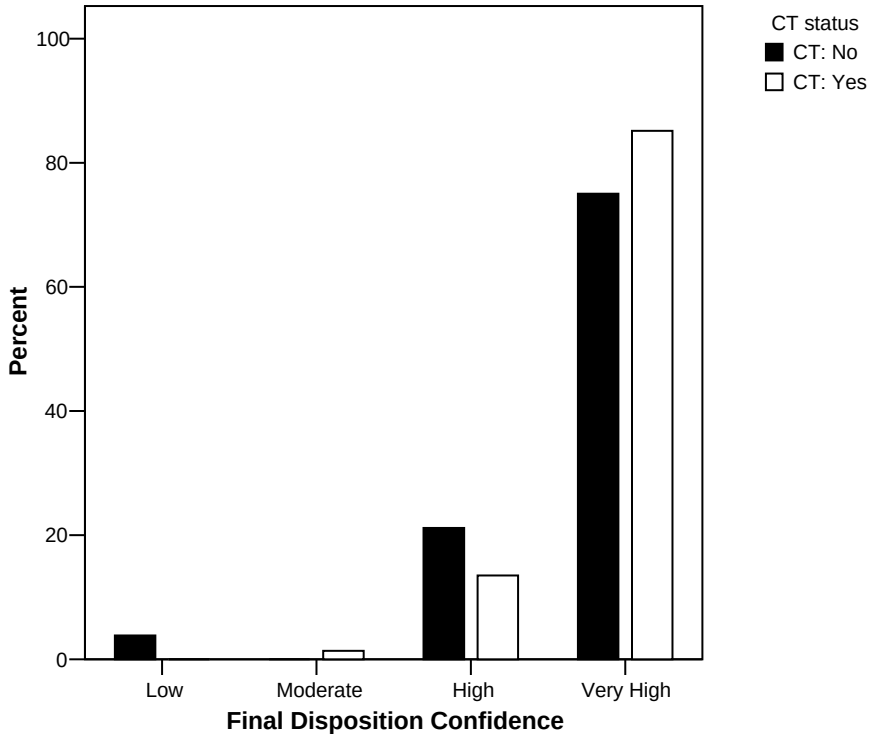


Figure 2. Comparison of Physicians' Confidence for their Disposition, Comparing Preliminary and Final Decisions (n = 126).





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