**Supplementary Material**

**Supplementary Table 1. Demographic characteristics of aneurysms by age.**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Characteristic** | **N** | **20-30** | **31-40** | **41-50** | | **51-60** | **61-70** | **71-80** | **81-90** | **91-100** | ***p* value** |
| **Hypertension** | | | | | | | | | | | |
| **Unruptured** | 1407 | 3 (16%) | 15 (21%) | | 85 (42%) | 173 (54%) | 268 (59%) | 209 (68%) | 27 (82%) | 1(50%) | **<.001\*** |
| **Ruptured** | 605 | 3 (16%) | 7 (16%) | 51 (44%) | | 85 (52%) | 89 (67%) | 53 (62%) | 34 (79%) | 2 (67%) | **<.001\*** |
| **Smoking** | | | | | | | | | | | |
| **Unruptured** | 1397 |  | | | | | | | | | **<.001\*** |
| Never smoker |  | 13 (68%) | 42 (59%) | 110 (54%) | | 168 (53%) | 277 (61%) | 214 (71%) | 25 (76%) | 2 (100%) |  |
| Prior smoker |  | 3 (16%) | 8 (11%) | 36 (18%) | | 68 (21%) | 94 (21%) | 51 (17%) | 4 (12%) | 0 (0%) |  |
| Current smoker |  | 3 (16%) | 21 (30%) | 56 (28%) | | 82 (26%) | 80 (18%) | 36 (12%) | 4 (12%) | 0 (0%) |  |
| **Ruptured** | 587 |  | | | | | | | | | **<.001\*** |
| Never smoker |  | 7 (39%) | 29 (69%) | 64 (56%) | | 93 (57%) | 74 (58%) | 51 (65%) | 38 (93%) | 2 (100%) |  |
| Prior smoker |  | 1 (5.6%) | 3 (7.1%) | 11 (9.6%) | | 9 (5.5%) | 18 (14%) | 12 (15%) | 2 (4.9%) | 0 (0%) |  |
| Current smoker |  | 10 (56%) | 10 (24%) | 39 (34%) | | 61 (37%) | 36 (28%) | 16 (20%) | 1 (2.4%) | 0 (0%) |  |
| **Aneurysm number** | | | | | | | | | | | |
| **Unruptured** | 1407 |  | | | | | | | | | **.016\*** |
| One |  | 15 (79%) | 61 (84%) | 169 (84%) | | 262 (82%) | 384 (85%) | 273 (89%) | 31 (94%) | 2 (100%) |  |
| Two |  | 4 (21%) | 8 (11%) | 27 (13%) | | 30 (9.4%) | 47 (10%) | 27 (8.8%) | 2 (6.1%) | 0 (0%) |  |
| Three and more |  | 0 (0%) | 4 (5.5%) | 6 (3.0%) | | 28 (8.8%) | 21 (4.6%) | 6 (2.0%) | 0 (0%) | 0 (0%) |  |
| **Ruptured** | 606 |  | | | | | | | | | .141\* |
| One |  | 15 (79%) | 38 (88%) | 92 (79%) | | 135 (82%) | 117 (88%) | 68 (80%) | 42 (98%) | 2 (67%) |  |
| Two |  | 1 (5.3%) | 4 (9.3%) | 18 (16%) | | 17 (10%) | 10 (7.5%) | 11 (13%) | 1 (2.3%) | 1 (33%) |  |
| Three and more |  | 3 (16%) | 1 (2.3%) | 6 (5.2%) | | 12 (7.3%) | 6 (4.5%) | 6 (7.1%) | 0 (0%) | 0 (0%) |  |

\*Fisher’s exact test was utilized for comparison among groups

**Supplementary Table 2. Prevalence of unruptured and ruptured aneurysms across age groups**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Unruptured** |  |  |  |  |  |  |  |  | Total |
| Age | 20-30 | 31-40 | 41-50 | 51-60 | 61-70 | 71-80 | 81-90 | 91-100 |  |
| Number (%) | 19  (1.4%) | 73  (5.2%) | 202  (14%) | 320  (23%) | 452 (32%) | 306 (22%) | 33 (2.3%) | 2  (0.1%) | 1407 (100%) |
| **Ruptured** |  |  |  |  |  |  |  |  | Total |
| Age | 20-30 | 31-40 | 41-50 | 51-60 | 61-70 | 71-80 | 81-89 | 90-100 |  |
| Number (%) | 19 (3.1%) | 43 (7.1%) | 117 (19%) | 164 (27%) | 133 (22%) | 85 (14%) | 43 (7.1%) | 3 (0.5%) | 607 (100%) |

**Supplementary Table 3. Location of ruptured and unruptured aneurysms across age groups.**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Characteristic** | | **N** | **20-30** | | **31-40** | | **41-50** | | **51-60** | **61-70** | **71-80** | **81-89** | **90-100** | ***p*** |
| **Circulation** | | | | | | | | | | | | | | |
| **Unruptured** | 1,407 | | |  | | | | | | | | | | .114\* |
| Anterior |  | | | 17 (89%) | | 68 (93%) | | 192 (95%) | 306 (96%) | 421 (93%) | 286 (93%) | 27 (82%) | 2 (100%) |  |
| Posterior |  | | | 2 (11%) | | 5 (6.8%) | | 10 (5.0%) | 14 (4.4%) | 31 (6.9%) | 20 (6.5%) | 6 (18%) | 0 (0%) |  |
| **Ruptured** | 607 | | |  | | | | | | | | | | .82\* |
| Anterior |  | | | 16 (84%) | | 37 (86%) | | 105 (90%) | 144 (88%) | 119 (89%) | 76 (89%) | 39 (91%) | 2 (67%) |  |
| Posterior |  | | | 3 (16%) | | 6 (14%) | | 12 (10%) | 20 (12%) | 14 (11%) | 9 (11%) | 4 (9.3%) | 1 (33%) |  |

\*Fisher’s exact test was utilized for comparison among groups

**Supplementary table 4. Location of aneurysm in each age group**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Characteristic** | **N** | **20-30** | **31-40** | **41-50** | **51-60** | **61-70** | **71-80** | **81-90** | **91-100** | ***p* value** |
| **Aneurysm location** | | | | | | | | | | |
| **Unruptured N (%)** | 1,407 |  | | | | | | | | **.022\*** |
| ICA |  | **9 (47%)** | **44 (60%)** | **86 (43%)** | **128 (40%)** | **137 (30%)** | **98 (32%)** | **11 (33%)** | **1 (50%)** |  |
| ACOM |  | 0 (0%) | **8 (11%)** | **30 (15%)** | **43 (13%)** | **62 (14%)** | **43 (14%)** | 2 (6.1%) | 0 (0%) |  |
| ACA |  | 0 (0%) | 1 (1.4%) | 6 (3.0%) | 12 (3.8%) | 20 (4.4%) | 14 (4.6%) | 1 (3.0%) | 0 (0%) |  |
| PCOM |  | 1 (5.3%) | 3 (4.1%) | 21 (10%) | 37 (12%) | 56 (12%) | **43 (14%)** | **7 (21%)** | **1 (50%)** |  |
| MCA |  | **7 (37%)** | **11 (15%)** | **47 (23%)** | **85 (27%)** | **135 (30%)** | **83 (27%)** | **5 (15%)** | 0 (0%) |  |
| VA |  | 0 (0%) | 1 (1.4%) | 5 (2.5%) | 3 (0.9%) | 5 (1.1%) | 4 (1.3%) | 1 (3.0%) | 0 (0%) |  |
| BA |  | **2 (11%)** | 4 (5.5%) | 5 (2.5%) | 8 (2.5%) | 24 (5.3%) | 15 (4.9%) | 4 (12%) | 0 (0%) |  |
| VBJ |  | 0 (0%) | 1 (1.4%) | 2 (1.0%) | 1 (0.3%) | 11 (2.4%) | 5 (1.6%) | 1 (3.0%) | 0 (0%) |  |
| PCA |  | 0 (0%) | 0 (0%) | 0 (0%) | 3 (0.9%) | 2 (0.4%) | 1 (0.3%) | 1 (3.0%) | 0 (0%) |  |
| **Ruptured N (%)** | 607 |  | | | | | | | | **<.001\*** |
| ICA |  | **6 (32%)** | 4 (9.3%) | 14 (12%) | 13 (7.9%) | 6 (4.5%) | 7 (8.2%) | 2 (4.7%) | 0 (0%) |  |
| ACOM |  | 2 (11%) | **10 (23%)** | **28 (24%)** | **45 (27%)** | **27 (20%)** | **27 (32%)** | **10 (23%)** | **1 (33%)** |  |
| ACA |  | 0 (0%) | 2 (4.7%) | 3 (2.6%) | 8 (4.9%) | 12 (9.0%) | 4 (4.7%) | 1 (2.3%) | 0 (0%) |  |
| PCOM |  | **4 (21%)** | **7 (16%)** | **19 (16%)** | **25 (15%)** | **23 (17%)** | **23 (27%)** | **17 (40%)** | **1 (33%)** |  |
| MCA |  | **3 (16%)** | **14 (33%)** | **38 (32%)** | **51 (31%)** | **46 (35%)** | **15 (18%)** | **8 (19%)** | 0 (0%) |  |
| VA |  | 2 (11%) | 1 (2.3%) | 3 (2.6%) | 8 (4.9%) | 8 (6.0%) | 3 (3.5%) | 1 (2.3%) | 0 (0%) |  |
| BA |  | 1 (5.3%) | 4 (9.3%) | 9 (7.7%) | 10 (6.1%) | 6 (4.5%) | 4 (4.7%) | 2 (4.7%) | **1 (33%)** |  |
| VBJ |  | 1 (5.3%) | 0 (0%) | 3 (2.6%) | 2 (1.2%) | 5 (3.8%) | 0 (0%) | 1 (2.3%) | 0 (0%) |  |
| PCA |  | 0 (0%) | 1 (2.3%) | 0 (0%) | 2 (1.2%) | 0 (0%) | 2 (2.4%) | 1 (2.3%) | 0 (0%) |  |

\*Fisher’s exact test was utilized for comparison among groups

ACOM= Anterior communicating artery; ACA= Anterior cerebral artery; PCOM= Posterior communicating artery; MCA= Middle cerebral artery; ICA= Internal carotid artery; PCA= Posterior cerebral artery; VBJ= Vertebrobasilar junction; PCA= Posterior cerebral artery.

**Supplementary Table 5. Univariate analysis of characteristics of ruptured aneurysms by age group**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Age** | **20-50 years** | | | | **51-70 years** | | | | **71-100 years** | | | |
| **Location** | **OR** | **95% CI** | | ***p*** | **OR** | **95% CI** | | ***p*** | **OR** | **95% CI** | | ***p*** |
| ACOM – ICA | 6.1 | 3.3 | 11.4 | **<.001** | 9.6 | 5.5 | 16.6 | **<.001** | 10.3 | 4.6 | 23.1 | **<.001** |
| ACA – ICA | 4.1 | 1.2 | 14.1 | **.023** | 8.7 | 4.2 | 18.0 | **<.001** | 4.1 | 1.2 | 13.8 | **.024** |
| PCOM – ICA | 6.9 | 3.5 | 13.8 | **<.001** | 7.2 | 4.0 | 12.9 | **<.001** | 9.8 | 4.4 | 21.7 | **<.001** |
| MCA – ICA | 4.9 | 2.8 | 8.6 | **<.001** | 6.1 | 3.6 | 10.4 | **<.001** | 3.2 | 1.4 | 7.2 | **.006** |
| VBJ – ICA | 6.9 | 3.3 | 14.5 | **<.001** | 10.5 | 5.6 | 19.5 | **<.001** | 4.9 | 1.9 | 12.7 | **.001** |
| PCA – ICA | NA | NA | NA | NA | 5.6 | 1.02 | 30.7 | **.048** | 18.3 | 2.7 | 124.3 | **.003** |
| **Morphology** |  |  |  |  |  |  |  |  |  |  |  |  |
| Irregular – regular | 3.9 | 2.0 | 4.7 | **<.001** | 1.9 | 1.5 | 2.6 | **<.001** | 3.4 | 2.2 | 5.4 | **<.001** |
| **Aneurysm size** |  |  |  |  |  |  |  |  |  |  |  |  |
| Medium – small | 1.3 | 0.8 | 2.2 | .246 | 1.0 | 0.7 | 1.4 | .932 | 1.0 | 0.6 | 1.6 | .921 |
| Large – small | 0.5 | 0.1 | 1.8 | .299 | 1.0 | 0.5 | 2.0 | .974 | 0.2 | 0.04 | 0.7 | **.018** |
| Giant – small | 0.2 | 0.02 | 2.0 | .182 | 0.0 | 0.0 | 2270 | .968 | 1.2 | 0.1 | 13.5 | .877 |
| **Width** | 0.97 | 0.93 | 1.02 | .224 | 0.93 | 0.92 | 0.99 | **.010** | 0.95 | 0.9 | 1.01 | .074 |
| **Height** | 1.0 | 0.97 | 1.04 | .794 | 1.0 | 0.93 | 1.0 | .930 | 0.97 | 0.93 | 1.02 | .294 |
| **Neck size** | 0.7 | 0.6 | 0.8 | **<.001** | 1.6 | 1.4 | 1.9 | **<.001** | 0.8 | 0.7 | 0.9 | **<.001** |
| **Aspect ratio** | 2.6 | 1.9 | 3.4 | **<.001** | 1.6 | 1.3 | 1.9 | **<.001** | 1.2 | 0.97 | 1.4 | .055 |

Univariate logistic regression was utilized. Odds ratios represent the log odds of “Rupture status = Ruptured” vs. “Unruptured status = Unruptured.”

ACOM= Anterior communicating artery; ACA= Anterior cerebral artery; PCOM= Posterior communicating artery; MCA= Middle cerebral artery; ICA= Internal carotid artery PCA= Posterior cerebral artery; VBJ= Vertebrobasilar junction PCA= Posterior cerebral artery

**Supplementary Table 6. Morphological characteristics by age**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Characteristic** | N | 20-30 | 31-40 | 41-50 | 51-60 | 61-70 | 71-80 | 81-90 | 91-100 | *p* value |
| **Height (mm)** |  |  |  |  |  |  |  |  |  |  |
| Unruptured | 1,389 | 3.3 (3.0, 4.7) | 4.5 (3.4, 7.0) | 4.0 (2.9, 5.5) | 4.5 (3.2, 6.0) | 4.7 (3.4, 6.6) | 4.7 (3.6, 7.0) | 6.4 (5.0, 9.5) | 7.2 (5.4, 9.1) | **<.001\*** |
| Ruptured | 604 | 3.4 (2.2, 5.1) | 5.3 (4.2, 7.5) | 4.9 (3.2, 7.0) | 4.8 (3.2, 7.0) | 5.0 (3.3, 8.0) | 4.4 (3.1, 6.3) | 6.0 (3.6, 8.3) | 4.2 (4.1, 6.4) | **.025\*** |
| **Neck size (mm)** |  |  |  |  |  |  |  |  |  |  |
| Unruptured | 1,374 | 3.6 (2.8, 4.3) | 4.1 (3.0, 5.0) | 3.6 (2.8, 4.6) | 3.8 (3.0, 4.8) | 4.0 (3.1, 5.4) | 4.2 (3.2, 5.5) | 5.0 (3.4, 6.0) | 6.5 (4.3, 8.8) | **<.001\*** |
| Ruptured | 586 | 2.00 (1.80, 2.30) | 2.77 (2.06, 4.20) | 2.71 (2.00, 3.72) | 3.00 (2.20, 3.88) | 3.00 (2.30, 4.10) | 3.25 (2.50, 4.48) | 3.44 (2.87, 5.18) | 5.14 (3.57, 5.34) | **<.001\*** |
| **Width (mm)** |  |  |  |  |  |  |  |  |  |  |
| Unruptured | 1,395 | 3.6 (3.0, 5.5) | 5.3 (3.5, 8.0) | 4.5 (3.3, 6.0) | 4.7 (3.5, 6.8) | 5.2 (3.9, 7.2) | 5.5 (4.2, 7.6) | 6.9 (4.5, 12.1) | 7.0 (5.0, 9.0) | **<.001\*** |
| Ruptured | 603 | 3.2 (2.3, 5.0) | 4.9 (3.8, 6.9) | 4.3 (3.1, 6.8) | 4.4 (3.2, 6.4) | 4.5 (3.0, 7.6) | 4.9 (3.1, 6.6) | 5.2 (3.6, 7.4) | 7.3 (5.1, 8.1) | .15\* |
| **ASPECT ratio** |  |  |  |  |  |  |  |  |  |  |
| Unruptured | 1,358 | 1.0 (0.8, 1.5) | 1.1 (0.9, 1.6) | 1.1 (0.8, 1.5) | 1.2 (0.9, 1.7) | 1.2 (0.9, 1.6) | 1.2 (0.9, 1.6) | 1.3 (1.0, 2.3) | 1.4 (1.2, 1.6) | .24\* |
| Ruptured | 533 | 1.50 (1.18, 1.94) | 2.00 (1.20, 2.80) | 1.68 (1.17, 2.27) | 1.67 (1.15, 2.36) | 1.51 (1.17, 2.04) | 1.38 (1.00, 2.02) | 1.50 (1.17, 1.81) | 1.53 (1.18, 1.76) | .27\* |

\*Wilcoxon rank sum or Kruskal Wallis tests were used.

Aspect ratio is calculated as the ratio between aneurysm height and neck size.

**Supplementary Table 7.** **Univariate logistic regression of high-risk location and morphological characteristics among different age groups**

|  |  |  |  |
| --- | --- | --- | --- |
| **Rupture presentation** | **OR** | **95%CI** | ***p*** |
|  |  |  |  |
| **18-70 Age Group & Regular aneurysms** | | |  |
| High-risk vs other locations | 1.33 | 0.97-1.81 | 0.075\* |
| **71-100 Age Group & Regular aneurysms** | | |  |
| High-risk vs other locations | 1.86 | 0.87- 4.01 | 0.112\* |
| **18-70 Age Group & Irregular aneurysms** | | |  |
| High-risk vs other locations | 1.72 | 1.16-2.55 | **0.007\*** |
| **71-100 Age Group & Irregular aneurysms** | | |  |
| High-risk vs other locations | 1.23 | 0.64-2.39 | 0.532\* |

\*Univariate logistic regression was utilized.

High risk location: ACOM, PCOM, MCA