

The Vascular Malformation Calculator:

A Model For Estimating The Life-time Natural
Risks Of Vascular Malformations Against The
Risks Of Intervention



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Estimating risk-benefit ratio

- ❧ Clinicians often make mental estimate of life-time risk AVM haemorrhage
- ❧ This is often done by multiplying the annual risk by number of years to gain
- ❧ A better method of calculating cumulative risk is to utilise probability calculation

Calculation: Simple Vs Probability, calculation

	Simple	Probability
1% annual risk over 10 years	10	9.6
2 % annual risk over 30 years	60	45

Calculating Cumulative risk

$$a = 1 - r$$

Where,

a, risk of the adverse event not occurring

r, risk of the adverse event happening

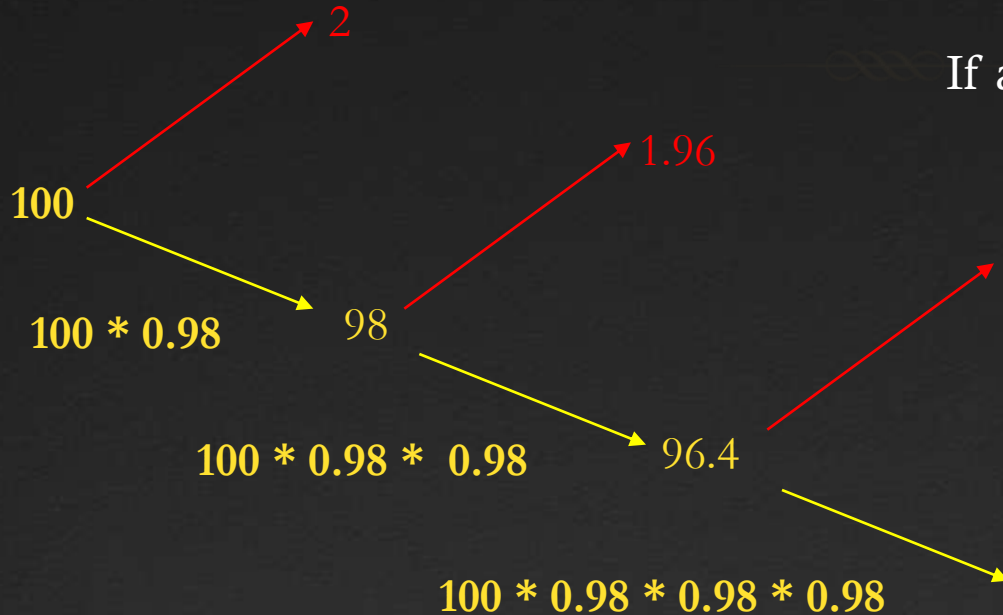
$$c = 100 \times (1 - a^{\text{years}})$$

Where,

c, cumulative risk of the the adverse event happening over the specified number of years

Maths of Probability

If annual risk of AVM haemorrhage = 2%



$$\begin{aligned} &100 * 0.98 \\ &100 * 0.98 * 0.98 \\ &100 * 0.98 * 0.98 * 0.98 \end{aligned}$$

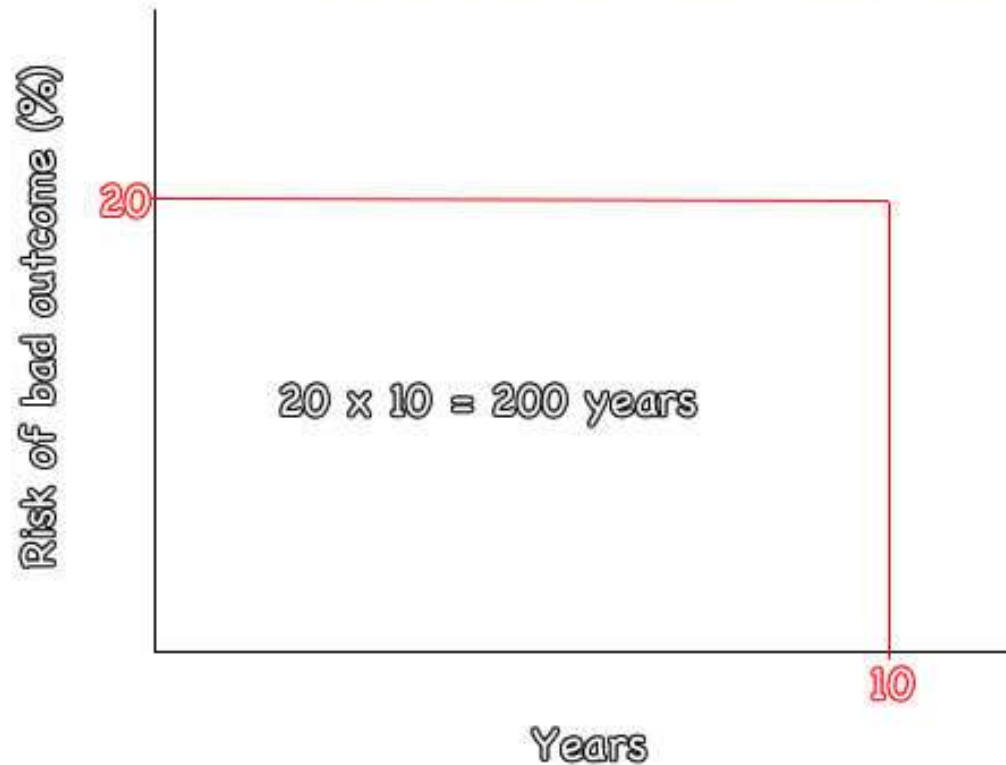
Chance of non-rupture = $100 * (1 - \text{risk of rupture})^{\text{years}}$

Chance of rupture = $100 - \text{chance of non-rupture}$

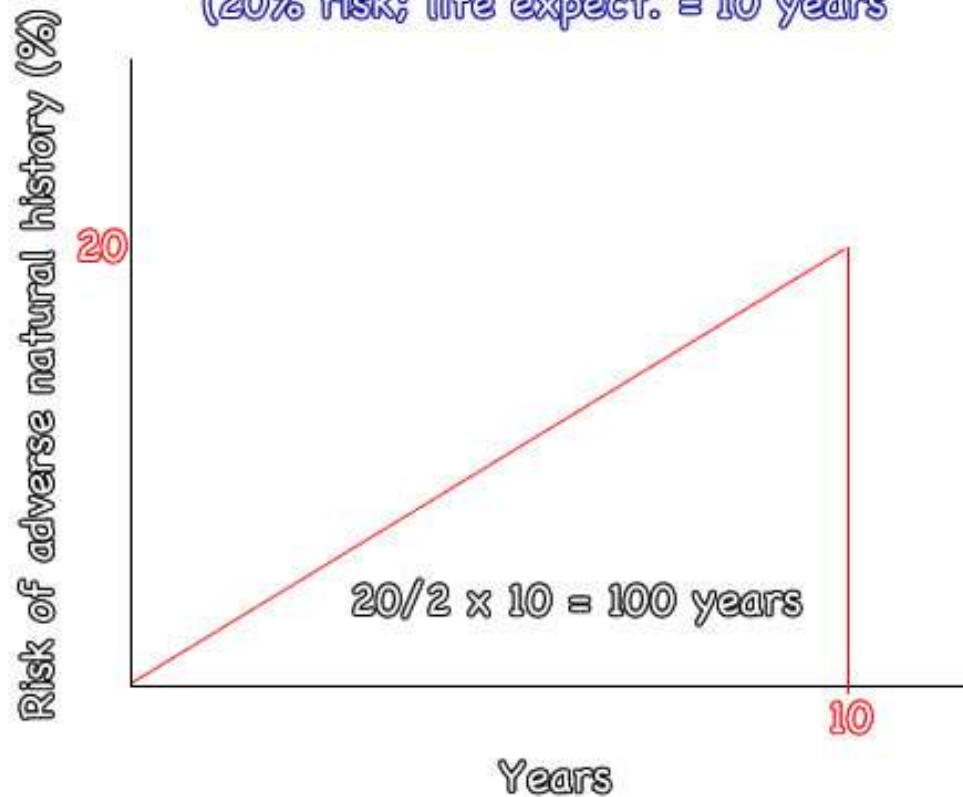
Risk of Intervention *Vs* natural history

- ∞ The Risk of intervention is immediate
- ∞ Risk of natural history is distributed over the life-time

Life-years lost from intervention
(20% bad outcome; life expect. = 10 years)



Life-years lost from adverse natural history
(20% risk; life expect. = 10 years)



A Calculator that takes into account,

- ∞ Annual risk of haemorrhage, morbidity, mortality
- ∞ The risk of intervention; adjustable risk
- ∞ The age, sex, average life expectancy of the patient
- ∞ The period over which the cumulative risk need to be calculated

Example #1

- ∞ 45-year lady from UK
- ∞ Use the figures from Ondra et al.'s study (Ondra SL et al. J Neurosurg 1990; 73: 387-391)
- ∞ Patient has a Spetzler-Martin Grade II AVM
- ∞ ? What is the cumulative life-time risk of adverse events for the patient
- ∞ ? Natural history Vs Intervention

Type of calculation

- Risk Vs benefit
- Cumulative risk

Calculation be based on 'age/average UK life expectancy' or for over 'a certain period'

- Age
- Time period

45



Sex

- Female
- Male

The average life-expectancy is 37.55 years

The annual risk of the adverse event

- Use Ondra et al.'s figures *(only applies to AVMs)*

- Use a single annual risk rate ; rate (%) = 1.0

Save setting

- Use multiple rates:

Initial rate: 18.2 , 11 Years

Save settings

Subsequent rate: 3.4

Calculate

Cumulative risk for serious morbidity and mortality would be about 64%

Cumulative risk of mortality would be about 31%

Cumulative risk for haematoma is about 78%

Type of calculation

- Risk Vs benefit
- Cumulative risk

Calculation be based on 'age/average UK life expectancy' or for over 'a certain period'

- Age
- Time period

45



Sex

- Female
- Male

The average life-expectancy is 37.55 years

The annual risk of serious morbidity and mortality associated with the natural history

- Use Ondra et al.'s figures *(only applies to AVMs)*

- Use a single annual risk rate ; rate (%) = 1.0

Save setting

- Use multiple rates:

Initial rate: 18.2 , 11 Years

Save settings

Subsequent rate: 3.4

Complications

- Spetzler and Martin study: Grade II

- Custom rate: 5.0

Calculate

Cumulative risk for serious morbidity and mortality would be about 64%

Cumulative risk of mortality would be about 31%

Cumulative risk for haematoma is about 78%

The average net years saved by the intervention would be about 14.1 year(s)