Cost-Effectiveness of CT Angiography in Screening for Aneurysm in Spontaneous Subarachnoid Hemorrhage

Pinakin Rameshchandra Jethwa MD; Ennis J. Duffis M.D.; Chirag D. Gandhi MD; Charles J. Prestigiacomo MD FACS
Rutgers University - New Jersey Medical School
Department of Neurological Surgery, Newark, NJ

Introduction

The popularity of using CT Angiography (CTA) to identify an aneurysm as the source of a spontaneous subarachnoid hemorrhage (SAH) has been increasing in recent years. The ability to non-invasively characterize a ruptured aneurysm and make earlier treatment decisions are obvious advantages to this technology; however, with the increasing frequency of endovascular treatments for ruptured aneurysms, some have argued that this practice is an unnecessary use of time and resources. We explored this issue using from a cost-effectiveness perspective.

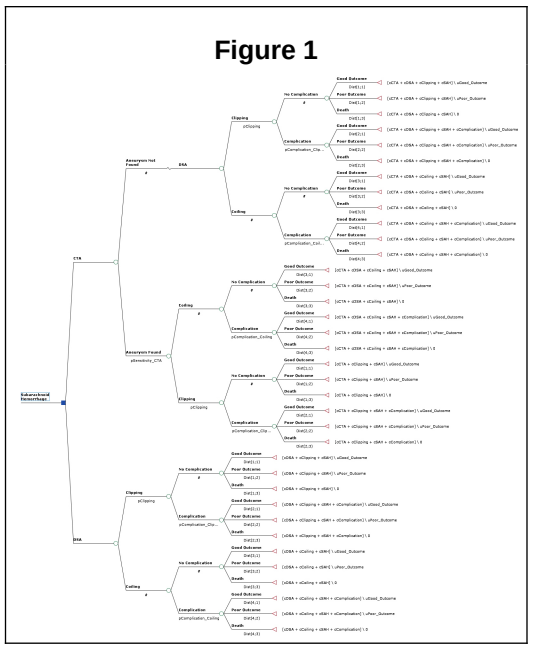
Methods

A two-armed decision tree was created using TreeAge Pro Suite 2012; comparing SAH follow up with Digital Subtraction Angiography (DSA) or CTA. Based on an extensive literature review, costs and utilities were assigned to each potential outcome accounting for screening methods, treatment modalities, and complications. Sensitivity analysis was performed to determine the most significant variables in the model and the cost-effectiveness of each strategy. A Monte Carlo simulation was then conducted, by sampling each

Results

The structure of the decision tree model is shown in Figure 1.

Figure 1



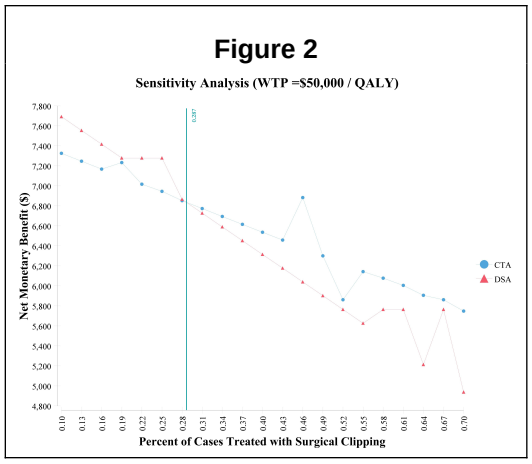
Input parameters for the model are given in Table 1 and are based on a thorough literature review. For our model we assumed a 25% aneurysm clipping rate and a 95% CTA sensitivity based on our recent institutional data. All analyses were performed using a willingness-to-pay (WTP) threshold of $50,000 / QALY.

Table 1

Type	Name	Description	Mean	Standard Deviation
Dirichlet	Distribution1	Outcome Probabilities for Uncomplicated Aneuysm Clipping	List(69.1;21.9;9)	
Dirichlet	Distribution2	Outcome Probabilities for Complicated Aneurysm Clipping	List(20;30;50)	
Dirichlet	Distribution3	Outcome Probabilities for Uncomplicated Aneurysm Coiling	List(76.5;15.5;8)	
Dirichlet	Distribution4	Outcome Probabilities for Complicated Aneurysm Coiling	List(20;30;50)	
Beta	pClipping	Proportion of Aneurysms Treated with Microsurgical Clipping	0.25	0.1
Beta	pComplication_Clipping	Probability of Complication from Surgical Clipping	0.11	0.05
Beta	pComplication_Coiling	Probability of Complication from Endovascular Coiling	0.9	0.05
Normal	cCTA	Cost of CT Angiogram	$561.96	100
Normal	cClipping	Cost of Surgical Clipping	$3,440.41	1000
Normal	cSAH	Cost of Hospitalization for Subarachnoid Hemorrhage	$33,106	5000
Beta	uGood_Outcome	Utility of mRS 0-2	0.8	0.1
Beta	uPoor_Outcome	Utility of mRS 3-5	0.3	0.1
Normal	cComplication	Costs Associated with Surgical Complication	$24,049	5000
Normal	cDSA	Cost of Digital Subtraction Angiogram	$2,063.36	500
Normal	cCoiling	Cost of Endovascular Coiling of Aneurysm	$2,406.14	500
Beta	pSensitivity_CTA	Sensitivity of CTA in Identifying Aneurysm in Spontaneous SAH	0.95	0.025

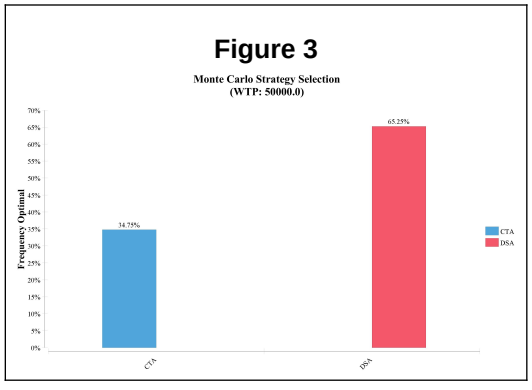
In the base case scenario (all variables kept at the mean value of their distribution), DSA was found to be the more cost-effective screening test. Sensitivity analysis revealed that CTA became the more cost-effective screening when the proportion of aneurysms clipped was greater than 28.7% (Figure 2).

Figure 2



The results of the 10,000-iteration Monte Carlo simulation revealed that DSA was the more cost-effective strategy in 64.6% of cases (Figure 3).

Figure 3



Conclusions

The most important factor in determining the cost-effectiveness of CTA as a screening test for ruptured aneurysms is the proportion of cases that are ultimately treated with microsurgical clipping. Our model suggests that the threshold for which CTA would be more cost-effective is a clipping rate of = 28.7%. The threshold at which CTA is more cost-effective could potentially be lowered if the information from the CTA data were used to perform a limited angiogram, as our model assume a complete angiogram were performed in all cases.

Learning Objectives

By the conclusion of this session, participants should be able to:

1) Understand the basic principles of cost-effectiveness research and its application to the problem analyzed.

2) Identify the key variables affecting the choice of screening test for a ruptured aneurysm.

3) Review their own data to determine if their institutional data is consistent with cost-effective care.